Beyond Einstein and Newton: A Scientific Odyssey Through Creation, Higher Dimensions, And The Cosmos

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"There is nothing new to be discovered in physics now. All that remains is more and more precise measurement."
: Lord Kelvin

Abstract: General public regards science as a beautiful truth. But it is absolutely-absolutely false. Science has fatal limitations. The whole the scientific community is ignorant about it. It is strange that scientists are not raising the issues. Science means truth, and scientists are proponents of the truth. But they are teaching incorrect ideas to children (upcoming scientists) in schools /colleges etc. One who will raise the issue will face unprecedented initial criticism. Anyone can read the book and find out the truth. It is open to everyone.
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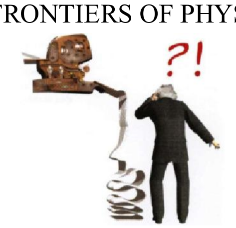
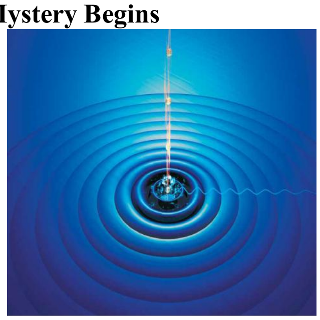
"But the creative principle resides in mathematics. In a certain sense, therefore, I hold it true that pure thought can grasp reality, as the ancients dreamed." -- Albert Einstein

A
LAYMAN'S JOURNEY
TO THE FRONTIERS OF PHYSICS



"Through
our perceptions, universe shapes itself.
Through
our thoughts, the universe is delivering its glories.
We are the medium through which the universe becomes conscious of its existence."

Chapter 1
A Cosmic Mystery Begins



Subaltern notable – built on the work of the great astronomers Galileo Galilei, Nicolaus Copernicus (who took the details of Ptolemy, and found a way to look at the same construction from a slightly different perspective and discover that the Earth is not the center of the universe) and Johannes Kepler – which take us on a journey from the time when Aristotle and the world of that era believed that Earth was the center of the universe and supported on the back of a giant tortoise to our contemporary age when we know better − regards body of knowledge as painterly truth. Rather it is absolutely-absolutely false. The word "certainty" in the Game of Science is a misleading term. The history of science, from Copernicus and Galileo to the present, is replete with examples that belie the charge of uncertainism in science. Despite the fact that science (which is guided by natural law and is testable against the empirical world) has revolutionized every aspect of human life and greatly clarified our understanding of the world, it has weighty limitations and it's a journey not a destination and the advance of knowledge is an infinite progression towards a goal that forever recedes. And it's our main ingredient for understanding − a means of accepting what we've learned, challenging what we (a hoard of talking monkeys who's consciousness is from a collection of connected neurons − hammering away on typewriters and by pure chance eventually ranging the values for the (fundamental) numbers that would allow the development of any form of intelligent life) think, and knowing that in some of the things that we think, there may be something to modify and to change. We now have considerable empirical data and highly successful scientific interpretations that bear on the question of certainty. The time has come to examine what those data and models tell us about the validity of the scientific hypothesis.

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underlying discomfort of multiverses?' or it is 'do we know enough?' But how perfectly we know about things? For many people this might sound like a startling claim. But scientific knowledge is often transitory: some (but not all) unquestionably fraught with misinterpretation. This is not a weakness but strength, for our better understanding of the events around us, and of our own existence. However, all that we can say how far we are from the truth, 'the reciprocal of uncertainty.' The very existence of certainty is a lot more baffled than it exists, even if we begin from a point of thinking it's pretty damn baffled
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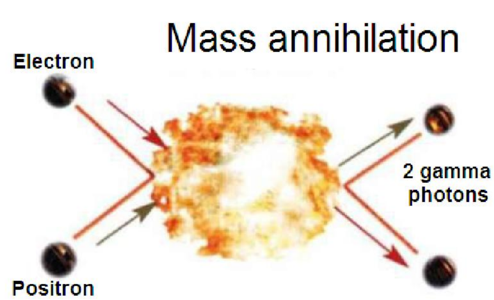


We understand the things we see
We don't understand what we can't
Cosmological Principle:
The universe is the same everywhere.
Homogeneous:
The universe looks the same from every point.
Isotropic:
The universe looks the same in every direction.
But WHY?

For lack of other theories, we forcibly adore the theories like the big bang, which posits that in the beginning of evolution all the observable galaxies and every speck of energy in the universe was jammed into a very tiny mathematically indefinable entity called the singularity (or the primeval atom named by the Catholic priest Georges Lemaitre, who was the first to investigate the origin of the universe that we now call the big bang). This extremely dense point exploded with unimaginable force, creating matter and propelling it outward to make the billions of galaxies of our vast universe. It seems to be a good postulate that the anticipation of a mathematically indefinable entity by a scientific theory implies that the theory has ruled out. It would mean that the usual approach of science of building a scientific model could anticipate that the universe must have had a beginning, but that it could not prognosticate how it had a beginning. Between 1920s and 1940s there were several attempts, most notably by the British physicist Sir Fred Hoyle (a man who ironically spent almost his entire professional life trying to disprove the big bang theory) and his co-workers: Hermann Bondi and Thomas Gold, to avoid the cosmic singularity in terms of an elegant model that supported the idea that as the universe expanded, new matter was continually created to keep the density constant on average. The universe didn't have a beginning and it continues to exist eternally as it is today. This idea was initially given priority, but a mountain of inconsistencies with it began to appear in the mid 1960's when observational discoveries apparently supported the evidence contrary to it. However, Hoyle and his supporters put forward increasingly contrived explanations of the observations. But the final blow to it came with the observational discovery of a faint background of microwaves (whose wavelength was close to the size of water molecules) throughout space in 1965 by Arno Penzias and Robert Wilson, which was the "the final nail in the coffin of the big bang theory" i.e., the discovery and confirmation of the cosmic microwave background radiation (which could heat our food stuffs to only about −270 degrees Centigrade — 3 degrees above absolute zero, and not very useful for popping corn) in 1965 secured the Big Bang as the best theory of the origin and evolution of the universe. Though Hoyle and Narlikar tried desperately, the steady state theory was abandoned.

"I found it very ugly that the field law of gravitation should be composed of two logically independent terms which are connected by addition. About the justification of such feelings concerning logical simplicity it is difficult to argue. I cannot help to feel it strongly and I am unable to believe that such an ugly thing should be realized in nature."

--Albert Einstein, in a Sept.26, 1947, letter to Georges Lema

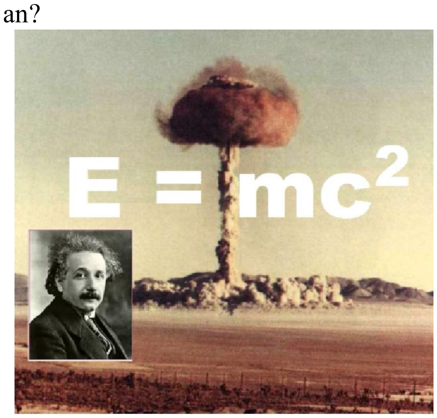
With many bizarre twists and turns, super strings − a generalized extension of string theory which predicts that all matter consists of tiny vibrating strings and the precise number of dimensions: ten. The usual three dimensions of space − length, width, and breadth − and one of time are extended by six more spatial dimensions − blinked into existence. Although the mathematics of super strings is so complicated that, to date, no one even knows the exact equations of the theory (we know only approximations to these equations, and even the approximate equations are so complicated that they as yet have been only partially solved) − The best choice we have at the moment is the super strings, but no one has seen a superstring and it has not been found to agree with experience and moreover there's no direct evidence that it is the correct description of what the universe is. Are there only 4 dimensions or could there be more: (x, y, z, t) + w, v,…? Can we experimentally observe evidence of higher dimensions? What are their shapes and sizes? Are they classical or quantum? Are dimensions a fundamental property of the universe or an emergent outcome of chaos by the mere laws of nature (which are shaped by a kind of lens, the interpretive structure of our human brains)? And if they exist, they could provide the key to unlock the deepest secrets of nature and Creation itself? We humans look around and only see four (three spatial dimensions and one time dimension i.e., space has three dimensions, I mean that it takes three numbers − length, breadth and height− to specify a point. And adding time to our description, then space becomes space-time with 4 dimensions) – why 4 dimensions? where are the other dimensions? Are they rolled the other dimensions up into a space of very small size, something like a million million million million millionth of an inch − so small that our most powerful instruments can probe? Up until recently, we have found no evidence for signatures of extra dimensions. No evidence does not mean that extra dimensions do not exist. However, being aware that we live in more dimensions than we see is a great prediction of theoretical physics and also something quite futile even to imagine that we are entering what may be the golden age of cosmology.

For n spatial dimensions: The gravitational force between two massive bodies is: $F_G = GMm / (r^{n-1})$ where G is the gravitational constant (which was first introduced by Sir Isaac Newton (who had strong philosophical ideas) as part of his popular publication in 1687 "Philosophiae Naturalis Principia Mathematica" and was first successfully measured by the English physicist Henry Cavendish), M and m are the masses of the two bodies and r is the distance between them. The electrostatic force between two charges is: $F_E = Qq/ 4\pi\varepsilon_0 (r^{n-1})$ where ε_0 is the absolute permittivity of free space, Q and q are the charges and r is the distance between them. What do we notice about both of these forces? Both of these forces are proportional to $1/ r^{n-1}$. So in a 4 dimensional universe (3 spatial dimensions + one time dimension) forces are proportional to $1/r^2$; in the 10 dimensional universe (9 spatial dimensions + one time dimension) they're proportional to $1/r^8$. Not surprisingly, at present no experiment is smart enough to solve the problem of whether or not the universe exists in 10 dimensions or more (i.e., to prove or disprove both of these forces are proportional to $1/r^8$ or proportional to $> 1/r^8$). However, yet mathematically we can imagine many spatial dimensions but the fact that that might be realized in nature is a profound thing. So far, we presume that the universe exists in extra dimensions because the mathematics of superstrings requires the presence of ten distinct dimensions in our universe or because a standard four dimensional theory is too small to jam all the forces into one mathematical framework. But what we know about the spatial dimensions we live in is limited by our own abilities to think through many approaches, many of the most satisfying are scientific.

Among many that we can develop, the most well-known, believed theory at the present is the standard four dimensional theory. However, development and change of the theory always occurs as many questions still remain about our universe we live in. And if space was 2 dimensional then force of gravitation between two bodies would have been = to GMm/r (i.e., the force of gravitation between two bodies would have been far greater than its present value). And if the force of gravitation between two bodies would have been far greater than its present value, the rate of emission of gravitational radiation would have been sufficiently high enough to cause the earth to spiral onto the Sun even before the sun become a black hole and swallow the earth. While if space was 1 dimensional then force of gravitation between two bodies would have been = GMm (i.e., the force of gravitation between two bodies would have been independent of the distance between them). The selection principle that we live in a region of the universe that is suitable for intelligent life which is called the anthropic principle (a term coined by astronomer Brandon Carter in 1974) would not have seemed to be enough to allow for the development of complicated beings like us. The universe would have been vastly different than it does now and, no doubt, life as we know it would not have existed. And if spacial dimensions would have been > than 3, the force of gravitation between two bodies would have been decreased more rapidly with distance than it does in three dimensions. (In three dimensions, the gravitational force drops to 1/4 if one doubles the distance. In four dimensions it would drops to 1/5, in five dimensions to 1/6, and so on.) The significance of this is that the orbits of planets, like the earth, around the sun would have been unstable to allow for the existence of any form of life and there would been no intelligent beings to observe the effectiveness of extra dimensions.

Although the proponents of string theory predict absolutely everything is built out of strings (which are described as patterns of vibration that have length but no height or width—like infinitely thin pieces of string), it could not provide us with an answer of what the string is made up of? And one model of potential multiple universes called the M Theory − has eleven dimensions, ten of space and one of time, which we think an explanation of the laws governing our universe that is currently the only viable candidate for a "theory of everything": the unified theory that Einstein was looking for, which, if confirmed, would represent the ultimate triumph of human reason− predicts that our universe is not only one giant hologram. Like the formation of bubbles of steam in boiling water − Great many holograms of possible shapes and inner dimensions were created, started off in every possible way, simply because of an uncaused accident called spontaneous creation. Our universe was one among a zillion of holograms simply happened to have the right properties − with particular values of the physical constants right for stars and galaxies and planetary systems to form and for intelligent beings to emerge due to random physical processes and develop and ask questions, Who or what governs the laws and constants of physics? Are such laws the products of chance or a mere cosmic accident or have they been designed? How do the laws and constants of physics relate to the support and development of life forms? Is there any knowable existence beyond the apparently observed dimensions of our existence? However, M theory sounds so bizarre and unrealistic that there is no experiment that can credit its validity. Nature has not been quick to pay us any hints so far. That's the fact of it; grouped together everything we know about the history of the universe is a fascinating topic for study, and trying to understand the meaning of them is one of the key aspects of modern cosmology.

And as more space comes into existence, more of the dark energy (an invisible and unexpected cosmological force which was a vanishingly small slice of the pie 13.7 billion years ago, but today it is about three times as much as visible matter and dark matter put together and it eclipses matter and hides in empty space and works for the universe's expansion i.e., pushes the edges of the universe apart − a sort of anti-gravity) would appear. Unfortunately, no one at the present time has any understanding of where this "energy of nothing" comes from or what exactly it is. Is it a pure cosmological constant (an arbitrary parameter from general relativity, has been taken to be zero for most of the twentieth century for the simple and adequate reason that this value was consistent with the data) or is it a sign of extra dimensions? What is the cause of the dark energy? Why does it exist at all? Why is it so different from the other energies? Why is the composition of dark energy so large (of about 73% of our universe − we only make up 0.03% of the universe)? String theory (a cutting-edge research that has integrated [Einstein's] discoveries into a quantum universe with numerous hidden dimensions coiled into the fabric of the cosmos - dimensions whose geometry may well hold the key to some of the most profound questions ever posed) gives us a clue, but there's no definitive answer. Well, all know is that it is a sort of cosmic accelerator pedal or an invisible energy what made the universe bang and if we held it in our hand; we couldn't take hold of it. In fact, it would go right through our fingers, go right through the rock beneath our feet and go all the way to the majestic swirl of the heavenly stars. It would reverse direction and come back from the stately waltz of orbiting binary stars through the intergalactic night all the way to the edge of our feet and go back and forth. How near are we to understand the dark energy? The question lingers, answer complicates and challenges everyone who yearns to resolve. And once we understand the dark energy, can we understand the birth and the death of the universe is also an?



Einstein letter to Professor G. Gamow (in August 4, 1946), with a comment handwritten by Gamow at the bottom

Dear Dr. Gamow

After receiving your manuscript I read it immediately and then forwarded it to Dr. Spitzer. I am convinced that the abundance of elements as function of the atomic weight is a highly important starting point for cosmogonic speculations. The idea that the whole expansion process started with a neutron gas seems to be quite natural too. The explanation of the abundance curve by formation of the heavier elements in making use of the known facts of probability coefficients seems to me pretty convincing. Your remarks concerning the formation of the big units (nebulae) I am not able to judge for lack of special knowledge.

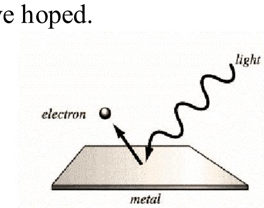
Thanking you for your kindness, I am

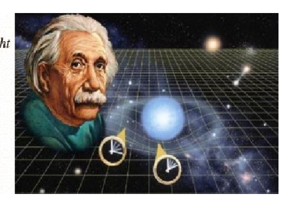
yours sincerely, Albert Einstein.

(Of course, the old man agrees with almost anything nowadays.)

--comment handwritten by Gamow

The entire universe is getting more disordered and chaotic with time i.e., the entropy of the universe is increasing toward greater disorder. And this observation is elevated to the status of a law, the so called Second law of thermodynamics (which was discovered by the great German physicist, Ludwig Boltzmann who laid down the second law of thermodynamics, committed suicide in 1906, in part because of the intense ridicule he faced while promoting the concept of atoms) i.e., the universe will tend toward a state of maximum entropy, such as a uniform gas near absolute zero (at this point, the atoms themselves almost come to a halt) and that there is nothing we have to do about it. No matter how advanced our conditions would be right for the generation of thoughts to predict things more or less, even if not in a simplest way, it can never squash the impending threat of the second law of thermodynamics (that will eventually result in the destruction of all intelligent life) nor it can bring us close to the answer of why was the entropy ever low in the first place. This makes cosmology (the study of the universe as a whole, including its birth and perhaps its ultimate fate) a bit more complicated than we would have hoped.





Explaining everything... is one of the greatest challenges we have ever faced. Hence, it has been an endeavor of science to find a single theory which could explain everything, where every partial theory that we've read so far (in school) is explained as a case of the one cogent theory within some special circumstances. Despite being a mystery skeptic, the Unified Field Theory (which Albert Einstein sought [but never realized] during the last thirty years of his life and capable of describing nature's forces within a single, all-encompassing, coherent framework) presents an infinite problem. This is embarrassing. Because we now realize before we can work for the theory of everything, we have to work for the ultimate laws of nature. At the present, we're clueless as to what the ultimate laws of nature really are. Are there new laws beyond the apparently observed dimensions of our universe? Do all the fundamental laws of nature unify? At what scale? Ultimately, however, it is likely that answers to these questions in the form of unified field theory may be found over the next few years or by the end of the century we shall know can there really be a complete unified theory that would presumably solve our problems? Or are we just chasing a mirage? Is the ultimate unified theory so compelling, that it brings about its own existence? However, if we − a puny and insignificant on the scale of the cosmos − do discover a unified field theory, it should in time be understandable in broad principle by everyone, not just a few people. Then we shall all be able to take part in the discussion of the questions of how and when did the universe begin? Was the universe created? Has this universe been here forever or did it have a beginning at the Big Bang? If the universe was not created, how did it get here? If the Big Bang is the reason there is something rather than nothing, and then before the Big Bang there was NOTHING and then suddenly we got A HUGE AMOUNT OF ENERGY where did it come from? What powered the Big Bang? What is the fate of the Universe? Is the universe heading towards a Big Freeze (the end of the universe when it reaches near absolute zero), a Big Rip, a Big Crunch (the final collapse of the universe), or a Big Bounce? Or is it part of an infinitely recurring cyclic model? Is inflation a law of Nature? Why the universe started off very hot and cooled as it expanded? Is the Standard Big Bang Model right? Or is it the satisfactory explanation of the evidence which we have and therefore merits our provisional acceptance? Is our universe finite or infinite in size and content? What lies beyond the existing space and time? What was before the event of creation? Why is the universe so uniform on a large scale (even though uncertainty principle − which fundamentally differentiates quantum from classic reasoning − discovered by the German physicist Werner Heisenberg in 1927 − implies that the universe cannot be completely uniform because there are some uncertainties or fluctuations in the positions and velocities of the particles)? Why does it look the same at all points of space and in all directions? In particular, why is the temperature of the cosmic microwave back-ground radiation so nearly the same when we look in different directions? Why are the galaxies distributed in clumps and filaments? When were the first stars formed, and what were they like?

If $k_BT = m_{electron}c^2$, then $T = m_{electron}c^2/k_B = 5.934 \times 10^9$ Kelvin.

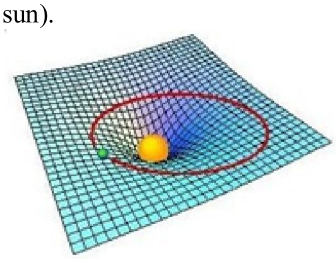
$T = 5.934 \times 10^9$ Kelvin imply the threshold temperature below which the electron is effectively removed from the universe.

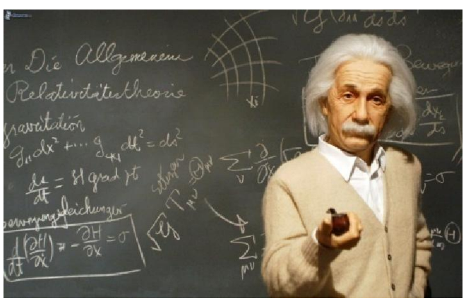
If $h\upsilon = m_{electron}c^2$, then $\upsilon = m_{electron}c^2/h = 1.23 \times 10^{20}$ per second.

What does $\upsilon = 1.23 \times 10^{20}$ per second imply? Does it imply the threshold frequency of vibration below which the electron is effectively removed from the universe? Or if string theory (which is part of a grander synthesis: M-theory and have captured the hearts and minds of much of the theoretical physics community while being apparently disconnected from any realistic chance of definitive experimental proof) is right i.e., every particle is a tiny one dimensional vibrating string of Planck length (the smallest possible length i.e., Planck time multiplied by the speed of light), then does $\upsilon = 1.23 \times 10^{20}$ per second imply the frequency of vibration of the string that attributes mass to the electron?

Why most of the matter in the Universe is dark? Is anthropic principle a natural coincidence? If we find the answers to them, it would be the ultimate triumph of human reason i.e., we might hold the key to illuminating the eternal conundrum of why we exist. It would bring to an end a long and glorious lesson in the history of mankind's intellectual struggle to understand the universe. For then we would know whether the laws of physics started off the universe in such an incomprehensible way or not. Chances are that these questions will be answered long after we're gone, but there is hope that the beginnings of those answers may come within the next few years, as some aspects of bold scientific theory that attempts to reconcile all the physical properties of our universe into a single unified and coherent mathematical framework begin to enter the realm of theoretical and experimental formulation.

Up until recently, a multitude of revolutions in various domains, from literature to experimental science, has prevailed over established ideas of modern age in a way never seen before. But we do not know about what is the exact mechanism by which an implosion of a dying star becomes a specific kind of explosion called a supernova. All that we know is that: When a massive star runs out of nuclear fuel, the gravitational contraction continues increasing the density of matter. And since the internal pressure is proportional to the density of matter, therefore the internal pressure will continually increase with the density of matter. And at a certain point of contraction, internal pressure will be very much greater than gravitational binding pressure and will be sufficiently high enough to cause the star of mass M and radius r to explode at a rate = total energy released × time, spraying the manufactured elements into space that would flung back into the gas in the galaxy and would provide some of the raw material for the next generation of stars and bodies that now orbit the sun as planets like the Earth. The total energy released would outshine all the other stars in the galaxy, approaching the luminosity of a whole galaxy (will nearly be the order of 10 to the power of 42 Joules) which is = (Total energy of the star – its Gravitational binding energy). In the aftermath of the supernova, we find a totally dead star, a neutron star – a cold star, supported by the exclusion principle repulsion between neutrons – about the size of Manhattan (i.e., ten to 50 times the size of our sun).





Why are there atoms, molecules, solar systems, and galaxies?

What powered them into existence?

How accurate are the physical laws and equations, which control them?

Why do the Fundamental Constants:

Planck's constant: $h = 6.625 \times 10^{-34}$ Js

Speed of light: $c = 3 \times 10^{8}$ m/s

Mass of electron: $m_{electron} = 9.1 \times 10^{-31}$ kg

Mass of proton: $m_{proton} = 1.672 \times 10^{-27}$ kg

Mass of neutron: $m_{neutron} = 1.675 \times 10^{-27}$ kg

Electron charge (magnitude): $e = 1.602 \times 10^{-19}$ C

Fine structure constant: $\alpha = e^2/\hbar c = 1/137.036$

Bohr radius: $a = \hbar / m_{electron}e^2 = 5.29 \times 10^{-11}$m

Bohr energies: $E_n = - m_{electron}e^4/2\hbar n^2 = -(13.6/n^2)$ eV

Classical electron radius: $r_{electron} = e^2/m_{electron}c^2 = 2.81 \times 10^{-15}$ m

QED coupling constant: $g_e = e\ (4\pi/\hbar c)^{½} = 0.302822$

Weak coupling constants: $g_w = g_e / \sin\theta_w = 0.6295$; $g_z = g_w / \cos\theta_w = 0.7180$

Weak mixing angle: $\theta_w = 28.76^o$

Strong coupling constant: G = 1.214

have the precise values they do?

The answers have always seemed well beyond the reach of Dr. Science since the dawn of humanity − until now (some would claim the answer to these questions is that there is a transcendent God (a cosmic craftsman – a transcendent being than which no being could be more virtuous) who chose to create the universe that way according to some perfect mathematical principle. Then the question merely reflects to that of who or what created the God). But the questions are still the picture in the mind of many scientists today who do not spend most of their time worrying about these questions, but almost worry about them some of the time. All that science could say is that: The universe is as it is now. But it could not explain why it was, as it was, just after the Big Bang. This is a disaster for science. It would mean that science alone, could not predict how the universe began. Every attempt is made to set up the connection between theoretical predictions and experimental results but some of the experimental results throw cold water on the theoretical predictions.

Back in 1700s, people thought the stars of our galaxy structured the universe, that the galaxy was nearly static, and that the universe was essentially unexpanding with neither a beginning nor an end to time. A situation marked by difficulty with the idea of a static and unchanging universe, was that according to the Newtonian theory of gravitation, each star in the universe supposed to be pulled towards every other star with a force that was weaker the less massive the stars and farther they were to each other. It was this force caused all the stars fall together at some point. So how could they remain static? Wouldn't they all collapse in on themselves? A balance of the predominant attractive effect of the stars in the universe was required to keep them at a constant distance from each other. Einstein was aware of this problem. He introduced a term so-called cosmological constant in order to hold a static universe in which gravity is a predominant attractive force. This had an effect of a repulsive force, which could balance the predominant attractive force. In this way it was possible to allow a static cosmic solution. Enter the American astronomer Edwin Hubble. In 1920s he began to make observations with the hundred inch telescope on Mount Wilson and through detailed measurements of the spectra of stars he found something most peculiar: stars moving away from each other had their spectra shifted toward the red end of the spectrum in proportion to the distance between them (This was a Doppler effect of light: Waves of any sort -- sound waves, light waves, water waves -- emitted at some frequency by a moving object are perceived at a different frequency by a stationary observer. The resulting shift in the spectrum will be towards its red part when the source is moving away and towards the blue part when the source is getting closer). And he also observed that stars were not uniformly distributed throughout space, but were gathered together in vast collections called galaxies and nearly all the galaxies were moving away from us with recessional velocities that were roughly dependent on their distance from us. He reinforced his argument with the formulation of his well-known Hubble's law. The observational discovery of the stretching of the space carrying galaxies with it completely shattered the previous image of a static and unchanging cosmos (i.e., the motivation for adding a term to the equations disappeared, and Einstein rejected the cosmological constant a greatest mistake).

Thus the last and most successful creation of theoretical physics, namely quantum mechanics (QM), differs fundamentally from both Newton's mechanics, and Maxwell's e-m field. For the quantities which figure in QM's laws make no claim to describe physical reality itself, but only probabilities of the occurrence of a physical reality that we have in view. (Albert Einstein, 1931)

I cannot but confess that I attach only a transitory importance to this interpretation. I still believe in the possibility of a model of reality - that is to say, of a theory which represents things themselves and not merely the probability of their occurrence. On the other hand, it seems to me certain that we must give up the idea of complete localization of the particle in a theoretical model. This seems to me the permanent upshot of Heisenberg's principle of uncertainty. (Albert Einstein, 1934)

Many theoretical physicists and scientists of a fast developing science have discussed about mass annihilation at different times. Even a level one graduate know that when an electron and a positron approach each other, they annihilate i.e., destroy each other. This process what a quantum physicists call the mass annihilation. During the process their masses are converted into energy in accordance with $E = mc^2$. The energy thus released manifests as γ photons. A positron has the same mass as an electron but an opposite charge equal to $+e$. The energy released in the form of 2γ photons during the annihilation of a positron and an electron is therefore $E = 2h\upsilon = 2m_0c^2$ where m_0 is the rest mass of the electron or positron.

$2h\upsilon = 2m_0c^2$

Since $\upsilon = c/\lambda$. Therefore:

$\lambda = h/ m_0c$

But $h/ m_0c = \lambda_C$ (the Compton wavelength of the electron). Therefore:

$\lambda = \lambda_C$ (i.e., wavelength of the resulted gamma photon is = Compton wavelength of the annihilated electron).

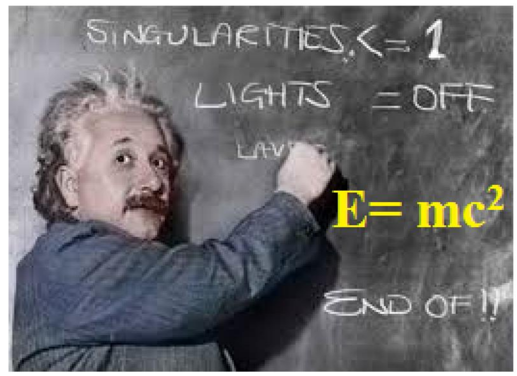
From this it follows that

$hc/ \lambda^2 = hc/ \lambda_C^2$

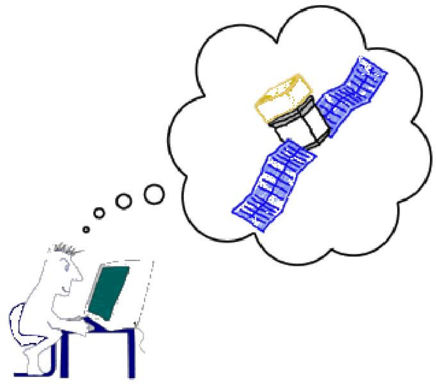
$hc/\lambda^2 \rightarrow$ force which moves the photon

$hc/\lambda_C^2 = 3.39 \times 10^{-2}$ Newton $\rightarrow$?

Is it a cutoff at which relativistic quantum field theory becomes crucial for its accurate description? Why is it so? What does it mean? The question is not fairly simple to be answered.



We story telling animals often claim that we know so much more about the universe. But we must beware of overconfidence. We have had false dawns before. At the beginning of this century, for example, it was thought that earth was a perfect sphere, but latter experimental observation of variation of value of g over the surface of earth confirmed that earth is not a perfect sphere. Today there is almost universal agreement that space itself is stretching, carrying galaxies with it, though we are experimentally trying to answer whether cosmic [expansion will] continue forever or slow to a halt, reverse itself [and] lead to a cosmic implosion. However, personally, we're sure that the accelerated expansion began with a state of infinite compression and primeval explosion called the hot Big Bang. But will it expand forever or there is a limit beyond which the average matter density exceeds a hundredth of a billionth of a billionth of a billionth (10^{-29}) of a gram per cubic centimeter so-called critical density (the density of the universe where the expansion of the universe is poised between eternal expansion and recollapse)... then a large enough gravitational force will permeate the cosmos to halt and reverse the expansion or the expansion and contraction are evenly balanced? We're less sure about that because events cannot be predicted with complete accuracy but that there is always a degree of uncertainty.



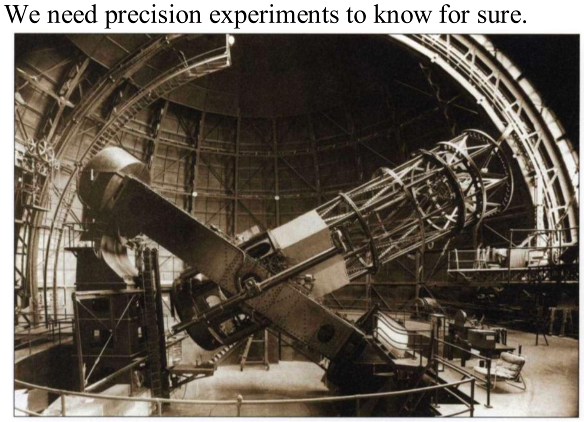
The picture of standard model of the Forces of Nature (a sensible and successive quantum-mechanical description developed by 1970s physicists) is in good agreement with all the observational evidence that we have today and remains consistent with all the measured properties of matter made in our most sophisticated laboratories on Earth and observed in space with our most powerful telescopes. Nevertheless, it leaves a number of important questions unanswered like the unanswered questions given in The Hitchhiker's Guide to the Galaxy (by Douglas Adams): Why are the strengths of the fundamental forces (electromagnetism, weak and strong forces, and gravity) are as they are? Why do the force particles have the precise masses they do? Do these forces really become unified at sufficiently high energy? If so how? Are there unobserved fundamental forces that explain other unsolved problems in physics? Why is gravity so weak? May because of hidden extra dimensions? Very likely, we are missing something important that may seem as obvious to us as the earth orbiting the sun – or perhaps as ridiculous as a tower of tortoises. Only time (whatever that may be) will tell.

The theory of evolution (which predicts: that the use of antiviral or antibacterial agents would result in the emergence of resistant strains. This principle is, of course, a mainstay of contemporary medicine and asserts that the natural selection is a choice of stable forms and a rejection of unstable ones. And the variation within a species occurs randomly, and that the survival or extinction of each organism depends upon its ability (an internal force or tendency) to adapt to the environment) lined up pictures of apes and humans and claimed that humans evolved from apes (i.e., the chimpanzee and the human share about 99.5 per cent of their evolutionary history). This spilled out onto the corridors of the academy and absolutely rocked Victorian England to the extent that people just barely raised their voice contradicting the biblical account of creation in the lecture hall rips of the architrave. And despite more than a century of digging straight down and passing through the fossil layers, the fossil record remains maddeningly sparse and provides us with no evidence that show evolutionary transition development of one species into another species. However, we are convinced that the theory of evolution, especially the extent to which it's been believed with blind faith, which may turn to be one of the great fairy tales for adults in the history books of the future. Like raisins in expanding dough, galaxies that are further apart are increasing their separation more than nearer ones. And as a result, the light emitted from distant galaxies and stars is shifted towards the red end of the spectrum. Observations of galaxies indicate that the universe is expanding: the distance D between almost any pair of galaxies is increasing at a rate $V = HD$ − beautifully explained by the Hubble's law (the law that agrees with Einstein's theory of an expanding universe). However, controversy still remains on the validity of this law. Andromeda, for example, for which the Hubble relation does not apply. And quantum theory (The revolutionary theory of the last century clashed with everyday experience which has proved enormously successful, passing with flying colors the many stringent laboratory tests to which it has been subjected for almost a hundred years) predicts that entire space is not continuous and infinite but rather quantized and measured in units of quantity called Planck length (10^{-33} cm – the length scale found at the big bang in which the gravitational force was as strong as the other forces and at this scale, space-time was "foamy," with tiny bubbles and wormholes appearing and disappearing into the vacuum) i.e., the entire space is divided into cells of volume i.e., Planck length to the power of 3, the smallest definable volume (i.e., the Planck volume) and of area i.e., Planck length to the power of 2, the smallest definable area (i.e., the Planck area) and time in units of quantity called Planck time (the time it takes for light to travel 1 Planck length, or 1.6×10^{-35} m). And each cell possesses energy equal to the Planck energy (10^{19} billion electron volts − the energy scale of the big bang, where all the forces were unified into a single super force). And energy density of each cell is = Planck energy / Planck volume. However, at the present there is no conclusive evidence in favor of quantization of space and time and moreover nobody knows why no spatial or time interval shorter than the Planck values exists?

For length: Planck length (a hundred billion billion times [10^{20}] smaller than an atomic nucleus) -1.6×10^{-33} centimeter.

For time: Planck time -5×10^{-44} seconds.

On the other hand, there is no evidence against what the quantum model inform us about the true nature of reality. But in order to unify Albert Einstein's general relativity (a theoretical framework for understanding the universe on the largest of scales: the immense expanse of the universe itself and it breaks down at times less than the Planck time and at distances smaller than the Planck length, predicts the existence of wormhole − a passageway between two universes – gives us a better way of grasping reality than Newtonian mechanics, because it tells us that there can be black holes, because it tells us there's a Big Bang) with the quantum physics that describe fundamental particles and forces, it is necessary to quantize space and perhaps time as well. And for a universe to be created out of nothing, the positive energy of motion should exactly cancel out the negative energy of gravitational attraction i.e., the net energy of the universe should be = zero. And if that's the case, the spatial curvature of the universe, Ω_k, should be = 0.0000 (i.e., perfect flatness). But the Wilkinson Microwave Anisotropy Probe (WMAP) satellite has established the spatial curvature of the universe, Ω_k, to be between − 0.0174 and + 0.0051. Then, how can it cost nothing to create a universe, how can a whole universe be created from nothing? On the other hand, there is a claim that the sum of the energy of matter and of the gravitational energy is equal to zero and hence there is a possibility of a universe appearing from nothing and thus the universe can double the amount of positive matter energy and also double the negative gravitational energy without violation of the conservation of energy. However, energy of matter + gravitational energy is = zero is only a claim based on Big Bang implications. No human being can possibly know the precise energy content of the entire universe. In order to verify the claim that the total energy content of the universe is exactly zero, one would have to account for all the forms of energy of matter in the universe, add them together with gravitational energy, and then verify that the sum really is exactly zero. But the attempt to verify that the sum really is exactly zero is not an easy task. We need precision experiments to know for sure.



The 100-inch Hooker telescope at Mount Wilson Observatory

Classical physics would have been much different

if…

A tree had fallen on Newton's head instead of the apple.

The backwards-moving electron when viewed with time moving forwards appears the same as an ordinary electron, except that it is attracted to normal electrons - we say it has a positive charge. For this reason it's called a positron. The positron is a sister particle to the electron, and is an example of an anti-particle...This phenomena is general. Every particle in Nature has an amplitude to move backwards in time, and therefore has an anti-particle. (Feynman, 1985)

For many years after Newton, partial reflection by two surfaces was happily explained by a theory of waves,* but when experiments were made with very weak light hitting photomultipliers, the wave theory collapsed: as the light got dimmer and dimmer, the photomultipliers kept making full sized clicks - there were just fewer of them. Light behaves as particles.

* This idea made use of the fact that waves can combine or cancel out, and the calculations based on this model matched the results of Newton's experiments, as well as those done for hundreds of years afterwards. But when experiments were developed that were sensitive enough to detect a single photon, the wave theory predicted that the clicks of a photomultiplier would get softer and softer, whereas they stayed at full strength - they just occurred less and less often. No reasonable model could explain this fact.

This state of confusion was called the wave - particle duality of light. (Feynman, 1985)

Gazing at the at the blazing celestial beauty of the night sky and asking a multitude of questions that have puzzled and intrigued humanity since our beginning − WE'VE DISCOVERED a lot about our celestial home; however, we still stand at a critical cross road of knowledge where the choice is between spirituality and science to accomplish the hidden truth behind the early evolution of the universe. In order to throw light on a multitude of questions that has so long occupied the mind of scientists and the people who have argued over the years about the nature of reality and whose business it is to ask why, the philosophers: Where did we and the universe come from? Where are we and the universe going? What makes us and the universe exists? Why we born? Why we die? Whether or not the universe had a beginning? If the universe had a beginning, why did it wait an infinite time before it began? What was before the beginning? Is our universe tunneled through the chaos at the Planck time from a prior universe that existed for all previous time? We must either build a sound, balanced, effective and extreme imaginative knowledge beyond our limit. Many theories were put forth by the scientists to look into the early evolution of the universe but none of them turned up so far. And if, like me, you have wondered looking at the star, and tried to make sense of what makes it shine the way it is. Did it shine forever or was there a limit beyond which it cannot or may not shine? And, where did the matter that created it all come from? Did the matter have a beginning in time? Or had the matter existed forever and didn't have a beginning? In other words, what cause made the matter exist? And, what made that cause exist? Some would claim the answer to this question is that matter could have popped into existence 13.9 billion years ago as a result of just the eminent physical laws and constants being there. Because there is a law such as gravity, the matter can and will create itself out of nothing. But how can matter come out of nothing? This apparently violates the conservation of matter. But there is a simple answer. Matter, of course, is what a makes up a hot star, a sun, a planet – anything you think of that occupies space. And if you divide the matter what do you get? Tiny masses… Well, because E = mc squared each tiny mass locks up tremendous amount of positive energy. And according to new model what's called the exchange theory of gravity, there is a continuous exchange of a massless particle of spin 2 called the graviton (the smallest bundle of the gravitational force field and the message particle for gravity and it is too small to be seen in the laboratory) between one mass and the other. This result in an exchange force called gravity and keeps them bound together – what constitutes the matter. Well if you add up the sum total positive energy of masses to the sum total negative energy of gravity what you get? Zero, the net energy of the matter is zero. Now twice zero is also zero. Thus we can double the amount of positive matter energy and also double the negative gravitational energy without violation of the conservation of matter or energy. Because the net energy of the matter is zero, the matter can and will create itself from literally nothing. A thought of nothing must have somehow turned into something is interesting, and significant, and worth writing a note about, and it's one of the possibilities. However, if this admittedly speculative hypothesis is correct, then the question to the ultimate answer is shouldn't we see at least some spontaneous creation of matter in our observable universe every now and then? No one has ever observed a matter popping into existence. This means that any "meta" or "hyper" laws of physics that would allow (even in postulate) a matter to pop into existence are completely outside our experience. The eminent laws of physics, as we know them, simply are not applicable here. Invoking the laws of physics doesn't quite do the trick. And the laws of physics are simply the human-invented ingredients of models that we introduce to describe observations. They are all fictitious, as far as we find a reference frame in which they are observed. The question of matter genesis is clear, and deceptively simple. It is as old as the question of what was going on before the Big Bang. Usually, we tell the story of the matter by starting at the Big Bang and then talking about what happened after. The answer has always seemed well beyond the reach of science. Until now.

Over the decades, there have been several heroic attempts to explain the origin of matter, all of them proven wrong. One was the so-called Steady State theory. The idea was that, as the galaxies moved apart from each other; new galaxies would form in the spaces in between, from matter that was spontaneously being created. The matter density of the universe would continue to exist, forever, in more or less the same state as it is today. In a sense disagreement was a credit to the model, every attempt was made to set up the connection between theoretical predictions and experimental results but the Steady State theory was disproved even with limited observational evidence. The theory therefore was abandoned and the idea of spontaneous creation of matter was doomed to fade away into mere shadows. As crazy as it might seem, the matter may have come out of nothing! The meaning of nothing is somewhat ambiguous here. It might be the pre-existing space and time, or it could be nothing at all. After all, no one was around when the matter began, so who can say what really happened? The best that we can do is work out the most vain imaginative and foolish theories, backed up by numerous lines of scientific observations of the universe.

Cats are alive and dead at the same time. But some of the most incredible mysteries of the quantum realm (a jitter in the amorphous haze of the subatomic world) get far less attention than Schrödinger's famous cat. Due to the fuzziness of quantum theory (that implies: the cosmos does not have just a single existence or history), and specifically Heisenberg's uncertainty principle (which fundamentally differentiates quantum from classic reasoning − discovered by the German physicist Werner Heisenberg in 1927), one can think of the vacuum fluctuations as virtual matter –antimatter pairs that appear together at some time, move apart, then come together and annihilate one another and revert back to energy. Spontaneous births and deaths of roiling frenzy of particles so called virtual matter –antimatter pairs momentarily occurring everywhere, all the time – is the evidence that mass and energy are interconvertible; they are two forms of the same thing. If one argue that matter was a result of such a fluctuation. So then the next question is what cause provided enough energy to make the virtual matter – antimatter pairs materialize in real space. And if we assume some unknown cause has teared the pair apart and boosted the separated virtual matter –antimatter into the materialized state. The question then is what created that cause. In other words, what factor created that cause? And what created that factor. Or perhaps, the cause, or the factor that created it, existed forever, and didn't need to be created. The argument leads to a never-ending chain that always leaves us short of the ultimate answer. Unfortunately, Dr. Science cannot answer these questions. So, the problem remains. However, quantum origin and separation of the matter still delights theoretical physicists but boggles the mind of mere mortals, is the subject of my thought; have the quantum laws found a genuinely convincing way to explain matter existence apart from divine intervention? If we find the answer to that, it would be the ultimate triumph of human reason – for then we would know the ultimate Cause of the Matter. Over the decades, we're trying to understand how the matter began and we're also trying to understand all the other things that go along with it. This is very much the beginning of the story and that story could go in, but I think there could be surprises that no one has even thought of. Something eternal can neither be created nor destroyed. The first law of thermodynamics asserts that matter or energy can neither be created nor destroyed; it can be converted from one form to another. The overwhelming experience of experimental science confirms this first law to be a fact. But if the matter prevails in the boundary of understanding in that it neither started nor it ends: it would simply be. What place then for an evidence exposing that we live in a finite expanding universe which has not existed forever, and that all matter was once squeezed into an infinitesimally small volume, which erupted in a cataclysmic explosion which has become known as the Big Bang. However, what we believe about the origin of the matter is not only sketchy, but uncertain and based purely on human perception. There is no reliable and genuine evidence to testify about how the matter began and what may have existed before the beginning of the matter. The laws of physics tell us that the matter had a beginning, but they don't answer how it had begun. Mystery is running the universe in a hidden hole and corner, but one day it may wind up the clock work with might and main. The physical science can explain the things after big bang but fails to explain the things before big bang. We know that matter can be created out of energy, and energy can be created out of matter. This doesn't resolve the dilemma because we must also know where the original energy came from.

The electrostatic and gravitational forces according to Coulomb's and Newton's laws are both inverse square forces, so if one takes the ratio of the forces, the distances cancel. For the electron and proton, the ratio of the forces is given by the equation: $F_E / F_G = e^2 / 4\pi\varepsilon_0 G m_{proton} m_{electron}$ where e is the charge $= 1.602 \times 10^{-19}$ Coulombs, G is the gravitational constant, ε_0 is the absolute permittivity of free space $= 8.8 \times 10^{-12}$ F/m, m_{proton} is the mass of the proton $= 1.672 \times 10^{-27}$ kg and $m_{electron}$ is the mass of the electron $= 9.1 \times 10^{-31}$ kg. Plugging the values we get: $F_E / F_G = 10^{39}$ which means: F_E is $> F_G$. So, it was argued by a German mathematician, theoretical physicist and philosopher (some say it was Hermann Weyl), if the gravitational force between the proton and electron were not much smaller than the electrostatic force between them, then the hydrogen atom would have collapsed to neutron long before there was a chance for stars to form and life to evolve. $F_E > F_G$ must have been numerically fine - tuned for the existence of life. Taking $F_E / F_G = 10^{39}$ as an example in most physics literature we will find that gravity is the weakest of all forces, many orders of magnitude weaker than electromagnetism. But this does not make sense any way and it is not true always and in all cases. Note that the ratio F_E / F_G is not a universal constant; it's a number that depends on the particles we use in the calculation. For example: For two particles each of Planck mass (mass on the order of 10 billion billion times that of a proton) and Planck charge the ratio of the forces is 1 i.e., $F_E / F_G = 1$. Moreover, when the relativistic variation of electron mass with velocity is taken into account then the ratio F_E / F_G becomes velocity dependent.

NIELS BOHR (1885 — 1962)

Everything we call real is made of things that cannot be regarded as real.

If quantum mechanics hasn't profoundly shocked you, you haven't understood it yet.

Considering the particle nature of the electron the force which moves the electron mass m in a circular orbit around the nucleus is given by the equation: $F = mv^2/r$, where v = orbital velocity of the electron and r = radius of the circular orbit.

Considering the wave nature of the electron the force which moves the electron wave in a circular orbit around the nucleus is given by the equation: $F = h\upsilon/\lambda$, where h = Planck's constant, υ and λ are the wavelength and frequency of the wave associated electron.

Considering the wave-particle duality of the electron:

$mv^2 / r = h\upsilon/\lambda$

Since:

$mv = p$ and $h / \lambda = p$ (where p = momentum of the electron). Therefore:

$v / r = \upsilon$

But $v/r = \omega$ (the angular velocity of the electron). Therefore:

$\omega = \upsilon$

But according to existing literature (which states that: in the case of circular motion, the angular velocity of the electron is same as its angular frequency), the angular velocity of the electron moving in circular orbit ω is $= 2\pi\upsilon$.

Hence

ω is $\neq \upsilon$

Because ω is $\neq \upsilon$:

mv^2 / r is $\neq h\upsilon/\lambda$

Since the angular frequency of the electron is: $\omega = 2\pi\upsilon$. Therefore:

mv^2 / r must be equal to $2\pi\, h\upsilon/\lambda$

Which means: the force which moves the electron mass in a circular orbit around the nucleus is always > than the force which moves the electron wave in a circular orbit around the nucleus.

Does our universe exist inside a black hole of another universe? The question lingers, unanswered until now. Even though the existence of alternative histories with black holes, suggests this might be possible i.e., our universe lies inside a black hole of another universe, we cannot prove or disprove this conjecture any way. Meaning that the event horizon of a black hole is boundary at which nothing inside can escape and then how might one can cross its event boundary and testify whether or not our universe exist inside a black hole of another universe. Thus we cannot answer the central question in cosmology: Does our universe exist inside a black hole of another universe? However, the fact that we are simply an advanced breed of talking monkeys surviving on a sumptuous planet, have been reckoning at least from last hundred years − turning unproved belief into unswerving existence through the power of perception and spending our brief time in the sun working at understanding the deepest mysteries of nature by doing repeated calculations and getting some answer that seem very likely makes us feel something very special-- a bit premature to buy tickets to the nearest galaxy to visit the next goldilocks planet or hunt dinosaurs.

The physicist has been spending a month, as he or she does each year, sequestered with colleagues, such as fellow theoretical physicists, to discuss many great mysteries of the cosmos. But despite its simple approximation as a force, and its beautifully subtle description as a property of space-time which in turn can be summarized by Einstein's famous equation, which essentially states:

Matter-energy → curvature of space-time

, we've come to realize over the past century that we still don't know what gravity actually is. It has been a closed book ever since the grand evolution of human understanding and all physicists hang this book up on their wall and distress about it. Unhesitatingly you would yearn to know where this book comes from: is it related to metaphysical science or perhaps to the greatest blast puzzles of physics still to be discovered, like cosmic string and magnetic monopoles? Nobody knows and for the moment, nature has not said yes in any sense. It's one of the 10,000 bits puzzling cosmic story with a cracking title. You might say the laws of physics designed that book, and we don't know how they designed that book. The elevated design of this book, an extract of which appears in the cosmic art gallery, sets out to the belief that it must have designed as it could not have created out of chaos. In some sense, the origin of the cosmic problem today remains what it was in the time of Newton (who not only put forward a theory of how bodies move in space and time, but he also developed the complicated mathematics needed to analyze those motions) – one of the greatest challenges of 21st Century science certainly keep many an aficionado going. Yet, we toasting each other with champagne glasses in laboratories around the world-- have made a bold but brilliant move. In less than a hundred years, we have found a new way to wonder what gravity is. The usual approach of science of constructing a set of rules and equations cannot answer the question of why if you could turn off gravity, space and time would also vanish. In short, we don't have an answer; we now have a whisper of the grandeur of the problem. We don't know exactly how it is intimately related to space and time. It's a mystery that we're going to chip at from quantum theory (the theory developed from Planck's quantum principle and Heisenberg's uncertainty principle which deals with phenomena on extremely small scales, such as a millionth of a millionth of an inch). However, when we try to apply quantum theory to gravity, things become more complicated and confusing.

But no matter how clever the word, it is what I call a dippy process! Having to resort to such hocus pocus has prevented us from proving that the theory of quantum electrodynamics is mathematically self-consistent…. I suspect that renormalization is not mathematically legitimate. (Feynman, 1985)

Mankind's deepest desire for scientific intervention introduced a new idea that of time. Most of the underlying assumptions of physics are concerned with time. Time may sound like a genre of fiction, but it is a well-defined genuine concept. Some argue that time is not yet discovered by us to be objective features of the mundane world: even without considering time an intrinsic feature of the mundane world, we can see that things in the physical world change, seasons change, people adapt to that drastic changes. The fact that the physical change is an objective feature of the physical world, and time is independent of under whatever circumstances we have named it. Others think time as we comprehend it does not endure beyond the bounds of our physical world. Beyond it, maybe one could run forward in time or just turn around and go back. This could probably mean that one could fall rapidly through their former selves. In a bewildering world, the question of whether the time never begin and has always been ticking, or whether it had a beginning at the big bang, is really a concern for physicists: either science could account for such an inquiry. If we find the answer to it, it would be the ultimate triumph of human justification for our continuing quest. And, our goal of a complete description of the universe we live in is self-justified. The understanding we have today is that time is not an illusion like what age-old philosophers had thought, but rather it is well defined mathematical function of an inevitable methodical framework for systematizing our experiences. If one believed that the time had a beginning, the obvious question was how it had started? The problem of whether or not the time had a beginning was a great concern to the German Philosopher, Immanuel Kant (who believed that every human concept is based on observations that are operated on by the mind so that we have no access to a mind-independent reality). He considered the entire human knowledge and came to the conclusion that time is not explored by humans to be objective features of the mundane world domain, but is a part of an inevitable systematic framework for coordinating our experiences. How and when did the time begin? No other scientific question is more fundamental or provokes such spirited debate among physicists. Since the early part of the 1900s, one explanation of the origin and fate of the universe, the Big Bang theory, has dominated the discussion. Although singularity theorem (a theorem showing that a singularity, a point where general relativity (a theory which predicts that time would come to an end inside a black hole – an invisible astrophysical entity that no one has seen, but scientists have observed gravitational evidence consistent with predictions about it, so most scientists believe it exists) breaks down, must exist under certain circumstances; in particular, that the universe must have started with a singularity) predicted that the time, the space, and the matter or energy itself had a beginning, they didn't convey how they had a beginning. It would clearly be nice for singularity theorems if they had a beginning, but how can we distinguish whether they had a beginning? Inasmuch as the time had a beginning at the Big Bang it would deepen implication for the role of supreme divine creator (that much of humanity worships as the source of all reality) in the grand design of creation. But if it persists in the bounds of reason in that it has neither beginning nor end and nothing for a Creator to do. What role could ineffable benevolent creator have in creation? Life could start and new life forms could emerge on their own randomly sustaining themselves by reproducing in the environment fitted for the functional roles they perform. Personally, we're sure that the time began with a hot Big Bang. But will it go on ticking forever? If not, when it will wind up its clockwork of ticking? We're much less sure about that. However, we are just a willful gene centered breed of talking monkeys on a minor planet of a very average galaxy. But we have found a new way to question ourselves and we have learned to do them. That makes us something very special. Moreover, everything we think we understand about the universe would need to be reassessed. Every high school graduate knows cosmology, the very way we think of things, would be forever altered. The distance to the stars and galaxies and the age of the universe (13.7 billion years − number has now been experimentally determined to within 1% accuracy) would be thrown in doubt. Even the expanding universe theory, the Big Bang theory, and black holes would have to be re-examined. The Big Bang theory of universe assumes the present form of the universe originated from the hot fire ball called singularity and it assumes time did not exist before the Big Bang. But Erickcek deduced on the basis of NASA's, Wilkinson Microwave Anisotropy Probe (WMAP) that the existence of time and empty space is possible before the Big Bang.

A photon generated at the center of the star makes its way to the surface. It may take up to several million years to get to the surface, and the gravitational potential energy of the photon at the surface of the star is given by: $PE = -GMm/r$, where $G = 6.673 \times 10^{-11}\ Nm^2/kg^2$ is Gravitational constant, m is the photon mass, M and r denote the mass and radius of the star. If the photon wants to detach from the star surface, the force which moves the photon, mc^2/λ, should be equal to the force of gravitation experienced by the photon, GMm/r^2 i.e.,

$$GMm/r^2 = mc^2/\lambda$$

From this it follows that

$$r^2 = GM\lambda/c^2$$

For a photon to escape from the surface of the sun of mass $M = 2 \times 10^{30}$ kg and radius $r = 6.96 \times 10^{8}$ m, it should have to possess a wavelength of

$$\lambda = r^2 c^2 / GM = 32.6 \times 10^{13}\ m$$

i.e., energy equivalent to $6.08\ 10^{-40}$ joules.

(If a star collapses to a black hole, then r is = $2GM/c^2$

the equation $r^2 = GM\lambda/c^2$ takes the form:

$$\lambda = 4\ GM/c^2$$

i.e., photon should possess a wavelength of $\lambda = 4\ GM/c^2$ to escape from the surface of the black hole).

If the condition $GMm/r^2 = mc^2/\lambda$ is satisfied and the photon detaches the star surface, its energy shifts from $h\upsilon$ to $h\upsilon_0$. The change in photon energy is equivalent = gravitational potential energy of the photon i.e.,

$(h\upsilon - h\upsilon_0) = - GMm/r$

Since $m = h\upsilon/c^2$:

$(h\upsilon - h\upsilon_0) / h\upsilon = - GM/rc^2$

The gravitational binding energy of a star is given by $U = -3GM^2/5r$. Therefore, the equation

$(h\upsilon - h\upsilon_0) / h\upsilon = - GM/rc^2$ can be rewritten as:

$(h\upsilon - h\upsilon_0) / h\upsilon = 5U/3Mc^2$

or

$z = 1.66U / Mc^2$

where z = gravitational redshift. Since z is always < than 1, Mc^2 is greater than 1.66 times the gravitational binding energy of a star i.e.,

$Mc^2 > 1.66U$

Which means: $Mc^2 > 1.66U$ is a condition that must be satisfied for a star to allow the photon to escape from its surface.

The rate of loss of photon energy, − (dE/dt), is related to the photon frequency υ by the equation: $-dE/dt = h\upsilon^2$, where $E = h\upsilon$. But $\upsilon = c/\lambda$. Therefore:

$d\lambda = c \times dt$

Integrating over dλ from λ (the wavelength of the photon before detaching from the star surface) to λ_0 (the wavelength of the detached photon), and over dt from zero to t:

$(\lambda_0 - \lambda) = c \times t$

Since $\upsilon = c/\lambda$. Therefore:

$(\upsilon - \upsilon_0) / \upsilon\upsilon_0 = t$

$h (\upsilon - \upsilon_0) / h\upsilon\upsilon_0 = t$

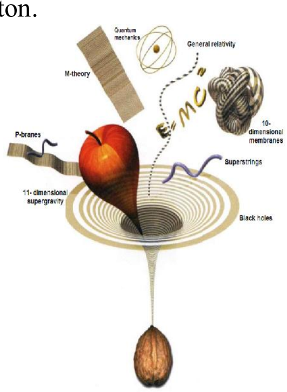
Since $(h\upsilon - h\upsilon_0) / h\upsilon = - GM/rc^2$. Therefore:

$t = - GM/r\upsilon_0 c^2$

The time it takes for the photon to detach from the star surface is given by:

$t = - GM\lambda_0 /rc^3$

From above equation it follows that as λ_0 increases, numerical value of t increases. But, because of the negative sign the actual value of t decreases. That is, more the time the photon takes to detach the star surface the lesser is the wavelength of the detached photon.



But what would happen if you travel back in time and kill your grandfather before he conceives your father? Would the arrow of time reverse? Because motion makes the clock tick slower, can we travel back in time and kill our grandfather before he conceive our father? If not, why the universe avoids the paradox? Time Travel − Science Fiction? Taking the laws of physics and punching them in the stomach and throwing them down the stairs – it's possible for you to break the universal speed limit. It is mind boggling to think about it – you're actually travelling backwards in time. What if you went back in time and prevented big bang from happening? You would prevent yourself from ever having been born! But then if you hadn't been born, you could not have gone back in time to prevent big bang from happening. The concept of time travel may sound something impressive and allow science fiction like possibilities for people who survived from the past, but somewhat it seems to be incredible like seeing broken tea cups gathering themselves together off the floor and jumping back on the table promoting cup manufacturers go out of business. However, travelling through time may not be the far-fetched science fiction theory. At the same time, can we open a portal to the past or find a shortcut to the future and master the time itself is still in question and forbidden by the second law of thermodynamics (which states that in any closed system like universe randomness, or entropy, never decreases with time). Of course, we have not seen anyone from the past (or have we?).

We asked how stars are powered and found the answer in the transformations of atomic nuclei. But there are still simple questions that we can ask. And one is: Is our universe merely the by-product of a cosmic accident? If the universe were merely the by-product of a grand accident, then our universe could have been a conglomeration of objects each going its own way. But everything we see in the universe obeys rules which are governed by a set of equations, without exception − which give philosophy a lot more attention than science. However, this does not mean that the universe obey rules because it exists in a plan which is created and shaped by a grinding hand. Maybe the universe is a lucky coincidence of a grand accident emerged with ingredients such as space, time, mass, and energy exist in one-to-one correspondence with the elements of reality, and hence it obeys a set of rational laws without exception. At this moment it seems as though Dr. Science will never be able to raise the curtain on the mystery of creation. Moreover, traditional philosophy is dead, that it has not kept up with modern developments in science, and there is no reason at justifying the grinding hand because the idea of God is extremely limited and goes no further than the opening sentence of the classical theology (which has always rejected the idea that God can classified or defined), and much is still in the speculative stage, and we must admit that there are yet no empirical or observational tests that can be used to test the idea of an accidental origin. No evidence. No scientific observation. Just a speculation. For those who have lived by their faith in the power of reason, the story may end like a bad dream since free will is just an illusion.

When a photon passes the star tangentially, the gravitational field of the star deflects the photon by an angle $\theta = \tan^{-1} (F_G / F_P)$ where F_G = force of the gravitational field of the star experienced by the photon and F_P = force which moves the photon. Even if $F_P \geq F_G$, θ will not be = 0 i.e., deflection occurs.

From the Big Bang to the Bodies such as stars or black holes including basic facts such as particle masses and force strengths, the entire universe works because the laws of physics make things happen. But if Meta or hyper laws of physics were whatever produced the universe then what produced those laws. Or perhaps, the laws, or the cause that created them, existed forever, and didn't need to be created. We must admit that there is ignorance on some issues, that is, we don't have a complete set of laws …. We are not sure exactly does the existing laws hold everywhere and at all time. Dr. Science gives us a clue, but there's no definitive answer to provide a purely natural, non-causal explanation for the existence of laws of physics and our place in it. So let's just leave it at the hypothetical laws of physics. The question, then, is why are there laws of physics? And we could say, well, that required a biblical deity, who created these laws of physics and the spark that took us from the laws of physics to the notions of time and space. Well, if the laws of physics popped into existence 13.8 billion years ago with divine help whatsoever, like theologians say, why aren't we seeing a at least one evidence of an ineffable creator in our observable universe every now and then? The origin of the Meta or hyper laws of physics remains a mystery for now. However, recent breakthroughs in physics, made possible in part by fantastic revolutionary understanding of the true nature of the mathematical quantities and theories of physics, may suggest an answer that may seem as obvious to us as the earth orbiting the sun – or perhaps as ridiculous as earth is a perfect sphere. We don't know whatever the answer may be because the Meta or hyper laws of physics are completely beyond our experience, and beyond our imagination, or our mathematics. This fact leads us to a big mystery and awaits the next generation of high energy experiments, which hope to shed light on the far-reaching answer that might be found in the laws that govern elemental particles.

The Drake Equation

$$N = R^* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

Where:

R^* = the rate at which stars are born in the galaxy,

f_p = the fraction of these stars that have planets,

n_e = the number of planets for each star that have the conditions for life,

f_l = the fraction of planets that actually develop life,

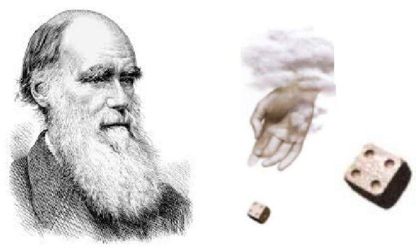
f_i = the fraction that develop intelligent life,

f_c = the fraction that are willing and able to communicate, and

L = the expected lifetime of a civilization.

Fermi's Paradox

If there are so many aliens, where are they?



Who are we? We find that we intelligent apes who have only recently left the trees, live on an fragile planet of a humdrum star by a matter of sheer luck or by divine providence, lost in a galaxy tucked away in some forgotten corner of a universe in which there are far more galaxies than people. Sending the Beatles song across the Universe and pointing the telescopes in Deep Space Network towards the North Star, Polaris, we seek to find intellectual beings like us outside the sheer number of planets, vast ocean of existence, our solar system, and our own Milky Way galaxy. How awe hunting for them across the empty stretches of the universe would be to acquire a bit of confirmation that either we're alone in this universe or we are not. However, we are not the only life-form in the universe, is reasonable to expect since we have no reason to assume that ours is the only possible form of life. Some sort of life could have happened in a universe of greatly different form, but

Where's the evidence?

The Burden of evidence is only on the people who regard themselves as reliable witnesses that sightings of UFOs are evidence that we are being visited by someone living in another galaxy who are much more advanced enough to spread through some hundred thousand million galaxies and visit the Earth. An alien, like the teapot, is a hypothesis that requires evidence.

The known forces of nature can be divided into four classes:

Gravity: This is the weakest of the four; it acts on everything in the universe as an attraction. And if not for this force, we would go zinging off into outer space and the sun would detonate like trillions upon trillions of hydrogen bombs.

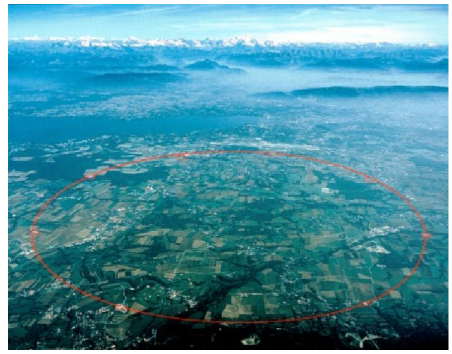
Electromagnetism: This is much stronger than gravity; it acts only on particles with an electric charge, being repulsive between charges of the same sign and attractive between charges of the opposite sign. More than half the gross national product of the earth, representing the accumulated wealth of our planet, depends in some way on the electromagnetic force. It light up the cities of New York, fill the air with music from radios and stereos, entertain all the people in the world with television, reduce housework with electrical appliances, heat their food with microwaves, track their planes and space probes with radar, and electrify their power plants.

Weak nuclear force: This causes radioactivity and plays a vital role in the formation of the elements in stars. And a slightly stronger this force, all the neutrons in the early universe would have decayed, leaving about 100 percent hydrogen, with no deuterium for later use in the synthesizing elements in stars.

Strong nuclear force: This force holds together the protons and neutrons inside the nucleus of an atom. And it is this same force that holds together the quarks to form protons and neutrons. Unleashed in the hydrogen bomb, the strong nuclear force could one day end all life on earth.

The inherent goal of unification is to show that all of these forces are, in fact, manifestations of a single super force. We can't perceive this unity at the low energies of our everyday lives, or even in our most powerful accelerators (capable of accelerating particles nearly up to the speed of light) at Fermi lab or LHC, the Large Hadron Collider, at CERN (European Centre for Nuclear Research), in Switzerland. But close to the Big Bang temperatures, at inconceivably high energies…

If the forces unify, the protons − which make up much of the mass of ordinary matter− can be unstable, and eventually decay into lighter particles such as antielectrons. Indeed, several experiments were performed in the Morton Salt Mine in Ohio to yield definite evidence of proton decay. But none have succeeded so far. However, the probability of a proton in the universe gaining sufficient energy to decay is so small that one has to wait at least a million million million million million years i.e., longer than the time since the big bang, which is about ten thousand million years.



A view of CERN showing the LEP (Large electron positron collider) ring

The strength of the gravitational force is measured by the dimensionless parameter α_G, which in standard international units is $Gm^2/\hbar c$ (where m is the mass of the proton or the electron). And the ratio α_G / α is $=136.25 \times (m /\text{Planck mass})^2$. And since m is < than Planck mass (the fundamental unit of mass constructed solely out of the three fundamental constants, $\hbar = h/2\pi$, G and c, about the same as a large bacteria or very small insect − which we can produce in a bubble chamber in the Fermi lab accelerator at the present time), it is clear that from the above equation α is > than α_G (i.e., the strength of electromagnetic force is > than the strength of gravitational force). But why? The answer is at the heart of the basic questions of particle physics. The eminent laws do not tell us why the initial configuration was such as to produce what we observe. For what purpose? Must we turn to the anthropic principle for an explanation? Was it all just a lucky chance? That would seem a counsel of despair, a negation of all our hopes of understanding the unfathomable order of the universe. However, this is an extended metaphor for many puzzles in physics uncovered with painstaking labor, and it is especially relevant to particle physics. Still, particle physics remains unfathomable to many people and a bunch of scientists chasing after tiny invisible objects.

If string theory is correct, then every particle is nothing but a vibrating, oscillating, dancing filament named a string. A string does something aside from moving – it oscillates in different ways. Each way represents a particular mode of vibration. Different modes of vibration make the string appear as a dark energy or a cosmic ray, since different modes of vibration are seen as different masses or spins.

If Higgs theory (which is the last piece of the Standard Model that has still eluded capture –which is one of the theories LHC experimentalists hope to discover and it is the capstone for conventional big bang cosmology --which biblical creationists reject) is correct, then a new field called the Higgs field which is analogous to the familiar electromagnetic field but with new kinds of properties permits all over the space (considered the origin of mass in Grand Unified Theory – a theory that unifies the weak, strong, and electromagnetic interactions, without gravity). Different masses of the particles are due to the different strengths of interaction of the particle with the Higgs field (more the strength of interaction of the particle with the Higgs field, more the mass of the particle).To make this easier for you, let's say it is cosmic high-fructose corn syrup − the more you go through it, the heavier you get.

If both the theories are right, then the different masses of the particles are due to (the different modes of vibration of the string plus the different strengths of interaction of the string with the Higgs field).

Which explanation is right?

Higgs theory runs rampant in the popular media claiming that String Theory Is Not The Only Game In Town. However, by the end of the decade, we will have our first glimpse of the new physics, whatever it well may be

STRING or HIGGS

The new physics will point to even more discoveries at the TeV scale and opens the door beyond the Standard Model and raise new questions like: if the Higgs field generate masses for the W and Z, and for the quarks and leptons− does it generate its own mass and if so how? What is its mass?

As a remarkable consequence of the uncertainty principle of quantum mechanics (which implies that certain pairs of quantities, such as the energy and time, cannot both be predicted with complete accuracy) the empty space is filled with what is called vacuum energy (energy that is present even in apparently empty space which has the curious property that unlike the presence of mass, the presence of vacuum energy would cause the expansion of the universe to speed up) − i.e., the empty space has energy and its energy density is constant and given by: $\rho = \Lambda c^2 / 8\pi G$ where Λ is the cosmological constant (which give space-time an inbuilt tendency to expand and measures the amount of dark energy in the universe. At present, the data supports density parameter (the parameter that measures the average density of matter in the universe) + cosmological constant = 1, which fits the prediction of inflation for a flat universe), c is the speed of light (which is 299,792,458 meters per second, or (approximately) 186,282 miles per second) and G is the universal gravitational constant. Since $c^2 / 8\pi G$ is constant, ρ and Λ are in fact equivalent and interchangeable. And since c^2 is $> 8\pi G$, therefore Λ is $< \rho$ which means: a very large amount of dark energy attributes to a fairly small vacuum energy density. Moreover, since c is not just the PHYSICAL constant but rather a fundamental feature of the way space and time are unified as space-time, does the equation $\rho = \Lambda c^2 / 8\pi G$ mean that as a consequence of dominance of the unification of space and time over a force called gravity − a very large amount of dark energy attributes to a fairly small vacuum energy density? And $c^2 / 8\pi G$ is $= 5.36 \times 10^{25}$ kg/m. What does the value 5.36×10^{25} kg per meter imply? Dr. Science remains silent on these profound questions. Ultimately, however, one would hope to find complete, consistent answers that would include all the mathematical techniques as approximations. The quest for such answers is known as the grand unification of the two basic partial theories: the general theory of relativity (which states that space and time are no longer absolute, no longer a fixed background to events. Instead, they are dynamical quantities that are shaped by the matter and energy in the universe) and quantum mechanics (a theory of the microcosm which has upended many an intuition, but none deeper than this one − developed by 1900 physicists in response to a number of glaring problems that arose when 19th century conceptions of physics were applied to the microscopic world, where subatomic particles are held together by particle like forces dancing on the sterile stage of space-time, which is viewed as an empty arena, devoid of any content). Unfortunately, however, these two theories are inconsistent with each other – i.e., quantum mechanics and general relativity do not work together. How the ideas of general relativity can be consolidated with those of quantum theory is still a? until we progress closer toward the laws that govern our universe.

The latest theory of subatomic particles (the quantum theory) gives an estimated value of vacuum energy density that is about 120 orders of magnitude larger than the measured value — claiming our best theory cannot calculate the value of the largest energy source in the entire universe. Dr Science advances over the wreckage of its theories by continually putting its ideas to experimental test; no matter how beautiful its idea might be; it must be discarded or modified if it is at odds with experiment. It would have been clearly be nice for quantum theory if the value of vacuum energy density were in the order of 10^{96} kg per cubic meter, but the measured value were in the order of 10^{-27} kg per cubic meter. Thus, the best candidate we have at the moment, the quantum theory, brought about its downfall by predicting the value of vacuum energy density that is about 120 orders of magnitude larger than the measured value.

We a lot of exposure with darkness and disbelief and a state of not having an immediate conclusion, and this vulnerability is of great significance, I think. When we don't comprehend the mind of nature, we are in the middle of darkness. When we have an intuitive guess as to what the outcome is; we are unsealed. And when we are fairly damn sure of what the final result is going to be, we are still in some uncertainty. And uncertainty being too complex to come about randomly is evidence for human continuing quest for justification. Sometimes, very hard, impossible things just strike and we call them thoughts. In most of the self-reproducing organisms the conditions would not be right for the generation of thoughts to predict things more or less, even if not in a simplest way, only in the few complex organisms like us spontaneous thoughts would generate and what is it that breathes fire into a perception. The human perception is enormous; it's extensive and unlimited, and outrageous that we can ask simple questions. And they are: What the dark energy is up to? What it is about? Why this mysterious form of energy permeates all of space blowing the galaxies farther and farther apart? How accurate are the physical laws (which are essentially the same today as they were at the time of Newton despite the scientific revolutions and paradigm shifts), which control it? Why it made the universe bang? Unfortunately, the laws that we are using are not able to answer these questions because of the prediction that the universe started off with infinite density at the big bang singularity (where all the known laws would break down). However, if one looks in a commonsense realistic point of view the laws and equations which are considered as inherent ingredients of reality − are simply the man-made ingredients introduced by the rational beings who are free to observe the universe as they want and to draw logical deductions from what they see − to describe the objective features of reality. The scientific data is fallible, changeable, and influenced by scientific understanding is refreshing. Here's an example of what I mean. In most physics textbooks we will read that the strength of the electromagnetic force is measured by the dimensionless parameter $\alpha = e^2/4\pi\varepsilon_0\hbar c$ (where e is the charge = 1.602×10^{-19} Coulombs, ε_0 is the absolute permittivity of free space = 8.8×10^{-12} F/m, c is the speed of light in vacuum and ħ is the reduced Planck's constant), called the fine structure constant, which was taught to be constant became variant when the standard model of elementary particles and forces revealed that α actually varies with energy.

The Quantum theory of electrodynamics (a relativistic quantum field theory or a quantum field theory – arguably the most precise theory of natural phenomena ever advanced which seems to govern everything small – through which we have been able to solidify the role of photons as the "smallest possible bundles of light" and to reveal their interactions with electrically charged particles such as electrons, in a mathematically complete, predictive, and convincing framework) and General Relativity (which dominates large things and is now called a classical theory which predicts that the universe started off with infinite density at the big bang singularity) both try to assign mass to the singularity. But according to generally accepted history of the universe, according to what is known as the hot big bang model. At some finite time in the past i.e., between ten and twenty thousand million years ago. At this time, all matter (which is characterized by the physical quantity we define as mass) would have been on top of each other − which is called the singularity, the density ρ would have been INFINITE. If density → infinite then volume V which is M/ ρ approaches zero. So if V approaches zero then mass M which is density times volume approaches zero. Hence the singularity cannot have mass in a zero volume, by definition of mass and volume. However, a good mathematical theory can prove anything with that amount of wiggle room, and findings are really determined by nothing except its desire. For all theoreticians and tens of thousands of university graduates at least know, the universe started off with infinite density at the hot big bang singularity with infinitely hot temperatures. And at such high temperatures that are reached in thousands of H-bomb explosions, the strong and weak nuclear forces and the gravity and electromagnetic force were all unified into a single force. What was before the Big Bang? Was the Big Bang created? If the Big Bang was not created, how was this Big Bang accomplished, and what can we learn about the agent and events of creation? Is it the product of chance or was been designed? What is it that blocked the pre-Big Bang view from us? Is Big Bang singularity an impenetrable wall and we cannot, in physics, go beyond it? To answer one question, another question arises. Erickcek's model suggests the possibility of existence of space and time before the big bang. But the world famed Big Bang theory abandons the existence of space and time before the big bang. Both the theories are consistent and based upon sophisticated experimental observations and theoretical studies. Truth must be prejudiced with honest scientific inquiry to illuminate the words of Genesis. And this is possible only if the modern scientific community would simply open its eyes to the truth.

Do black holes really exist? If they exist, why we haven't observed one hole yet? Can black holes be observed directly, and if so, how? If the production of the tiny black holes is feasible, can particle accelerators, such as the Large Hadron Collider (LHC) in Switzerland at the famed CERN nuclear laboratory create a micro black hole that will eventually eat the world? If not − if there are no black holes, what are the things we detect ripping gas off the surface of other stars? What is the structure of space-time just outside the black hole? Do their space times have horizons? : are the major questions in theoretical physics today that haunts us. The effort to resolve these complex paradoxes is one of the very few things that lifts human mind a little above the level of farce, and gives it some of the grace of province inspiring new ideas and new experiments.

Most people think of a black hole as a voracious whirlpool in space, sucking down everything around it. But that's not really true! A black hole is a place where gravity has gotten so strong that even light cannot escape out of its influence.

How a black hole might be formed?

The slightly denser regions of the nearly uniformly distributed atoms (mostly hydrogen) which lack sufficient energy to escape the gravitational attraction of the nearby atoms, would combine together and thus grow even denser, forming giant clouds of gas, which at some point become gravitationally unstable, undergo fragmentation and would break up into smaller clouds that would collapse under their own gravity. As these collapses, the atoms within them collide with one another more and more frequently and at greater and greater speeds – the gas heats up i.e., the temperature of the gas would increase, until eventually it become hot enough to start nuclear fusion reactions. And a consequence of this is that the stars like our sun (which are made up of more than one kind of gas particle) are born to radiate their energy as heat and light. But the stars of radius

$r = 2GM/c^2$

or

$Mc^2 = 2GM^2/r$

Since $GM^2/r = -5U/3$ (where U = gravitational binding energy of a star):

$Mc^2 = - 3.33U$

i.e., stars of rest mass energy = 3.33 times their negative gravitational binding energy further collapse to produce dark or frozen stars (i.e., the mass of a star is concentrated in a small enough spherical region, so that its mass divided by its radius exceeds a particular critical value, the resulting space-time warp is so radical that anything, including light, that gets too close to the star will be unable to escape its gravitational grip). And these dark stars are sufficiently massive and compact and possess a strong gravitational field that prevent even light from escaping out its influence: any light emitted from the surface of the star will be dragged back by the star's gravitational attraction before it could get very far. Such stars become black voids in space and were coined in 1969 by the American scientist John Wheeler "the black holes" (i.e., black because they cannot emit light and holes because anything getting too close falls into them, never to return). Classically, the gravitational field of the black holes (which seem to be among the most ordered and organized objects in the whole universe) is so strong that they would prevent any information including light from escaping out of their influence i.e., any information is sent down the throat of a black hole or swallowed by a black hole is forever hidden from the outside universe (this goes by the statement that "black holes have no hair"—that is, they have lost all information, all hair, except for these three parameters: its mass, spin and charge), and all one could say of the gravitational monster what the poet Dante said of the entrance to Hell: "All hope abandon, ye who enter here." Anything or anyone who falls through the black hole will soon reach the region of infinite density and the end of time. However, only the laws of classical general relativity does not allow anything (not even light) to escape the gravitational grip of the black hole but the inclusion of quantum mechanics modifies this conclusion− quantum fields would scatter off a black hole. Because energy cannot be created out of nothing, the pair of short-lived virtual particles (one with positive energy and the other with negative energy) appears close to the event horizon of a black hole. The gravitational might of the black hole inject energy into a pair of virtual particles... that tears them just far enough apart so that one with negative energy gets sucked into the hole even before it can annihilate its partner... its forsaken partner with positive energy... gets an energy boost from the gravitational force of the black hole... escape outward to infinity (an abstract mathematical concept that was precisely formulated in the work of mathematician Georg Cantor in the late nineteenth century)... where it appear as a real particle (and to an observer at a distance, it will appear to have been emitted from the black hole). Because E= mc squared (i.e., energy is equivalent to mass), a fall of negative energy particle into the black hole therefore reduces its mass with its horizon shrinking in size. As the black hole loses mass, the temperature of the black hole (which depends only on its mass) rises and its rate of emission of particle increases, so it loses mass more and more quickly. We don't know does the emission process continue until the black hole dissipates completely away or does it stop after a finite amount of time leaving black hole remnants.

The attempt to understand the Hawking radiation has a profound impact upon the understanding of the black hole thermodynamics, leading to the description of what the black hole entropic energy is.

Black hole entropic energy = Black hole temperature × Black hole entropy

$E_s = T \times S_{BH}$

$E_s = 1/2 \times Mc^2$

This means that the entropic energy makes up half of the mass energy of the black hole. For a black hole of one solar mass ($M = 2 \times 10^{30}$ kg), we get an entropic energy of 9×10^{46} joules – much higher than the thermal entropic energy of the sun.

Given that power emitted in Hawking radiation is the rate of energy loss of the black hole:

$P = -c^2 (dM / dt)$ or $P = 2 \times (-dE_s / dt)$

The more power a black hole radiates per second, the more entropic energy being lost in Hawking radiation. However, the entropic energy of the black hole of one solar mass is about 9×10^{46} joules of which only 4.502×10^{-29} joules per second is lost in Hawking radiation.

$Mc^2 = 2 T \times S_{BH}$

If $M \rightarrow 0$, then S_{BH} which is $(4\pi k_B GM^2/ \hbar c) \rightarrow 0$

$T = Mc^2 / 2S_{BH} = 0/0$

But according to the equation

$T = (\hbar c^3 / 8\pi GMk_B)$

When $M \rightarrow 0$

$T = (\hbar c^3 / 8\pi GMk_B) = \hbar c^3 / 0$

2 different results for T (i.e., $T = 0/0$ and $T = \hbar c^3 / 0$) when $M \rightarrow 0$ – which is never justified.

Taking the analogy between the laws of black holes (which govern the physics of black hole: (first law): The variation of the mass M of the black hole is given by the Smarr formula -- $dM = (\kappa/8\pi) dA + \Omega dJ + \Phi dQ$ (where M stood for mass, κ for surface gravity, A for area of the event Horizon, J for angular momentum, Ω for angular velocity, Q for charge and Φ for the electrostatic potential) – which implies the size and shape of the black hole depends only on its mass, charge and rate of rotation, and not on the nature of the star that had collapsed to form it; (second law): No physical process can decrease the area A of the horizon, $dA \geq 0$; (third law): surface gravity $\kappa = 0$ cannot be reached in a finite time) and laws of thermodynamics (which govern the physics of heat: (first law) the total amount of matter and energy is conserved; (second law) total entropy always increases and (third law) we cannot reach absolute zero) seriously... would... force one to assign a temperature to the black hole (its precise value determined by the formula: $T = \hbar c^3/ 8\pi GMk_B$). In this formula the symbol c stands for the speed of light (an awkward conversion factor for everyday use because it's so big. Light can go all the way around the equator of the Earth in about 0.1 seconds), ħ for reduced Planck's constant, G for universal gravitational constant, and k_B for Boltzmann's constant. Finally M represents the mass of the black hole. This formula confirms that a black hole ought to emit particles and radiation as if it were a hot body with a temperature that depends only on the black hole's mass: the higher the mass, the lower the temperature. And this formula can also be rewritten as:

T / Planck temperature = Planck mass / 8π M

If T equals Planck temperature, then M equals Planck mass / 8π which mean: even if the temperature of the black hole approaches Planck temperature, the black hole cannot attain a mass = Planck mass. The factor 1/8π prevents the black hole from attaining a mass = Planck mass. We do not know what the factor 1/8π really means and why this factor prevents the black hole from attaining a mass = Planck mass because the usual approach of Dr. Science of constructing a set of rules and equations cannot answer the question of what and why but how. And if M equals the mass of the electron, then T becomes > than Planck temperature. If T becomes > than Planck temperature, then current physical theory breaks down because we lack a theory of quantum gravity (and temperature > than Planck temperature cannot exist only for the reason that the quantum mechanics breaks down at temperature > than 10 to the power of 33 Kelvin). However, it is only theoretically possible that black holes with mass M = mass of the electron could be created in high energy collisions. No black holes with mass M = mass of the electron have ever been observed, however – indeed, normally the creation of micro black holes (with mass <= mass of the electron) take place at high energy (i.e., $>10^{28}$ electron volts − roughly greater than million tons of TNT explosive), which is a quadrillion times beyond the energy of the LHC. Even if the quantum black holes (with mass <= mass of the electron) are created, they would be extremely difficult to spot - and they are the large emitters of radiation (because $T = \hbar c^3/ 8\pi GMk_B$) and they shrink and dissipate faster even before they are observed. Though the emission of particles from the primordial black holes is currently the most commonly accepted theory within scientific community, there is some disputation associated with it. There are some issues incompatible with quantum mechanics that it finally results in information being lost, which makes physicists discomfort and this raises a serious problem that strikes at the heart of our understanding of science. However, most physicists admit that black holes must radiate like hot bodies if our ideas about general relativity and quantum mechanics are correct. Thus even though they have not yet managed to find a primordial black hole emitting particles after over two decades of searching. Despite its strong theoretical foundation, the existence of this phenomenon is still in question. Alternately, those who don't believe that black holes themselves exist are similarly unwilling to admit that they emit particles.

In the nuclear reaction mass of reactants is always greater than mass of products. The mass difference is converted to energy, according to the equation which is as famous as the man who wrote it.

For a nuclear reaction: $p + Li_7 \rightarrow \alpha + \alpha + 17.2$ MeV

Mass of reactants:

p= 1.0072764 amu

Li_7 = 7.01600455 amu

Total mass of reactants = 7.01600455 amu + 1.0072764 amu = 8.02328095 amu

Mass of products:

α= 4.0015061amu

Total mass of products = α + α = 2α = 8.0030122 amu

As from above data it is clear that

Total mass of reactants is greater than Total mass of products. The mass difference (8.02328095 amu − 8.0030122 amu = 0.02026875 amu) is converted to energy 18.87 MeV, according to the equation $E = mc^2$. However, the observed energy is 17.2 MeV.

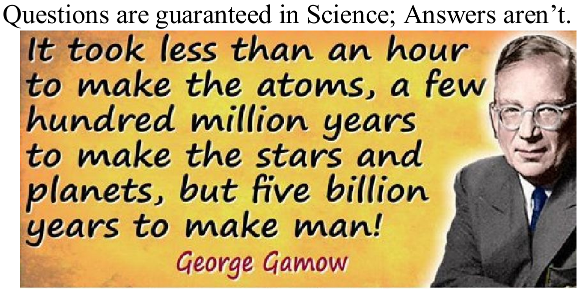
Expected energy = 18.87 MeV (i.e., 0.02026875 amu × c^2)

Experimentally observed energy = 17.2 MeV

Expected energy is ≠ observed energy

Energy difference = (18.87 − 17.2) MeV = 1.67 MeV

Where the energy 1.67 MeV is gone? The question is clear and deceptively simple. But the answer is just being blind to the complexity of reality. Questions are guaranteed in Science; Answers aren't.



If we could peer into the fabric of space-time at the Planck length (the distance where the smoothness of relativity's space-time and the quantum nature of reality begin to rub up against each other), we would see the 4 dimensional fabric of space-time is simply the lowest energy state of the universe. It is neither empty nor uninteresting, and its energy is not necessarily zero (which was discovered by Richard Dick Feynman, a colorful character who worked at the California Institute of Technology and played the bongo drums at a strip joint down the road− for which he received Nobel Prize for physics in 1965). Because E = mc squared, one can think that the virtual particle-antiparticle pairs of mass m are continually being created out of energy E of the 4 dimensional fabric of space-time consistent with the Heisenberg's uncertainty principle of quantum mechanics (which tells us that from a microscopic vantage point there is a tremendous amount of activity and this activity gets increasingly agitated on ever smaller distance and time scales), and then, they appear together at some time, move apart, then come together and annihilate each other giving energy back to the space-time without violating the law of energy conservation (which has not changed in four hundred years and still appear in relativity and quantum mechanics). Spontaneous births and deaths of virtual particles so called quantum fluctuations occurring everywhere, all the time − is the conclusion that mass and energy are interconvertible; they are two different forms of the same thing. However, spontaneous births and deaths of so called virtual particles can produce some remarkable problem, because infinite number of virtual pairs of mass m can be spontaneously created out of energy E of the 4 dimensional fabric of space-time, does the 4 dimensional fabric of space-time bears an infinite amount of energy, therefore, by Einstein's famous equation $E = mc^2$, does it bears an infinite amount of mass. If so, according to general relativity, the infinite amount of mass would have curved up the universe to infinitely small size. But which obviously has not happened. The word virtual particles literally mean that these particles cannot be observed directly, but their indirect effects can be measured to a remarkable degree of accuracy. Their properties and consequences are well established and well understood consequences of quantum mechanics. However, they can be materialized into real particles by several ways. All that one require an energy = energy required to tear the pair apart + energy required to boost the separated virtual particle-antiparticles into real particles (i.e., to bring them from virtual state to the materialize state).

The equation $m = m_0 / (1 - v^2/c^2)^{1/2}$ is the same as: $mvdv + v^2dm = c^2dm$ which on rearranging we get:

$dm/dv = mv / (c^2 - v^2)$

Assuming that mass of non-relativistic particle varies with velocity and under the condition:

$v << c$, the above equation may be rewritten as:

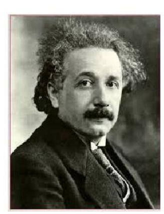
$dm/dv = mv /c^2$ which on rearranging:

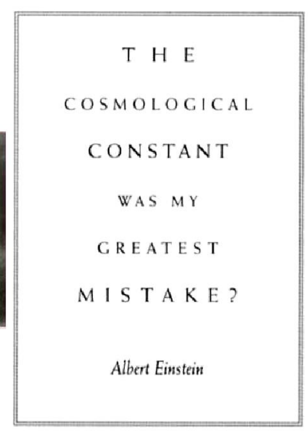
$dm/m = dv\, v /c^2$ and integrating over m from m_0 (the rest mass of the particle) to m (the mass of the moving particle) and over v from zero to v we get:

$\ln (m/m_0) = v^2/2c^2$

From this it follows that

$m = m_0 \exp (v^2/2c^2)$





Case 1:

$m = m_0 / (1 - v^2/c^2)^{½}$

For v = 30km/s = 3×10^4 m/s

$m = 1.000000005m_0$

Case2:

$m = m_0 \exp(v^2/2c^2)$

For v = 30km/s = 3×10^4 m/s

$m = 1.000000005m_0$

Conclusion: for velocity v = 30km/s, both the equations give values of mass as $m = 1.000000005m_0$. Therefore, the equation $m = m_0 \exp(v^2/2c^2)$ justifies that mass of non-relativistic particle varies with velocity. However, since $m = 1.000000005m_0$ the variation of mass is negligible.

When Einstein was 26 years old, he calculated precisely how energy must change if the relativity principle was correct, and he discovered the relation $E = mc^2$ (which led to the Manhattan Project and ultimately to the bombs that exploded over Hiroshima and Nagasaki in 1945). This is now probably the only equation in physics that even people with no background in physics have at least heard of this and are aware of its prodigious influence on the world we live in. And since c is constant (because the maximum distance a light can travel in one second is 3 ×10 to the power of 8 meter), this equation tells us that mass and energy are interconvertible and are two different forms of the same thing and are in fact equivalent. Suppose a mass m is converted into energy E, the resulting energy carries mass = m and moves at the speed of light c. Hence, energy E is defined by E= mc squared. As we know c squared (the speed of light multiplied by itself) is an astronomically large number: 9 × 10 to the power of 16 meters square per second square. So if we convert a small amount of mass, we'll get a tremendous amount of energy. For example, if we convert 1kg of mass, we'll get energy of 9 × 10 to the power of 16 Joules (i.e., the energy more than 1 million times the energy released in a chemical explosion. Perhaps since c is not just the constant namely the maximum distance a light can travel in one second but rather a fundamental feature of the way space and time are married to form space-time. One can think that in the presence of unified space and time, mass and energy are equivalent and interchangeable. But WHY? The question lingers, unanswered. Until now.

The black holes of nature are the most perfect macroscopic objects there are in the universe: the only elements in their construction are our concepts of space and time.

\- Subrahmanyan Chandrasekhar (1910 – 1995)

However, the equation $E = mc^2$ has some remarkable consequences (e.g. conversion of less than 1% of 2 pounds of uranium into energy was used in the atomic bomb over Hiroshima and body at rest still contains energy. When a body is moving, it carries an additional energy of motion called kinetic energy. In chemical and nuclear interactions, kinetic energy can be converted into rest energy, which is equivalent to generating mass. Also, the rest energy can be converted into kinetic energy. In that way, chemical and nuclear interactions can generate kinetic energy, which then can be used to run engines or blow things up). Because $E = mc^2$, the energy which a body possess due to its motion will add to its rest mass. This effect is only really significant for bodies moving at speeds close to the speed of light. For example, at 10 percent of the speed of light a body's mass M is only 0.5 percent more than its rest mass m, while at 90 percent of the speed of light it would be more than twice its rest mass. And as an body approaches the speed of light, its mass raise ever more quickly, it acquire infinite mass and since an infinite mass cannot be accelerated any faster by any force, the issue of infinite mass remains an intractable problem. For this reason all the bodies are forever confined by relativity to move at speeds slower than the speed of light. Only tiny packets/particles of light (dubbed "photons" by chemist Gilbert Lewis) that have no intrinsic mass can move at the speed of light. There is little disagreement on this point. Now, being more advanced, we do not just consider conclusions like photons have no intrinsic mass. We constantly test them, trying to prove or disprove. So far, relativity has withstood every test. And try as we might, we can measure no mass for the photon. We can just put upper limits on what mass it can have. These upper limits are determined by the sensitivity of the experiment we are using to try to weigh the photon. The last number we can see that a photon, if it has any mass at all, must be less than 4 ×10 to the power of − 48 grams. For comparison, the electron has a mass of 9 × 10 to the power of − 28 grams. Moreover, if the mass of the photon is not considered to zero, then quantum mechanics would be in trouble. And it also an uphill task to conduct an experiment which proves the photon mass to be exactly zero. Tachyons the putative class of hypothetical particles (with negative mass squared: $m^2 < 0$) is believed to travel faster than the speed of light. But, the existence of tachyons is still in question and if they exist, how can they be detected is still a? However, on one thing most physicists agree: (Just because we haven't found anything yet that can go faster than light doesn't mean that we won't one day have to eat our words. We should be more open-minded to other possibilities that just may not have occurred to us). Moreover, in expanding space − recession velocity keeps increasing with distance. Beyond a certain distance, known as the Hubble distance, it exceeds the velocity greater than the speed of light in vacuum. But, this is not a violation of relativity, because recession velocity is caused not by motion through space but by the expansion of space.

"His work has given one of the most powerful of all impulses to the progress of science. His ideas will be effective as long as physical science lasts," Einstein wrote about Max Planck (1858—1947).

The first step toward quantum theory had come in 1900, when German scientist Max Planck in Berlin discovered that the radiation from a body that was glowing red-hot was explainable if light could be emitted or absorbed only if it came in indivisible discrete pieces, called quanta. And each quanta behaved very much like point particles of energy $E = h\upsilon$. In one of his groundbreaking papers, written in 1905 when he was at the patent office, Einstein showed that Planck's quantum hypothesis could explain what is called the photoelectric effect, the way certain metals give off electrons when light falls on them − discovered by German physicist Heinrich Hertz in 1887. He attributed particle nature to a photon (that made up a crisis for classical physics around the turn of the 20th century and it provided proof of the quantization of light) and considered a photon as a particle of mass $m = h\upsilon/c^2$ and said that photoelectric effect is the result of an elastic collision between a photon of incident radiation and a free electron inside the photo metal. During the collision the electron absorbs the energy of the photon completely. A part of the absorbed energy $h\upsilon$ of the photon is used by the electron in doing work against the surface forces of the metal. This part of the energy ($h\upsilon_1$) represents the work function W of the photo metal. Other part ($h\upsilon_2$) of the absorbed energy $h\upsilon$ of the photon manifests as kinetic energy (KE) of the emitted electron i.e.,

$(h\upsilon_2) = KE$

But $h\upsilon_2 = p_2c$ (p_2 is the momentum and c is the speed of light in vacuum) and $KE = pv/2$ where p is the momentum and v is the velocity of ejected electron. Therefore: $p_2c = pv/2$. If we assume that $p_2 = p$ i.e., momentum p_2 completely manifests as the momentum p of the ejected electron, then

$v = 2c$

Nothing can travel faster than the speed of light in vacuum, which itself frame the central principle of Albert Einstein's special theory of relativity (which resolved the conflict of James Clerk Maxwell's laws of electromagnetism (which stated that one cannot catch up with a departing beam of light) by overturning the understanding of space and time). If the electron with rest mass = 9.1 × 10 to the power of –31 kg travels with the velocity v = 2c, then the fundamental rules of physics would have to be rewritten. However, v=2c is meaningless as the non-relativistic electron can only travel with velocity $v << c$. Hence: p_2 is $\neq$ p. This means: only a part (p_{2A}) of the momentum p_2 manifests as the momentum p of the ejected electron.

$p_2 = (p_{2A}) + (p_{2B})$

$p_2 = p + ?$

The stopping potential "V_S'' required to stop the electron of charge e (which is = – 1.602 × 10 $^{-19}$ Coulombs) and kinetic energy KE emitted from a metal surface is calculated using the equation:

$KE = e \times V_S$

If the kinetic energy of the emitted electron is 0 i.e., KE = 0, then V_S required to stop the emitted electron = 0. Under this condition: $e = KE / V_S = 0/0$ i.e., charge on the electron becomes UNDEFINED. There can be no bigger limitation than this. Electron charge cannot be undefined because e is = – 1.602 × 10 $^{-19}$ Coulombs.

$E = h\upsilon$ (which implies the energy a photon can have is proportional to its frequency: larger frequency (shorter wavelength) implies larger photon energy and smaller frequency (longer wavelength) implies smaller photon energy) – because h is constant, energy and frequency of the photon are equivalent and are different forms of the same thing. And since h − which is one of the most fundamental numbers in physics, ranking alongside the speed of light c and confines most of these radical departures from life-as-usual to the microscopic realm − is incredibly small (i.e., 6 × 10 to the power of –34 — a decimal point followed by 33 zeros and a 6 — of a joule second), the frequency of the photon is always greater than its energy, so it would not take many quanta to radiate even ten thousand megawatts. And some say the only thing that quantum mechanics (the great intellectual achievement of the first half of this century) has going for it, in fact, is that it is unquestionably correct. Since the Planck's constant is almost infinitesimally small, quantum mechanics is for little things. Suppose this number would have been too long to keep writing down i.e., h would have been = 6.625×10 to the power of 34 Js, then the wavelength of photon would have been very large. Since the area of the photon is proportional to the square of its wavelength, photon area would have been sufficiently large to consider the photon to be macroscopic. And quantum mechanical effects would have been noticeable for macroscopic objects. For example, the De Broglie wavelength of a 100 kg man walking at 1 m/s would have been = h/mv = (6.625 ×10 ^{34} Js) / (100kg) (1m/s) = 6.625 × 10 to the power of 32 m (very large to be noticeable).The work on atomic science in the first thirty five years of this century took our understanding down to lengths of a millionth of a millimeter. Then we discovered that protons and neutrons are made of even smaller particles called quarks (which were named by the Caltech physicist Murray Gell-Mann, who won the Nobel Prize in 1969 for his work on them). We might indeed expect to find several new layers of structure more basic than the quarks and leptons that we now regard as elemental particles. Are there elementary particles that have not yet been observed, and, if so, which ones are they and what are their properties? What lies beyond the quarks and the leptons? If we find answers to them, then the entire picture of particle physics would be quite different.

"Another very good test some readers may want to look up, which we do not have space to describe here, is the Casimir effect, where forces between metal plates in empty space are modified by the presence of virtual particles. Thus virtual particles are indeed real and have observable effects that physicists have devised ways of measuring. Their properties and consequences are well established and well understood consequences of quantum mechanics."

― Gordon L. Kane

Experimental evidence supporting the Watson and Crick model was published in a series of five articles in the same issue of Nature – caused an explosion in biochemistry and transformed the science. Of these, Franklin and Gosling's paper was the first publication of their own x-ray diffraction data and original analysis method that partially supported the Watson and Crick model; this issue also contained an article on DNA (a main family of polynucleotides in living cells) structure by Maurice Wilkins and two of his colleagues, whose analysis supported their double-helix molecular model of DNA. In 1962, after Franklin's death, Watson, Crick, and Wilkins jointly received the Nobel Prize in Physiology or Medicine. From each gene's point of view, the 'background' genes are those with which it shares bodies in its journey down the generations. DNA (deoxyribonucleic acid) – which is known to occur in the chromosomes of all cells (whose coded characters spell out specific instructions for building willow trees that will shed a new generation of downy seeds). Most forms of life including vertebrates, reptiles, Craniates or suckling pigs, chimps and dogs and crocodiles and bats and cockroaches and humans and worms and dandelions, carry the amazing complexity of the information within the some kind of replicator— molecules called DNA in each cell of their body, that a live reading of that code at a rate of one letter per second would take thirty-one years, even if reading continued day and night. Just as protein molecules are chains of amino acids, so DNA molecules are chains of nucleotides. Linking the two chains in the DNA, are pairs of nucleic acids (purines + pyrimidines). There are four types of nucleic acid, adenine "A", cytosine "C", guanine "G", and thiamine "T." An adenine (purine) on one chain is always matched with a thiamine (pyrimidine) on the other chain, and a guanine (purine) with a cytosine (pyrimidine). Thus DNA exhibits all the properties of genetic material, such as replication, mutation and recombination. Hence, it is called the molecule of life. We need DNA to create enzymes in the cell, but we need enzymes to unzip the DNA. Which came first, proteins or protein synthesis? If proteins are needed to make proteins, how did the whole thing get started? We need precision genetic experiments to know for sure.

The backwards-moving electron when viewed with time moving forwards appears the same as an ordinary electron, except that it is attracted to normal electrons - we say it has a positive charge. For this reason it's called a positron. The positron is a sister particle to the electron, and is an example of an anti-particle...This phenomena is general. Every particle in Nature has an amplitude to move backwards in time, and therefore has an anti-particle. (Feynman, 1985)

For many years after Newton, partial reflection by two surfaces was happily explained by a theory of waves,* but when experiments were made with very weak light hitting photomultipliers, the wave theory collapsed: as the light got dimmer and dimmer, the photomultipliers kept making full sized clicks - there were just fewer of them. Light behaves as particles. This idea made use of the fact that waves can combine or cancel out, and the calculations based on this model matched the results of Newton's experiments, as well as those done for hundreds of years afterwards. But when experiments were developed that were sensitive enough to detect a single photon, the wave theory predicted that the clicks of a photomultiplier would get softer and softer, whereas they stayed at full strength - they just occurred less and less often. No reasonable model could explain this fact.

This state of confusion was called the wave - particle duality of light. (Feynman, 1985)

Albert Einstein's theory of general relativity (a theoretical framework for understanding the universe on the largest of scales) predicts that massive bodies that are accelerated will cause the emission of gravity waves, ripples in the curvature of 4 dimensional fabric of space-time that travel away in all directions like waves in a lake at a specific speed, the speed of light (which is not something we can see with the naked eye). These are similar to light waves, which are ripples of the electromagnetic field, but they have not yet been observed even though a number of powerful gravity wave detectors are being built in outer space and huge atom smashers in the United States, Europe, and Japan to detect them with an accuracy of one part in a billion trillion (corresponding to a shift that is one hundredth the width of a single atom) – and are considered as a decades-old dream of probing the mysteries of the universe and the fossils from the very instant of creation.... since no other signal have survived from that era. Like light, gravity waves carry energy away from the bodies that emit them. One would therefore expect a system of massive bodies to settle down eventually to a stationary state, because the energy in any movement would be carried away by the emission of gravity waves. (It is rather like dropping a tennis ball into water: at first it bobs up and down a great deal, but as the ripples carries away its energy, it eventually settles down to a stationary state). For example, the movement of the earth in its orbit round the sun produces gravitational waves. The effect of the energy loss will be to change the orbit of the earth so that gradually it gets nearer and nearer to the sun at a rate $= - dr/dt = 64G^3 (M_{sun} \times m_{earth}) (M_{sun} + m_{earth}) / 5 c^5 r^3$, eventually collides with it, and settles down to a stationary state. The rate of energy loss into space in the form of gravity waves in the case of the earth and the sun is very low – about enough to run a small electric heater and is $= - dE/dt = 32 G^4 (M_{sun} \times m_{earth})^2 (M_{sun} + m_{earth}) / 5c^5 r^5$.

Dividing – dE/dt by – dr/dt, we get: $2 \times (-dE/dt) = G (M_{sun} \times m_{earth}) / r^2 \times (- dr/dt)$

Since $G (M_{sun} \times m_{earth}) / r^2 = F_{Gravitation}$ (the force of gravitation between the earth and the sun). Therefore: $2 (-dE/dt) = F_{Gravitation} \times (- dr/dt)$

Suppose no gravity waves is emitted by the earth-sun system, then

$(-dE/dt) = 0$ and $(-dr/dt) = 0$

$F_{Gravitation} = 2 \times \{(-dE/dt) / (-dr/dt)\} = 2 \times (0/0) = 0 / 0$ i.e., the force of gravitation between the earth and the sun becomes UNDEFINED. The earth-sun system should lose its energy in the form of weak gravity waves in order to maintain a well-defined force of gravitation between them. We can test this precision observation to measure the accuracy of general relativity itself. If proved correct, we find that general relativity is at least 99.7 percent accurate and it would represent the crowning achievement of the last two thousand years of research in physics, ever since the Greeks first began the search for a single coherent and comprehensive theory of the universe.

Gravity waves are vibrations in the 4 dimensional fabric of space-time. Gravitons are their quanta

The life time of the earth-sun orbit is given by the equation:

$t_{life} = 5c^5 r^4 / 256 G^3 (M_{sun} \times m_{earth}) (M_{sun} + m_{earth})$

Now comparing the above equation with the equation $- dr/dt = 64G^3 (M_{sun} \times m_{earth}) (M_{sun} + m_{earth}) / 5 c^5 r^3$ we get:

$- dr/dt = r / 4t_{life}$

Representing the rate of orbital decay (− dr/dt) by the symbol R_1 we get:

$R_1 = r / 4t_{life}$

However, the distance between the orbiting masses not only decrease due to the emission of gravity waves but also increase at the same time due to the Hubble expansion of the space. The rate of increase of distance between the earth and sun due to the expansion of the space is given by the equation:

$R_2 = dr/dt = H \times r$, where H is the Hubble parameter.

On dividing R_1 by R_2 we get:

$R_1 / R_2 = 1 / 4Ht_{life}$

Since $H = 1/ t_{age}$ (where t_{age} = age of the universe). Therefore:

$R_1 / R_2 = t_{age} / 4t_{life}$

Since the life time of the earth-sun orbit is about 3.44×10^{30} s:

$R_1 / R_2 = t_{age} / 4 \times (3.44 \times 10^{30}\ s)$

Since $t_{age} \approx 4.347 \times 10^{17}$s. Therefore:

$R_1 / R_2 = 3.159 \times 10^{-14}$

Which means: $R_2 > R_1$ i.e., the rate of increase of distance between the earth and the sun due to the Hubble expansion of space is far greater than the rate of decrease of distance between the earth and the sun due to the emission of gravity waves.

If $t_{age} = 4t_{life} = 1.376 \times 10^{31}$s, then

$R_1 = R_2$

i.e., when the age of the universe approaches 1.376×10^{31}s the rate of decrease of distance between the earth and the sun due to the emission of gravity waves is exactly equal to the rate of increase of distance between the earth and the sun due to the Hubble expansion of space (i.e., $R_1 = R_2$). However, even before t_{age} approaches 1.376×10^{31}s the earth will be swallowed by the sun in the red giant stage of its life in a few billion years' time.

A theory is a good theory if it satisfies one requirement. It must make definite predictions about the results of future observations. Basically, all scientific theories are scientific statements that predict, explain, and perhaps describe the basic features of reality. Despite having received some great deal, discrepancies frequently lead to doubt and discomfort. For example, the most precise estimate of sun's age is around 10 million years, based on linear density model. But geologists have the evidence that the formation of the rocks, and the fossils in them, would have taken hundreds or thousands of millions of years. This is far longer than the age of the Earth, predicted by linear density model. Hence the earth existed even before the birth of the sun! Which is absolutely has no sense. The linear density model therefore fails to account for the age of the sun. Any physical theory is always provisional, in the sense that it is only a hypothesis: it can be disproved by finding even a single observation that disagrees with the predictions of the theory. Towards the end of the nineteenth century, physicists thought they were close to a complete understanding of the universe. They believed that entire universe was filled by a hypothetical medium called the ether. As a material medium is required for the propagation of waves, it was believed that light waves propagate through ether as the pressure waves propagate through air. Soon, however, inconsistencies with the idea of ether begin to appear. Yet a series of experiments failed to support this idea. The most careful and accurate experiments were carried out by two Americans: Albert Michelson and Edward Morley (who showed that light always traveled at a speed of one hundred and eighty six thousand miles a second (no matter where it came from) and disproved Michell and Laplace's idea of light as consisting of particles, rather like cannon balls, that could be slowed down by gravity, and made to fall back on the star) at the Case School of Applied Science in Cleveland, Ohio, in 1887 − which proved to be a serve blow to the existence of ether. All the known subatomic particles in the universe belong to one of two groups, Fermions or bosons. Fermions are particles with integer spin ½ and they make up ordinary matter. Their ground state energies are negative. Bosons are particles (whose ground state energies are positive) with integer spin 0, 1, 2 and they act as the force carriers between fermions (For example: The electromagnetic force of attraction between electron and a proton is pictured as being caused by the exchange of large numbers of virtual massless bosons of spin 1, called photons).

Positive ground state energy of bosons plus negative ground state energy of fermions = 0

But Why?

May be because to eliminate the biggest infinity in supergravity theory (the theory which introduced a superpartner to the conjectured subatomic particle with spin 2 that is the quanta of gravity "the graviton" (called the gravitino, meaning "little graviton," with spin 3/2) – that even inspired one of the most brilliant theoretical physicists since Einstein "Stephen Hawking" to speak of "the end of theoretical physics" being in sight when he gave his inaugural lecture upon taking the Lucasian Chair of Mathematics at Cambridge University, the same chair once held by Isaac Newton – a person who developed the theory of mechanics, which gave us the classical laws governing machines which in turn, greatly accelerated the Industrial Revolution, which unleashed political forces that eventually overthrew the feudal dynasties of Europe)?

There is strong evidence... that the universe is permeated with dark matter approximately six times as much as normal visible matter (i.e. invisible matter became apparent in 1933 by Swiss astronomer Fritz Zwicky – which can be considered to have energy, too, because $E = mc^2$ – exist in a huge halo around galaxies and does not participate in the processes of nuclear fusion that powers stars, does not give off light and does not interact with light but bend starlight due to its gravity, somewhat similar to the way glass bends light). Although we live in a dark matter dominated universe (i.e., dark matter, according to the latest data, makes up 23 percent of the total matter/energy content of the universe) experiments to detect dark matter in the laboratory have been exceedingly difficult to perform because dark matter particles such as the neutralino, which represent higher vibrations of the superstring – interact so weakly with ordinary matter. Although dark matter was discovered almost a century ago, it is still a mystery shining on library shelves that everyone yearns to resolve.

Energy budget of the universe

Dark Matter, 23 %

Dark Energy, 73%

Ordinary Matter, 4%

Out of 4% we only make up 0.03% of the ordinary matter.

Opening up the splendor of the immense heavens for the first time to serious scientific investigation. On the short time scale of our lives, not surprisingly, we underwent many transformations in our slow, painful evolution, an evolution often overshadowed by religious dogma and superstition to seek the answer to the question from the beginnings of our understanding. No progress was made in any scientific explanations because the experimental data were non-existent and there were no theoretical foundations that could be applied. In the latter half of the 20th century, there were several attempts such as quantum mechanics (the theory of subatomic physics and is one of the most successful theories of all time which is based on three principles: (1) energy is found in discrete packets called quanta; (2) matter is based on point particles but the probability of finding them is given by a wave, which obeys the Schrödinger wave equation; (3) a measurement is necessary to collapse the wave and determine the final state of an object), the "big bang," probability theory, the general relativity (a theoretical framework of geometry which has been verified experimentally to better than 99.7 percent accuracy and predicts that the curvature of space-time gives the illusion that there is a force of attraction called gravity) to adjust to ensure agreement with experimental measurements and answer the questions that have so long occupied the mind of philosophers (from Aristotle to Kant) and scientists. However, we must admit that there is ignorance on some issues, for example, "we don't have a complete theory of universe which could form a framework for stitching these insights together into a seamless whole – capable of describing all phenomena…. We are not sure exactly how universe happened." However, the generally accepted history of the universe, according to what is so-called the big bang theory (proposed by a Belgian priest, Georges Lemaître, who learned of

Einstein's theory and was fascinated by the idea that the theory logically led to a universe that was expanding and therefore had a beginning) has completely changed the discussion of the origin of the universe from almost pure speculation to an observational subject. In such model one finds that our universe started with an explosion. This was not any ordinary explosion as might occur today, which would have a point of origin (center) and would spread out from that point. The explosion occurred simultaneously everywhere, filling all space with infinite heat and energy. At this time, order and structure were just beginning to emerge − the universe was hotter and denser than anything we can imagine (at such temperatures and densities (of about a trillion trillion trillion trillion trillion trillion (1 with 72 zeros after it) tons per cubic inch) gravity and quantum mechanics were no longer treated as two separate entities as they were in point-particle quantum field theory, the four known forces were unified as one unified super force) and was very rapidly expanding much faster than the speed of light (this did not violate Einstein's dictum that nothing can travel faster than light, because it was empty space that was expanding) and cooling in a way consistent with Einstein field equations. As the universe was expanding, the temperature was decreasing. Since the temperature was decreasing, the universe was cooling and its curvature energy was converted into matter like a formless water vapor freezes into snowflakes whose unique patterns arise from a combination of symmetry and randomness. Approximately 10^{-37} seconds into the expansion, a phase transition caused a cosmic inflation, during which the universe underwent an incredible amount of superliminal expansion and grew exponentially by a factor e^{3Ht} (where H was a constant called Hubble parameter and t was the time) – just as the prices grew by a factor of ten million in a period of 18 months in Germany after the First World War and it doubled in size every tiny fraction of a second – just as prices double every year in certain countries. After inflation stopped, the universe was not in a de Sitter phase and its rate of expansion was no longer proportional to its volume since H was no longer constant. At that time, the entire universe had grown by an unimaginable factor of 10^{50} and consisted of a hot plasma "soup" of high energetic quarks as well as leptons (a group of particles which interacted with each other by exchanging new particles called the W and Z bosons as well as photons). There were a number of different varieties of quarks: there were six "flavors," which we now call up, down, strange, charmed, bottom, and top. And among the leptons the electron was a stable object and muon (that had mass 207 times larger than electron and now belongs to the second redundant generation of particles found in the Standard Model) and the tauon (that had mass 3,490 times the mass of the electron) were allowed to decay into other particles. And associated to each charged lepton, there were three distinct kinds of ghostly particles called neutrinos (the most mysterious of subatomic particles, are difficult to detect because they rarely interact with other forms of matter. Although they can easily pass through a planet or solid walls, they seldom leave a trace of their existence. Evidence of neutrino oscillations prove that neutrinos are not massless but instead have a mass less than one-hundred-thousandth that of an electron):

- the electron neutrino (which was predicted in the early 1930s by Wolfgang Pauli and discovered by Frederick Reines and Clyde Cowan in mid-1950s)
- the muon neutrino (which was discovered by physicists when studying the cosmic rays in late 1930s)
- the tauon neutrino (a heavier cousin of the electron neutrino)

Assuming the black hole of mass M would emit Hawking radiation at the same rate P through its evaporation time, expression for evaporation time of the black hole can be written as

$t_{ev} = Mc^2/P$

On the other hand, assuming the black hole would not emit Hawking radiation at the same rate through its evaporation time, expression for evaporation time of the black hole can be written as

$t_{ev} = Mc^2/3P$

In general,

$t_{ev} = k\,(Mc^2/P)$

If k =1, then the black hole would emit Hawking radiation at the same rate through its evaporation time.

If k =1/3, then the black hole would not emit Hawking radiation at the same rate through its evaporation time.

What the factor k imply?

Temperatures were so high that these quarks and leptons were moving around so fast that they escaped any attraction toward each other due to nuclear or electromagnetic forces. However, they possessed so much energy that whenever they collided, particle – antiparticle pairs of all kinds were being continuously created and destroyed in collisions. And the uncertainty in the position of the particle times the uncertainty in its velocity times the mass of the particle was never smaller than a certain quantity, which was known as Planck's constant. Similarly, $\Delta E \times \Delta t$ was $\leq h/4\pi$ (where h was a quantity called Planck's constant and π = 3.14159... was the familiar ratio of the circumference of a circle to its diameter). Hence the Heisenberg's uncertainty principle (which captures the heart of quantum mechanics – i.e. features normally thought of as being so basic as to be beyond question (e.g. that objects have definite positions and speeds and that they have definite energies at definite moments) are now seen as mere artifacts of Planck's constant being so tiny on the scales of the everyday world) was a fundamental, inescapable property of the universe. At some point an unknown reaction led to a very small excess of quarks and leptons over antiquarks and antileptons — of the order of one part in 30 million. This resulted in the predominance of matter over antimatter in the universe. The universe continued to decrease in density and fall in temperature, hence the typical energy of each particle was decreased in inverse proportion to the size of the universe (since the average energy – or speed – of the particles was simply a measure of the temperature of the universe). The symmetry (a central part of the theory [and] its experimental confirmation would be a compelling, albeit circumstantial, piece of evidence for strings) however, was unstable and, as the universe cooled, a process called spontaneous symmetry breaking phase transitions placed the fundamental forces of physics and the parameters of elementary particles into their present form. After about 10^{-11} seconds, the picture becomes less speculative, since particle energies drop to values that can be attained in particle physics experiments. At about 10^{-6} seconds, there was a continuous exchange of smallest constituents of the strong force called gluons between the quarks and this resulted in a force that pulled the quarks to form little wisps of matter which obeys the strong interactions and makes up only a tiny fraction of the matter in the universe and is dwarfed by dark matter called the baryons (protons – a positively charged particles very similar to the neutrons, which accounts for roughly half the particles in the nucleus of most atoms − and neutrons – a neutral subatomic particles which, along with the protons, makes up the nuclei of atoms – belonged to the class baryons) as well as other particles. The small excess of quarks over antiquarks led to a small excess of baryons over antibaryons. The proton was composed of two up quarks and one down quark and the neutron was composed of two down quarks and one up quark. And other particles contained other quarks (strange, charmed, bottom, and top), but these all had a much greater mass and decayed very rapidly into protons and neutrons. The charge on the up quark was = + 2/3 e and the charge on the down quark was = – 1/3 e. The other quarks possessed charges of + 2/3 e or – 1/3 e. The charges of the quarks added up in the combination that composed the proton but cancelled out in the combination that composed the neutron i.e.,

Proton charge was = (2/3 e) + (2/3 e) + (–1/3 e) = e

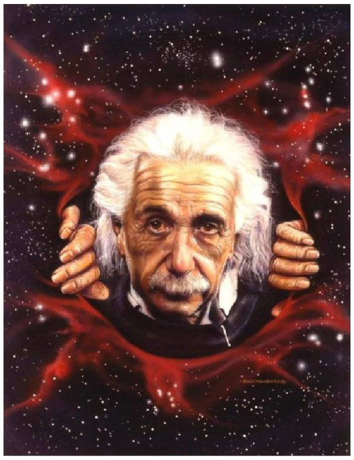
Neutron charge was = (2/3 e) + (–1/3 e) + (–1/3 e) = 0

And the force that confined the mass of the proton or the neutron (i.e., its constituent particles) to its radius was = its rest mass energy divided by its radius i.e., for the proton of radius ≈ 1.112 × 10^{-15} meter: F was = 13.52 × 10 to the power of 26 Newton. And this force was so strong that it is now proved very difficult if not impossible to obtain an isolated quark. As we try to pull them out of the proton or neutron it gets more and more difficult. Even stranger is the suggestion that the harder and harder if we could drag a quark out of a proton this force gets bigger and bigger – rather like the force in a spring as it is stretched causing the quark to snap back immediately to its original position. This property of confinement prevented one from observing an isolated quark (and the question of whether it makes sense to say quarks really exist if we can never isolate one was a controversial issue in the years after the quark model was first proposed). However, now it has been revealed that experiments with large particle accelerators indicate that at high energies the strong force becomes much weaker, and one can observe an isolated quark. In fact, the standard model (one of the most successful physical theories of all time and since it fails to account for gravity (and seems so ugly), theoretical physicists feel it cannot be the final theory) in its current form requires that the quarks not be free. The observation of a free quark would falsify that aspect of the standard model, although nicely confirm the quark idea itself and fits all the experimental data concerning particle physics without exception. Each quark possessed baryon number = 1/3: the total baryon number of the proton or the neutron was the sum of the baryon numbers of the quarks from which it was composed. And the electrons and neutrinos contained no quarks; they were themselves truly fundamental particles. And since there were no electrically charged particles lighter than an electron and a proton, the electrons and protons were prevented from decaying into lighter particles – such as photons (that carried zero mass, zero charge, a definite energy E_{photon} = pc and a momentum p = mc) and less massive neutrinos (with very little mass, no electric charge, and no radius — and, adding insult to injury, no strong force acted on it). And a free neutron being heavier than the proton was not prevented from decaying into a proton (plus an electron and an antineutrino). The temperature was now no longer high enough to create new proton–antiproton pairs, so a mass annihilation immediately followed, leaving just one in 10^{10} of the original protons and neutrons, and none of their antiparticles (i.e., antiparticle was sort of the reverse of matter particle. The counterparts of electrons were positrons (positively charged), and the counterparts of protons were antiprotons (negatively charged). Even neutrons had an antiparticle: antineutrons). A similar process happened at about 1 second for electrons and positrons (positron: the antiparticle of an electron with exactly the same mass as an electron but its electric charge is +1e). After these annihilations, the remaining protons, neutrons and electrons were no longer moving relativistically and the energy density of the universe was dominated by photons − (what are sometimes referred to as the messenger particles for the electromagnetic force) − with a minor contribution from neutrinos. The density of the universe was about 4×10^{9} times the density of water and much hotter than the center of even the hottest star – no ordinary components of matter as we know them – molecules, atoms, nuclei – could hold together at this temperature. And the total positive charge due to protons plus the total negative charge due to electrons in the universe was = 0 (Just what it was if electromagnetism would not dominate over gravity and for the universe to remain electrically neutral).

And a few minutes into the expansion, when the temperature was about a billion (one thousand million; 10 to the power of 9) kelvin and the density was about that of air, protons and neutrons no longer had sufficient energy to escape the attraction of the strong nuclear force and they started to combine together to produce the universe's deuterium and helium nuclei in a process called Big Bang nucleosynthesis. And most of the protons remained uncombined as hydrogen nuclei. And inside the tiny core of an atom, consisting of protons and neutrons, which was roughly 10^{-13} cm across or roughly an angstrom, a proton was never permanently a proton and also a neutron was never permanently a neutron. They kept on changing into each other. A neutron emitted a π meson (a particle predicted by Hideki Yukawa (for which he was awarded the Nobel Prize in physics in 1949) – composed of a quark and antiquark, which is unstable because the quark and antiquark can annihilate each other, producing electrons and other particles) and became proton and a proton absorbed a π meson and became a neutron. That is, the exchange force resulted due to the absorption and emission of π mesons kept the protons and neutrons bound in the nucleus. And the time in which the absorption and emission of π mesons took place was so small that π mesons were not detected. And a property of the strong force called asymptotic freedom caused it to become weaker at short distances. Hence, although quarks were bound in nuclei by the strong force, they moved within nuclei almost as if they felt no force at all.

Within only a few hours of the big bang, the Big Bang nucleosynthesis stopped. And after that, for the next million years or so, the universe just continued expanding, without anything much happening. Eventually, once the temperature had dropped to a few thousand degrees, there was a continuous exchange of virtual photons between the nuclei and the electrons. And the exchange was good enough to produce — what else? — A force (proportional to a quantity called their charge and inversely proportional to the square of the distance between them). And that force pulled the electrons towards the nuclei to form neutral atoms (the basic unit of ordinary matter, made up of a tiny nucleus (consisting of protons and neutrons) surrounded by orbiting electrons). And these atoms reflected, absorbed, and scattered light and the resulted light was red shifted by the expansion of the universe towards the microwave region of the electromagnetic spectrum. And there was cosmic microwave background radiation (which, through the last 15 billion years of cosmic expansion, has now cooled to a mere handful of degrees above absolute zero (–273ºC − the lowest possible temperature, at which substances contain no heat energy and all vibrations stop— almost: the water molecules

are as fixed in their equilibrium positions as quantum uncertainty allows) and today, scientists measure tiny deviations within this background radiation to provide evidence for inflation or other theories).



The irregularities in the universe meant that some regions of the nearly uniformly distributed atoms had slightly higher density than others. The gravitational attraction of the extra density slowed the expansion of the region, and eventually caused the region to collapse to form galaxies and stars. And the nuclear reactions in the stars transformed hydrogen to helium (composed of two protons and two neutrons and symbolized by $_{2}He^{4}$, highly stable—as predicted by the rules of quantum mechanics) to carbon (with their self-bonding properties, provide the immense variety for the complex cellular machinery— no other element offers a comparable range of possibilities) with the release of an enormous amount of energy via Einstein's equation $E = mc^2$. This was the energy that lighted up the stars. And the process continued converting the carbon to oxygen to silicon to iron. And the nuclear reaction ceased at iron. And the star experienced several chemical changes in its innermost core and these changes required huge amount of energy which was supplied by the severe gravitational contraction. And as a result the central region of the star collapsed to form a neutron star. And the outer region of the star got blown off in a tremendous explosion called a supernova, which outshone an entire galaxy of 100 billion stars, spraying the manufactured elements into space. And these elements provided some of the raw material for the generation of cloud of rotating gas which went to form the sun and a small amount of the heavier elements collected together to form the asteroids, stars, comets, and the bodies that now orbit the sun as planets like the Earth and their presence caused the fabric of space around them to warp (more massive the bodies, the greater the distortion it caused in the surrounding space).

The English scientist and mathematician Isaac Newton is seen here creating a shaft of light. Hulton Archive/Getty Images

The earth was initially very hot and without an atmosphere. In the course of time the planet earth produced volcanoes and the volcanoes emitted water vapor, carbon dioxide and other gases. And there was an atmosphere. This early atmosphere contained no oxygen, but a lot of other gases and among them some were poisonous, such as hydrogen sulfide (the gas that gives rotten eggs their smell). And the sunlight dissociated water vapor and there was oxygen. And carbon dioxide in excess heated the earth and balance was needed. So carbon dioxide dissolved to form carbonic acid and carbonic acid on rocks produced limestone and subducted limestone fed volcanoes that released more carbon dioxide. And there was high temperature and high temperature meant more evaporation and dissolved more carbon dioxide. And as the carbon dioxide turned into limestone, the temperature began to fall. And a consequence of this was that most of the water vapor condensed and formed the oceans. And the low temperature meant less evaporation and carbon dioxide began to build up in the atmosphere. And the cycle went on for billions of years. And after the few billion years, volcanoes ceased to exist. And the molten earth cooled, forming a hardened, outer crust. And the earth's atmosphere consisted of nitrogen, oxygen, carbon dioxide, plus other miscellaneous gases (hydrogen sulfide, methane, water vapor, and ammonia). And then a continuous electric current through the atmosphere simulated lightning storms. And some of the gases came to be arranged in the form of more complex organic molecules such as simple amino acids (the basic chemical subunit of proteins, when, when linked together, formed proteins) and carbohydrates (which were very simple sugars). And the water vapor in the atmosphere probably caused millions of seconds of torrential rains, during which the organic molecules reached the earth. And it took two and a half billion years for an ooze of organic molecules to react and built earliest cells as a result of chance combinations of atoms into large structures called macromolecules and then advance to a wide variety of one – celled organisms, and another billion years to evolve through a highly sophisticated form of life to primitive mammals endowed with two elements: genes (a set of instructions that tell them how to sustain and multiply themselves), and metabolism (a mechanism to carry out the instructions). But then evolution seemed to have speeded up. It only took about a hundred million years to develop from the early mammals (the highest class of animals, including the ordinary hairy quadrupeds, the whales and Mammoths, and characterized by the production of living young which are nourished after birth by milk from the teats (MAMMAE, MAMMARY GLANDS) of the mother) to Homosapiens. This picture of a universe that started off very hot and cooled as it expanded (like when things are compressed they heat up... and, when things... expand... they cool down) is in agreement with all the observational evidence which we have today (and it explains Olbers' paradox: The paradox that asks why the night sky is black. If the universe is infinite and uniform, then we must receive light from an infinite number of stars, and hence the sky must be white, which violates observation). Nevertheless, it leaves a number of important questions unanswered:

Why the universe started off very hot i.e., why it violently emerged from a state of infinite compression?

Why is the universe the same everywhere i.e., looks the same from every point (homogeneous) and looks the same in every direction (isotropic)? If the cosmic inflation made the universe flat, homogeneous and isotropic, then what is the hypothetical field that powered the inflation? What are the details of this inflation?

Much is explained by protons and electrons. But there remains the neutrino…

$\approx 10^{9}$ neutrinos/ proton. What is their physical picture in the universe?

The big bang theory, on its own, cannot explain these features or answer these questions because of its prediction that the universe started off with infinite density at the big bang singularity. At the singularity (a state of infinite gravity), all the known physical laws of cosmology would break down: one couldn't predict what would come out of the infinitely dense Planck-sized nugget called the singularity. The search for the origin and fate of the universe (which is determined by whether the Omega (Ω_0) density parameter is less than, equal to or greater than 1) is a distinctly human drama, one that has stretched the mind and enriched the spirit. We (a species ruled by all sorts of closer, warmer, ambitions and perceptions) are all, each in our own way, seekers of an absolute limit of scientific explanation (that may never be achieved) and we each long for an answer to why we exist... as our future descendants marvels at our new view of the universe... we are... contributing our wrong to the human letter reaching for the stars.

Sun emits 2×1038 neutrinos per second but only 30 neutrinos are interacting in a person per year.

The fine tuning coincidences are updated and refurbished and have been somewhat misleadingly categorized under the designation anthropic principle, a term coined by astronomer Brandon Carter in 1974 – which states that the physical properties of the universe are as they are because they permit the emergence of life. This teleological principle tries to explain why some physical properties of matter seem so fine-tuned as to permit the existence of life -- and are widely claimed to provide prima facie evidence for purposeful design—a design with life and perhaps humanity in mind. However, fatal to the evidence of deistic design:

ARGUMENT 1

As we know that, inside the sun, we have $N_{Protons}$ (say), which can be calculated by the equation: $N_{Protons} = M_{sun} / m_{Proton}$, where M_{sun} = mass of the sun and m_{Proton} = rest mass of the proton. If m_{Proton} was still smaller than 1.672×10^{-27} kg, then $N_{Protons}$ would have been larger than 1.196×10^{57}. Hence, the stellar life time of the sun would have been slightly higher than its actual value.

ARGUMENT 2

The universe is a pretty big place seems like an awful waste of space

Nearest star: 4.22 light years.

Nearest galaxy: 2.44 million light years.

Galaxies within our horizon are now 40 billion light years away.

Universe beyond horizon: 10 to the 10 to the 100 times bigger.

ARGUMENT 3

The Goldilocks Planet is not all that well suited for human life.

2/3 salt water unfit for drinking.

Humans are restricted only to surface.

Atmosphere does not block harmful ultraviolet radiation which causes skin cancer and other genetic disorders.

Natural calamities like floods, earthquakes, famine and droughts, diseases like cancer, AIDS, kill millions millions of people yearly.

ARGUMENT 4

Only two photons of every billion emitted by sun are used to warm the Earth surface, the rest radiating uselessly into space.. And lack of oxygen and cosmic microwave background radiation (which is well characterized by a 2.728 ± 0.002 Kelvin black body spectrum over more than three decades in frequency) prevents humans from spending years in outer space.

--is the unwarranted assumption that the universe is exquisitely designed with the goal of generating and sustaining observers. Of course, fine tuning coincidences are only needed to fill in the details of evidence for the existence of insulated interpositions of Divine power. If the universe were congenial to human life, then we would expect it to be easy for humanlike life to develop and survive throughout the vast stretches of the universe (an intricately complex place). We must admit that much of what we believe, including our fundamental coincidences about the universe:

COINCIDENCE 1

If c would have been = 3×10 to the power of −8 meters per second, then according to the equation E = mc squared (which asserts: energy and mass is the ultimate convertible currency): 1 kg of mass would have yielded only 9 × 10 to the power of −16 joules of energy. Hence, thousands and thousands of hydrogen atoms in the sun would have to burn up to release 4 × 10 to the power of 26 joules of energy per second in the form of radiation. Therefore, sun would have ceased to black hole even before an ooze of organic molecules would react and built earliest cells and then advance to a wide variety of one – celled organisms, and evolve through a highly sophisticated form of life to primitive mammals.

COINCIDENCE 2

If the value of G would have been far greater than its actual value, then according to the equation $F_{Gravity} = GMm/r^2$ (which asserts-- that the strength of attraction between two bodies is larger for larger-mass bodies and smaller for smaller-mass bodies and is larger for smaller separations between the bodies and smaller for larger separations): Each star in the universe would have been attracted toward every other star by a force far greater than its present value, so it seemed the stars would have got very near each other, the attractive forces between them would have become stronger and dominate over the repulsive forces so that the stars would have fell together at some point to form a sphere of roughly infinite density.

COINCIDENCE 3

If Λ (cosmological constant – a constant that measures the curvature of an empty space devoid of gravitational fields) would have been = 0, then according to the equation vacuum energy density (a non-vanishing energy density of the vacuum that is the same at every point in the Universe) = $\Lambda c^2 / 8\pi G$ would have been = 0 i.e., the entire vacuum would have been empty. The empty vacuum though unstable would have ceased to exist.

COINCIDENCE 4

If the value of G would have been far greater than its actual value, then according to the equation $U = -3GM^2 / 5r$: The gravitational binding energy of a star would have been far greater than its present value, so it seemed the matter inside the star would have been very much compressed and far hotter than it is. And the distance between the constituents of the star would have been decreased beyond the optimum distance (maximum distance below which the gravitational force is no longer attractive it turns to a repulsive force) then all the stars would have exploded spraying the manufactured elements into space. No sun would have existed to support life on the earth.

COINCIDENCE 5

If there was no principle what is called Pauli's exclusion principle (discovered in 1925 by an Austrian physicist, Wolfgang Pauli – for which he received the Nobel Prize in 1945) stating that two similar particles cannot exist in the same state; that is, they cannot have both the same position and the same velocity, within the limits given by the uncertainty principle.

Translation of a machine typed copy of a letter that Wolfgang Pauli sent to a group of physicists

Dear radioactive ladies and gentlemen,

… I have hit upon a 'desperate remedy' to save… the law of conservation of energy. Namely the possibility that there exists in the nuclei electrically neutral particles, that I call neutrons… I agree that my remedy could seem incredible… but only the one who dare can win…

Unfortunately I cannot appear in person, since I am indispensable at a ball here in Zurich.

Your humble servant

W. Pauli

(December 4, 1930)

COINCIDENCE 6

The two quarks would have occupied precisely the same point with the same properties, and then would not have stayed in the same position for long. And quarks would have not formed separate, well-defined protons and neutrons. And nor would these, together with electrons have formed separate, well-defined atoms. And the world would have collapsed before it ever reached its present size.

COINCIDENCE 7

If E and B in light would have been invariant (where E and B are the electric and magnetic fields), then according to the equation $dE/dB = c$ (an equation that successfully unites electricity and magnetism in the framework of the electromagnetic field and asserts electromagnetic disturbances travel at a fixed and never-changing speed equal to that of light): the speed of light c which is dE/dB would have been undefined and all nuclear physics would have to be recalibrated. Nuclear weapons, nuclear medicine and radioactive dating would have been affected because all nuclear reactions are based on Einstein's relation between matter and energy i.e., E= mc squared.

COINCIDENCE 8

If the Boltzmann's constant was a variable then the universal gas constant (which is Boltzmann's constant times the Avogadro number) would have been a variable. And kinetic theory of gases would have been much different if the universal gas constant would have been a variable.

COINCIDENCE 9

If any one of the constants (absolute permittivity of free space ε_0 or absolute permeability of free space μ_0) were zero, then c (the speed of light which is = 1 / square root of $(\varepsilon_0 \times \mu_0)$) would have been infinite. And if any one of the constants (ε_0 or μ_0) was a variable, then c would not have remained a fundamental constant.

--is a blind leap of faith. We, after all, carbon-based biological systems operating a billion times slower than computer chips made of silicon, can carry the implications of the illusion of intelligent design about as far as we can imagine we could go -- classifying as an argument from design is the contemporary claim that the laws and constants of physics are "fine-tuned" so that the universe is able to contain life – which is commonly -- have been publicized in the popular print media, featured in television specials on PBS and BBC, and disseminated through a wide variety of popular and scholarly books, including entries from prestigious academic publishing houses such as Oxford and Cambridge University Presses -- but misleading. Furthermore, blind faith can justify anything and we have no reason to conclude that earthlike planets and sunlike stars and life itself are far too complex to have arisen by coincidence or could not have had a purely accidental origin because astrobiologists have now demonstrated that captured material from a comet -- analyzed immediately after striking Earth so that effects of contamination by earthly matter are minimal-- possessed lysine, an amino acid, in the sample, suggesting that the evolution of life on Earth had only begun after accidental jump-start from space i.e., the first ingredients of life accidently came from space after Earth formed.

On the other hand, we -- survival machines evolved by the principle of natural selection --robot vehicles blindly programmed to preserve the selfish molecules known as genes— who need Newtonian mechanics operating in a three-dimensional universe to have planets circling the sun, multiple stable elements of the periodic table to provide a sufficient variety of atomic "building blocks" for life, need atomic structure to be constrained by the laws of quantum mechanics, further need the orderliness in chemical reactions that is the consequence of Boltzmann's equation for the second law of thermodynamics and for an energy source like the sun transfer its life-giving energy to a habitat like Earth we who require the laws of electromagnetic radiation that Maxwell described— ask a multitude of certain questions contemplating the immense complexity of the cosmos and seek answers on a grand scale which points firmly to the fact that is daunting, but still short of proof that every design, every adaptation, and every act fits comfortably inside a survival sceptical viewpoint. However, it is tempting to believe, but, the apparent survival-tuning is something bordering on the mysterious........ there is no rational explanation for the cause of the appropriateness of the language of survival. Is it a product of cosmic coincidence or merely an exceedingly ingenious design product of an intelligent designer or an act of a superior will (people of faith believe it as God's signature or a pinnacle of God's divine handiwork)? In the millennia of Homo sapiens evolution, we have found it something quite... puzzling. Even that great Jewish scientist Albert Einstein (who freed us from the superstition of the past and interpreted the constancy of the speed of light as a universal principle of nature that contradicted Newtonian theory) sustained a mystical outlook on the universe that was, he said, constantly renewed from the wonder and humility that filled him when he gazed at the universe. I wonder, can our finite minds ever truly understand such things as mysticism and infinity? The scientific community is prepared to consider the idea that God is the cause of the appropriateness of the language of survival a more respectable hypothesis today than at any time in the last 100 years. But Victor Stenger arguments deny the existence of an intelligent creator, or God or super natural will who crafted the survival tuning or survival habitation in planet Earth.

Questions and answers that point firmly to the fact that every design, every adaptation, and every act fits comfortably inside a survival sceptical viewpoint

Question:

Why the electron moves around the nucleus?

Answer:

If it does not move around the nucleus, it cannot generate centrifugal force. If it does not generate centrifugal force, it will be pulled into the nucleus. The electron revolves around the nucleus because it wants to survive itself from being pulled into the nucleus due to the electrostatic force attraction of the nucleus.

Similarly,

in order to survive itself from being pulled into the sun due to the gravitational force attraction of the sun, earth moves around the sun.

in order to survive itself from being pulled towards the earth due to the gravitational force attraction of the earth, moon moves around the earth.

Question:

Why the earth spins?

Answer:

If it does not spin, it cannot generate magnetic field. If it does not generate magnetic field, it cannot deflect and protect itself from the incoming asteroids. The earth spins because it wants to survive itself from the incoming asteroids.

Question:

Why the neutron combines with proton to form nucleus?

Answer:

If it does not combine with proton, then it will remain unbound. If it remains unbound, it will decay into its constituent particles. The neutron combines with proton because it wants to survive itself from the decay into a proton (plus an electron and an antineutrino).

Question:

Why the cells are linked to each other?

Answer:

If they do not, then they won't be able to survive long.

Question:

Why the electron is elemental?

Answer:

The electron is elemental because it wants to survive itself from the decay into lighter particles – such as photons and less massive neutrinos.

Question:

Why the earth holds the atmosphere?

Answer:

If it does not hold the atmosphere, then it cannot protect itself from the space junk that would do damage to it. The earth holds the atmosphere because it wants to survive itself from the incoming space junks.

Question:

Why the camel bear hump?

Answer:

If it does not, then it cannot store fat. If it does not store fat, then it cannot last for several months without food. The camel bear hump because it wants to survive successfully in desert conditions.

Question:

Why the empty space produces virtual particles?

Answer:

The empty space produces virtual particles because it wants to survive itself from its instability. Though unstable it ceases to exist.

Question:

Why the universe expands?

Answer:

If it does not, then gravity will collapse it into a hot fire ball called singularity. The universe expands because it wants to survive from the big crunch.

Question:

Why the objects scatter light?

Answer:

The objects scatter light because they want to survive themselves from invisibility.

Question:

Why the green plants bear tiny molecular pigments called chlorophyll?

Answer:

If they do not, they cannot carry out a dye sensitized photochemical redox process – the conversion of sunlight, water and carbon dioxide into carbohydrates and oxygen i.e., the process of photosynthesis. The green plants bear chlorophyll pigments because they want to carry out the process of photosynthesis to manufacture their own food and survive.

Question:

Why a flying Bat emit ultrasonic waves?

Answer:

If it does not, then it cannot catch its prey. The bat emits ultrasonic because it wants to survive itself from starvation.

Question:

Why the star emits radiation?

Answer:

If it does not, then it cannot balance the inward gravitational pull. The star emits radiation because it wants to survive itself from the gravitational collapse.

Question:

Why the black hole absorbs mass?

Answer:

If it does not, then it will eventually disappear more rapidly due to the process of Hawking radiation. The black hole absorbs mass because it wants to survive long.

Question:

Why the green plants bear stomata?

Answer:

If they do not, then they cannot respire through their leaves and they cannot exchange gases necessary for cellular processes such as photosynthesis. The green plants bear stomata because it wants to carry out cellular processes in order to survive.

Question:

Why Do Cactus bear painful Spines?

Answer:

If it does not, then it cannot protect itself from the attack of javelina, tortoises and pack rats. The cactus bears painful spines because it wants to survive itself from the attack of animals and people.

Question:

Why do deer have long legs and narrow hooves?

Answer:

If it does not, it cannot be swift runner and good jumper. The deer have long legs and narrow hooves because it wants to survive itself from the attack of humans, wolves, mountain lions, bears, jaguars, and coyotes.

Question:

Why do Polar bear possess thick layer of fur?

Answer:

The Polar bear possess thick layer of fur because it wants to survive itself from the cold, snowy inhospitable climate.

Professor Victor Stenger's ARGUMENTS that proves God (who created humans as a distinct life-form) does not exist

ARGUMENT 1

An All-Virtuous Being Cannot Exist

1. God is (by definition) a being than which no greater being can be thought.
2. Greatness includes the greatness of virtue.
3. Therefore, God is a being than which no being could be more virtuous.
4. But virtue involves overcoming pains and danger.
5. Indeed, a being can only be properly said to be virtuous if it can suffer pain or be destroyed.
6. A God that can suffer pain or is destructible is not one than which no greater being can be thought.

7. For you can think of a greater being, one that is non-suffering and indestructible.

8. Therefore, God does not exist.

ARGUMENT 2

A Perfect Creator Cannot Exist

1. If God exists, then he is perfect.

2. If God exists, then he is the creator of the universe.

3. If a being is perfect, then whatever he creates must be perfect.

4. But the universe is not perfect.

5. Therefore, it is impossible for a perfect being to be the creator of the universe.

6. Hence, it is impossible for God to exist.

ARGUMENT 3

A Transcendent Being Cannot Be Omnipresent

1. If God exists, then he is transcendent (i.e., outside space and time).

2. If God exists, he is omnipresent.

3. To be transcendent, a being cannot exist anywhere in space.

4. To be omnipresent, a being must exist everywhere in space.

5. Hence it is impossible for a transcendent being to be omnipresent.

6. Therefore, it is impossible for God to exist.

ARGUMENT 3

A Personal Being Cannot Be Nonphysical

1. If God exists, then he is nonphysical.

2. If God exists, then he is a person (or a personal being).

3. A person (or personal being) needs to be physical.

4. Hence, it is impossible for God to exist.

ARGUMENT 4

A Lack of Evidence

No objective evidence is found, concluding beyond a reasonable doubt that a God does not exist.

(For more arguments please refer the book: God The failed Hypothesis by Victor Stenger).

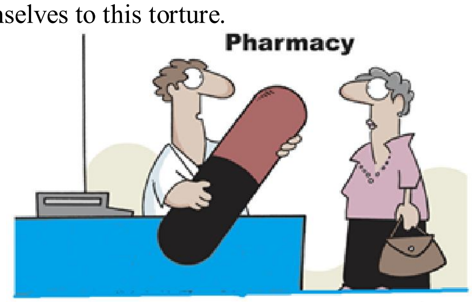
Chapter 2

The Hall of Shame: How Bad Science can cause Real Harm in Real Life

"Although Nature needs thousands or millions of years to create a new species, man needs only a few dozen years to destroy one."

: Victor Scheffer

We humans, who began as a mineral and then emerged into plant life and into the animal state and then to being aggressive mortal beings fought a survival struggle in caveman days, to get more food, territory or partner with whom to reproduce, now are glued to the TV set, marveling at the adventures of science and their dazzling array of futuristic technology from teleportation to telekinesis: rocket ships, fax machines, supercomputers, a worldwide communications network, gas-powered automobiles and high-speed elevated trains. The science has opened up an entirely new world for us. And our lives have become easier and more comfortable. With the help of science we have estimated about 8,000 chemotherapeutic exogenous non-nutritive chemical substances which when taken in the solid form by the mouth enter the digestive tract and there they are transformed into a solution and passed on to the liver where they are chemically altered and finally released into the blood stream. And through blood they reach the site of action and binds reversibly to the target cell surface receptors to produce their pharmacological effect. And after their pharmacological effect they slowly detaches from the receptor. And then they are sent to the liver. And there they are transformed into a more water soluble compound called metabolite and released from the body through urine, sweat, saliva, and excretory products. However, the long term use of chemotherapeutic drugs for diseases like cancer, diabetes leads to side effects. And the side effects — including nausea, loss of hair, loss of strength, permanent organ damage to the heart, lung, liver, kidneys, or reproductive system etc. — are so severe that some patients rather die of disease than subjecting themselves to this torture.



"Each capsule contains your medication plus its side effects."

And smallpox (an acute contagious disease caused by the variola virus, a member of the orthopoxvirus family) was a leading cause of death in 18th century, and the inexorable spread of the disease reliably recorded the death rate of some hundred thousand people. And the death toll surpassed 5000 people a day. Yet Edward Jenner, an English physician, noticed something special occurring in his small village. People who were exposed to cowpox did not get smallpox when they were exposed to the disease. Concluding that cowpox could save people from smallpox, Edward purposely infected a young boy who lived in his village first with cowpox, then with smallpox. Fortunately, Edward's hypothesis worked well. He had successfully demonstrated the world's first vaccine and eradicated the disease. And vaccines which once saved humanity from the smallpox (which was a leading cause of death in 18th-century England), now have associated with the outbreaks of diseases like pertussis (whooping cough) which have begun showing up in the United States in the past forty years.

TOP 5 DRUGS WITH REPORTED SIDE EFFECTS

(Withdrawn from market in September 2004)

Drug: Byetta
Used for: Type 2 diabetes
Side effect: Increase of blood glucose level

Drug: Humira
Used for: Rheumatoid arthritis
Side effect: Injection site pain

Drug: Chantix
Used for: Smoking cessation
Side effect: Nausea

Drug: Tysabri
Used for: Multiple sclerosis
Side effect: Fatigue

Drug: Vioxx*
Used for: Arthritis
Side effect: Heart attack

In 1930s, Paul Hermann Muller a research chemist at the firm of Geigy in Basel, with the help of science introduced the first modern insecticide (DDT: dichloro diphenyl trichloroethane) and it won him the 1948 Nobel Prize in Physiology and Medicine for its credit of saving thousands of human lives in World War II by killing typhus-carrying lice and malaria-carrying mosquitoes, dramatically reducing Malaria and Yellow Fever around the world. But in the late 1960s DDT which was a world saver was no longer in public favor – it was blamed moderately hazardous and carcinogenic. And most applications of DDT were banned in the U.S. and many other countries. However, DDT is still legally manufactured in the U.S., but only sold to foreign countries. At a time when Napoleon was almost disturbing whole of Europe due to his aggressive policies and designs and most of the world was at war – the science gave birth to the many inventions which took place in the field of textile industry and due to invention of steam engine and development of means of transportation and communication. Though it gave birth in England, yet its inventions spread all over the world in a reasonably period. And rapid industrialization was a consequence of new inventions and demand for expansion of large industrial cities led to the large scale exploitation of agricultural land. And socio-economic growth was peaking, as industries were booming, and agricultural lands were decreasing, as the world enjoyed the fruits of the rapid industrialization. As a result of this, the world's population was growing at an exponential rate and the world's food supply was not in the pace of the population's increase. And this resulted in widespread famine in many parts of the world, such as England, and as starvation was rampant. In that time line, science suppressed that situation by producing more ammonia through the Haber Bosch Process (more ammonia, more fertilizers. more fertilizers, more food production). But at the same time, science which solved the world's hunger problems also led to the production of megatons of TNT (trinitrotoluene) and other explosives which were dropped on all the cities leading to the death of some hundred million people.

Global warming shrinking the Greenland's ice shelves

Rapid industrialization which once raised the economic and living standard of the people has now become a major global issue. The full impact of an industrial fuel economy has led to the global warming (i.e., the increase of Earth's average surface temperature due to effect of too much carbon dioxide emissions from industrial centers which acts as a blanket, trap heat and warm the planet).And as a result, Greenland's ice shelves have started to shrink permanently, disrupting the world's weather by altering the flow of ocean and air currents around the planet. And violent swings in the climate have started to appear in the form of floods, droughts, snow storms and hurricanes.

And industries are the main sources of sulfur dioxide emission and automobiles for nitrogen oxides. And the oxides of nitrogen and sulfur combine with the moisture in the atmosphere to form acids. And these acids reach the Earth as rain, snow, or fog and react with minerals in the soil and release deadly toxins and affect a variety of plants and animals on the earth. And these acids damage buildings, historic monuments, and statues, especially those made of rocks, such as limestone and marble, that contain large amounts of calcium carbonate. For example, acid rain has reacted with the marble (calcium carbonate) of Taj Mahal causing immense damage to this wonderful structure (i.e., Taj is changing color).

And science once introduced refrigerators for prolonging storage of food but now refrigerators are the active sources of chlorofluorocarbons (CFC) which interact with the UV light during which chlorine is separated. And this chlorine in turn destroys a significant amount of the ozone in the high atmosphere admitting an intense dose of harmful ultraviolet radiation. And the increased ultraviolet flux produces the related health effects of skin cancer, cataracts, and immune suppression and produces a permanent change in the nucleotide sequence and lead to changes in the molecules the cell produce, which modify and ultimately affect the process of photosynthesis and destroy green plants. And the massive extinction of green plants may lead to famine and immense death of all living species including man.

Fertilizers which once provided a sufficient amount of the essential nitrates to plants to synthesize chlorophyll and increase crop growth to feed the growing population and satisfy the demand for food, has now blamed for causing hypertrophication i.e., fertilizers left unused in soil are carried away by rain water into lakes and rivers, and then to coastal estuaries and bays. And the overload of fertilizers induces explosive growth of algal blooms, which prevents light from getting into the water and thereby preventing the aquatic plants from photosynthesizing, a process which provides oxygen in the water to animals that need it, like fish and crabs. So, in addition to the lack of oxygen from photosynthesis, when algal blooms die they decompose and they are acted upon by microorganisms. And this decomposition process consumes oxygen, which reduces the concentration of dissolved oxygen. And the depleted oxygen levels in turn lead to fish kills and a range of other effects promoting the loss of species biodiversity. And the large scale exploitation of forests for industrialization and residential purposes has not only led to the loss of biodiversity but has led the diseases like AIDS (Acquired immunodeficiency syndrome caused by a virus called HIV (Human immunodeficiency virus) which alters the immune system, making victim much more vulnerable to infections and diseases) to transmit from forests to cities.

At the dawn of the early century, the entire world was thoroughly wedded to fossil fuels in the form of oil, natural gas, and coal to satisfy the demand for energy. And as a result, fossil fuels were becoming increasingly rare and were slowly dooming to extinction. In that period, science (upon the work of Curie and Einstein) introduced nuclear fission reaction (the process by which a heavy nucleus breaks down into two or more smaller nuclei, releasing energy. For example: if we hit a uranium-235 nucleus with a neutron, it split into a krypton nucleus, a barium nucleus, three neutrons, and energy) as an alternate to the world's energy supply and therefore prevented the world economy from coming to a grinding halt. But at the same time science introduced nuclear fission reaction to produce thousands of nuclear weapons, which were dropped on all the cities in World War II amounted to some two million tons, two megatons, of TNT, which flattened heavily reinforced buildings many kilometers away, the firestorm, the gamma rays and the thermal neutrons, which effectively fried the people. A school girl who survived the nuclear attack on Hiroshima, the event that ended the Second World War, wrote this first-hand account:

"Through a darkness like the bottom of hell, I could hear the voices of the other students calling for their mothers. And at the base of the bridge, inside a big cistern that had been dug out there, was a mother weeping, holding above her head a naked baby that was burned red all over its body. And another mother was crying and sobbing as she gave her burned breast to her baby. In the cistern the students stood with only their heads above the water, and their two hands, which they clasped as they imploringly cried and screamed, calling for their parents. But every single person who passed was wounded, all of them, and there was no one, there was no one to turn to for help. And the singed hair on the heads of the people was frizzled and whitish and covered with dust. They did not appear to be human, not creatures of this world."

Nuclear breakthroughs have now turned out to be the biggest existential threat to human survival. Nuclear waste is banking up at every single nuclear site. And as a result, every nation is suffering from a massive case of nuclear constipation (that Causes Intractable Chronic Constipation in Children).

Ninety-one percent of world adults and 60 percent of teens own this device that has revolutionized the most indispensable accessories of professional and social life. Science once introduced this device for wireless communication but now they are pointed to as a possible cause of everything from infertility to cancer to other health issues. And in a study conducted at the University of London, researchers sampled 390 cell phones to measure for levels of pathogenic bacteria. The results of the study showed that 92 percent of the cell phones sampled had heavily colonized by high quantities of various types of disease-prone bacteria with high resistances to commonly used antibiotics (around 25,000 bacteria per square inch) and the results concluded that their ability to transmit diseases of which the mobile phones are no exception. The fluoridation of water at optimal levels has been shown to be highly beneficial to the development of tooth enamel and prevention of dental cavities since the late 1800s. And studies showed that children who drink water fluoridated at optimal levels can experience 20 to 40 per cent less tooth decay. But now fluoridation of water has termed to cause lower IQ, memory loss, cancer, kidney stones & kidney failures – faster than any other chemical.

Science once introduced irradiation to prevent food poisoning by destroying molds, bacteria (such as one – celled animal 'Amoeba' – that have as much information in their DNA as 1,000 Encyclopedia Britannicas – which is almost unbelievably minute form of life which, after being cut into six separate parts, is able to produce six complete bodies to carry on as though nothing had happened), yeast and virus (the smallest living things which cannot reproduce itself unaided and therefore it is lifeless in the true sense. But when placed in the plasma of a living cell and, in forty eight minutes it can reproduce itself four hundred times) and control microbial infestation. But now it has been blamed to cause the loss of nutrients, for example vitamin E levels can be reduced by 25% after irradiation and vitamin C by 5-10% and damage food by breaking up molecules and creating free radicals. And these free radicals combine with existing chemicals (like preservatives) in the food to produce deadly toxins. This has caused some food manufacturers to limit or avoid the process and bills have even been introduced to ban irradiated foods in public cafeterias or to require irradiated food to carry sensational warning labels. And the rapid advancement of science combined with human aggression and aim for global supremacy has led even the smaller nations to weaponize anthrax spores and other viruses for maximum death and destruction. And thus the entire planet is gripped with fear that one day a terrorist group may pay to gain access to weaponized H5N1 flu and other viruses. And the rapid development of nuclear technology has led to the banking up of nuclear waste at every single nuclear site. And as a result, every nation is suffering from a massive case of nuclear constipation. And the enormous automation, capacity of artificial intelligence and their ability to interact like humans has caused the humans to be replaced by artificial intelligence. But now artificial intelligence is taking off on its own, and re-designing itself at an ever increasing rate. And this has turned out to be the biggest existential threat to human survival (i.e., one day artificial intelligence may plan for a war against humanity). Highly toxic gases, poisons, defoliants, and every technological state are planning for it to disable or destroy people or their domestic animals, to damage their crops, and/or to deteriorate their supplies, threaten every citizen, not just of a nation, but of the world.

Note: DNA carries information but cannot put that information to use, or even copy itself without the help of RNA and protein.

"You find it strange that I consider the comprehensibility of the world (to the extent that we are authorized to speak of such a comprehensibility) as a miracle or as an eternal mystery. Well, a priori one should expect a chaotic world, which cannot be grasped by the mind in any way.... The kind of order created by Newton's theory of gravitation, for example, is wholly different. Even if man proposes the axioms of the theory, the success of such a project presupposes a high degree of ordering of the objective world, and this could not be expected a priori. That is the "miracle" which is being constantly reinforced as our knowledge expands."

--Albert Einstein

Chapter 3

The 100 Most Influential Scientists of All Time

"Be less curious about people and more curious about ideas."

: Marie Curie

[1] **Sir Isaac Newton**

Birth: Dec. 25, 1642 [Jan. 4, 1643, New Style], Woolsthorpe, Lincolnshire, England

Death: March 20 [March 31], 1727, London

Known for: the Newtonian Revolution

[2] **Albert Einstein**

Birth: March 14, 1879, Ulm, Wurttemberg, Germany

Death: April 18, 1955, Princeton, N.J., U.S.

Known for: Twentieth-Century Science

[3] **Neils Bohr**

Birth: Oct. 7, 1885, Copenhagen, Denmark

Death: Nov. 18, 1962, Copenhagen

Known for: the Atom

[4] **Charles Darwin**

Birth: Feb. 12, 1809, Shrewsbury, Shropshire, England

Death: April 19, 1882, Downe, Kent

Known for: Evolution

[5] **Louis Pasteur**

Birth: Dec. 27, 1822, Dole, France

Death: Sept. 28, 1895, Saint-Cloud, near Paris

Known for: the Germ Theory of Disease

[6] **Sigmund Freud**

Birth: May 6, 1856, Freiberg, Moravia, Austrian Empire [now Přibor, Czech Republic]

Death: Sept. 23, 1939, London, England

Known for: Psychology of the Unconscious

[7] **Galileo Galilei**

Birth: Feb. 15, 1564, Pisa [Italy]

Death: Jan. 8, 1642, Arcetri, near Florence

Known for: the New Science

[8] **Antoine-Lau rent Lavoisier**

Birth: Aug. 26, 1743, Paris, France

Death: May 8, 1794, Paris

Known for: the Revolution in Chemistry

[9] **Johannes Kepler**

Birth: Dec. 27, 1571, Weil der Stadt, Wurttemberg [Germany]

Death: Nov. 15, 1630, Regensburg

Known for: Motion of the Planets

[10] **Nicolaus Copernicus**
Birth: Feb. 19, 1473, Toruń, Poland
Death: May 24, 1543, Frauenburg, East Prussia [now Frombork, Poland]
Known for: the Heliocentric Universe
[11] **Michael Faraday**
Birth: Sept. 22, 1791, Newington, Surrey, England
Death: Aug. 25, 1867, Hampton Court
Known for: the Classical Field Theory
[12] **James Clerk Maxwell**
Birth: June 13, 1831, Edinburgh, Scotland
Death: Nov. 5, 1879, Cambridge, Cambridgeshire, England
Known for: the Electromagnetic Field
[13] **Claude Bernard**
Birth: July 12, 1813, Saint-Julien
Death: February. 10, 1878, Paris
Known for: the Founding of Modern Physiology
[14] **Franz Boas**
Birth: July 9, 1858, Minden, Westphalia, Germany
Death: December 21, 1942, New York, U.S
Known for: Modern Anthropology
[15] **Werner Heisenberg**
Birth: December, 1901, Würzburg, Bavaria, German Empire
Death: 1 February 1976, Munich, Bavaria, West Germany
Known for: Quantum Theory
[16] **Linus Pauling**
Birth: Feb. 28, 1901, Portland, Ore., U.S.
Death: Aug. 19, 1994, Big Sur, California
Known for: Twentieth-Century Chemistry
[17] **Erwin Schrodinger**
Birth: Aug. 12, 1887, Vienna, Austria
Death: Jan. 4, 1961, Vienna
Known for: Wave Mechanics
[18] **John James Audubon**
Birth: April 26, 1785, Les Cayes, Saint-Domingue, West Indies [now in Haiti]
Death: Jan. 27, 1851, New York, N.Y., U.S.
Known for: drawings and paintings of North American birds
[19] **Ernest Rutherford**
Birth: Aug. 30, 1871, Spring Grove, N.Z.
Death: Oct. 19, 1937, Cambridge, Cambridgeshire, England
Known for: the Structure of the Atom
[20] **Paul Adrien Maurice Dirac**
Birth: Aug. 8, 1902, Bristol, Gloucestershire, England
Death: Oct. 20, 1984, Tallahassee, Florida, USA
Known for: Quantum Electrodynamics
[21] **Andreas Vesalius**
Birth: Dec. 1514, Brussels [now in Belgium]
Death: June 1564, island of Zacynthus, Republic of Venice [now in Greece]
Known for: the New Anatomy
[22] **Tycho Brahe**
Birth: Dec. 14, 1546, Knudstrup, Scania, Denmark
Death: Oct. 24, 1601, Prague
Known for: the New Astronomy
[23] **Comte de Buffon**
Birth: September 07, 1707, Montbard, Burgundy, France
Death: April 16, 1788, Paris, France
Known for: l'Histoire Naturelle
[24] **Ludwig Boltzmann**
Birth: February 20, 1844, Vienna, Austrian Empire (present-day Austria)
Death: September 5, 1906, Tybein near Trieste, Austria-Hungary [present-day Duino, Italy]
Known for: Thermodynamics
[25] **Max Planck**
Birth: April 23, 1858, Kiel, Schleswig [Germany]
Death: Oct. 4, 1947, Göttingen, West Germany
Known for: the Quanta
[26] **Marie Curie**
Birth: Nov. 7, 1867, Warsaw, Poland, Russian Empire
Death: July 4, 1934, near Sallanches, France
Known for: Radioactivity
[27] **Sir William Herschel**
Birth: Nov. 15, 1738, Hanover, Germany
Death: Aug. 25, 1822, Slough, Buckinghamshire, England
Known for: Sidereal astronomy
[28] **Charles Lyell**
Birth: Nov. 14, 1797, Kinnordy, Forfarshire, Scotland
Death: Feb. 22, 1875, London, England
Known for: Modern Geology
[29] **Pierre Simon de Laplace**
Birth: March 23, 1749, Beaumount-en-Auge, Normandy, France
Death: March 5, 1827, Paris
Known for: Black hole, nebular hypothesis of the origin of the solar system
[30] **Edwin Powell Hubble**
Birth: Nov. 20, 1889, Marshfield, Mo., U.S.
Death: Sept. 28, 1953, San Marino, California
Known for: Extragalactic astronomy
[31] **Joseph J. Thomson**
Birth: December 18, 1856, Cheetham Hill, Manchester, Lancashire, England, United Kingdom
Death: August 30, 1940, Cambridge, Cambridgeshire, England, UK
Known for: the Discovery of the Electron
[32] **Max Born**

Birth: December 11, 1882, Breslau, German Empire

Death: January 5, 1970, Göttingen, West Germany

Known for: Quantum Mechanics

[33] **Francis Harry Compton Crick**

Birth: June 8, 1916, Northampton, Northamptonshire, England

Death: July 28, 2004, San Diego, Calif., U.S.

Known for: Molecular Biology

[34] **Enrico Fermi**

Birth: Sept. 29, 1901, Rome, Italy

Death: Nov. 28, 1954, Chicago, Ill., U.S.

Known for: Statistical mechanics

[35] **Leonard Euler**

Birth: April 15, 1707, Basel, Switzerland

Death: September 18, 1783, Saint Petersburg, Russian Empire

Known for: Eighteenth-Century Mathematics

[36] **Justus Liebig**

Birth: May 12, 1803, Darmstadt, Grand Duchy of Hesse

Death: April 18, 1873, Munich, German Empire

Known for: Nineteenth-Century Chemistry

[37] **Arthur Stanley Eddington**

Birth: December 28, 1882, Kendal, Westmorland, England

Death: November 22, 1944, Cambridge, Cambridgeshire, England

Known for: Modern astronomy

[38] **William Harvey**

Birth: April 1, 1578, Folkestone, Kent, England

Death: June 3, 1657, London

Known for: Circulation of the Blood

[39] **Marcello Malpighi**

Birth: 1628

Death: 1694

Known for: Microscopic Anatomy

[40] **Christiaan Huygens**

Birth: 1629

Death: 1695

Known for: the Wave Theory of Light

[41] **Johann Carl Friedrich Gauss**

Birth: April 30, 1777, Brunswick, Duchy of Brunswick-Wolfenbüttel, Holy Roman Empire

Death: February 23, 1855, Göttingen, Kingdom of Hanover

Known for: Number theory, algebra, statistics, analysis, differential geometry, geodesy, geophysics, mechanics, electrostatics, astronomy, matrix theory & optics

[42] **Albrecht von Haller**

Birth: October 16, 1708, Bern, Swiss Confederacy

Death: December 12, 1777, Bern, Swiss Confederacy

Known for: Eighteenth-Century Medicine

[43] **Friedrich August Kekule von Stradonitz**

Birth: September 7, 1829, Darmstadt, Grand Duchy of Hesse

Death: July 13, 1896, Bonn, German Empire

Known for: Theory of chemical structure, tetravalence of carbon, structure of benzene

[44] **Robert Koch**

Birth: Dec. 11, 1843, Clausthal, Hannover [now Clausthal-Zellerfeld, Germany]

Death: May 27, 1910, Baden-Baden, Germany

Known for: Bacteriology

[45] **Murray Gell-Mann**

Birth: September 15, 1929, Manhattan, New York City, United States

Known for: Gell-Mann and Low theorem, Elementary particles, quarks, Gell-Mann matrices

[46] **Hermann Emil Louis Fischer**

Birth: October 09, 1852, Euskirchen, Rhine Province

Death: July 15, 1919, Berlin, Germany

Known for: Organic Chemistry

[47] **Dmitri Mendeleev**

Birth: Jan. 27 [Feb. 8, New Style], 1834, Tobolsk, Siberia, Russian Empire

Death: Jan. 20 [Feb. 2], 1907, St. Petersburg, Russia

Known for: the Periodic Table of Elements

[48] **Sheldon Glashow**

Birth: December 5, 1932, New York City, New York, USA

Known for: Electroweak theory & Georgi–Glashow model

[49] **James Dewey Watson**

Birth: April 6, 1928, Chicago, Illinois, U.S

Known for: the Structure of DNA

[50] **John Bardeen**

Birth: May 23, 1908, Madison, Wisconsin, U.S

Death: Jan. 30, 1991, Boston, Massachusetts, U.S

Known for: Superconductivity & BCS theory

[51] **John von Neumann**

Birth: December 28, 1903, Budapest, Austria-Hungary

Death: February 8, 1957, Walter Reed General Hospital Washington, D.C.

Known for: the Modern Computer

[52] **Richard P. Feynman**

Birth: May 11, 1918, New York, N.Y., U.S.

Death: Feb. 15, 1988, Los Angeles, California

Known for: Quantum Electrodynamics

[53] **Alfred Lothar Wegener**

Birth: Nov. 1, 1880, Berlin, Germany

Death: Nov. 1930, Greenland

Known for: Continental Drift

[54] **Stephen W. Hawking**

Birth: Jan. 8, 1942, Oxford, Oxfordshire, England

Known for: Quantum Cosmology

[55] **Antonie van Leeuwenhoek**

Birth: Oct. 24, 1632, Delft, Neth.

Death: Aug. 26, 1723, Delft

Known for: the Simple Microscope

[56] **Max von Laue**

Birth: Oct. 09, 1879, Pfaffendorf, Kingdom of Prussia, German Empire

Death: April 24, 1960, West Berlin

Known for: X-ray Crystallography

[57] **Gustav Kirchhoff**

Birth: March 12, 1824, Königsberg, Kingdom of Prussia [present-day Russia]

Death: October 17, 1887, Berlin, Prussia, German Empire [present-day Germany]

Known for: Kirchhoff's circuit laws, Kirchhoff's laws of spectroscopy, Kirchhoff's law of thermochemistry & Kirchhoff's law of thermal radiation

[58] **Hans Bethe**

Birth: July 2, 1906, Strassburg, Ger. [now Strasbourg, France]

Death: March 6, 2005, Ithaca, N.Y., U.S.

Known for: the Energy of the Sun

[59] **Euclid**

Known for: the Foundations of Mathematics

[60] **Gregor Mendel**

Birth: July 22, 1822, Heinzendorf, Austria [now Hynčice, Czech Rep.]

Death: Jan. 6, 1884, Brünn, Austria-Hungary [now Brno, Czech Rep.]

Known for: the Laws of Inheritance

[61] **Heike Kamerlingh Onnes**

Birth: September 21, 1853, Groningen, Netherlands

Death: February 21, 1926, Leiden, Netherlands

Known for: Superconductivity, Onnes-effect &Virial Equation of State

[62] **Thomas Hunt Morgan**

Birth: September 25, 1866, Lexington, Kentucky

Death: December 04, 1945, Pasadena, California

Known for: the Chromosomal Theory of Heredity

[63] **Hermann von Helmholtz**

Birth: August 31, 1821, Potsdam, Kingdom of Prussia

Death: September 08, 1894, Charlottenburg, German Empire

Known for: the Rise of German Science

[64] **Paul Ehrlich**

Birth: March 14, 1854, Strehlen, Lower Silesia, German Kingdom of Prussia

Death: August 20, 1915, Bad Homburg, Hesse, Germany

Known for: Chemotherapy

[65] **Ernst Walter Mayr**

Birth: July 05, 1904, Kempten, Germany

Death: February 03, 2005, Bedford, Massachusetts, United States

Known for: Evolutionary Theory

[66] **Theodosius Grygorovych Dobzhansky**

Birth: January 25, 1900, Nemyriv, Russian Empire

Death: December 18, 1975, San Jacinto, California, United States

Known for: the Modern Synthesis

[67] **Max Delbruck**

Birth: September 04, 1906, Berlin, German Empire

Death: March 9, 1981, Pasadena, California, United States

Known for: the Bacteriophage

[68] **Charles Scott Sherrington**

Birth: November 27, 1857, Islington, Middlesex, England

Death: March 04, 1952, Eastbourne, Sussex, England

Known for: Neurophysiology

[69] **Jean Baptiste Lamarck**

Birth: August 01, 1744, Bazentin, Picardy, France

Death: December 18, 1829, Paris, France

Known for: the Foundations of Biology

[70] **William Bayliss**

Birth: May 2, 1860, Wednesbury, Staffordshire, England

Death: August 27, 1924, London, England

Known for: Modern Physiology

[71] **John Dalton**

Birth: Sept. 5 or 6, 1766, Eaglesfield, Cumberland, England

Death: July 27, 1844, Manchester

Known for: the Theory of the Atom

[72] **Frederick Sanger**

Birth: August 13, 1918, Rendcomb, Gloucestershire, England

Death: November 19, 2013, Cambridge, Cambridgeshire, England

Known for: the Genetic Code

[73] **Louis Victor de Broglie**

Birth: August 15, 1892, Dieppe, France

Death: March 19, 1987, Louveciennes, France

Known for: Wave/Particle Duality

[74] **Carl Linnaeus**

Birth: May 23, 1707, Råshult, Stenbrohult parish (now within Älmhult Municipality), Sweden

Death: January 10, 1778, Hammarby (estate), Danmark parish (outside Uppsala), Sweden

Known for: the Binomial Nomenclature

[75] **J. Robert Oppenheimer**

Birth: April 22, 1904, New York, N.Y., U.S.
Death: Feb. 18, 1967, Princeton, N.J.
Known for: the Atomic Era

[76] **Sir Alexander Fleming**
Birth: Aug. 6, 1881, Lochfield Farm, Darvel, Ayrshire, Scotland
Death: March 11, 1955, London, England
Known for: Penicillin

[77] **Jonas Edward Salk**
Birth: October 28, 1914, New York
Death: June 23, 1995, La Jolla, California, United States
Known for: Vaccination

[78] **Robert Boyle**
Birth: Jan. 25, 1627, Lismore Castle, County Waterford, Ireland
Death: Dec. 31, 1691, London, England
Known for: Boyle's law

[79] **Francis Galton**
Birth: Feb. 16, 1822, near Sparkbrook, Birmingham, Warwickshire, England
Death: Jan. 17, 1911, Grayshott House, Haslemere, Surrey
Known for: Eugenics

[80] **Joseph Priestley**
Birth: March 13, 1733, Birstall Fieldhead, near Leeds, Yorkshire [now West Yorkshire], England
Death: Feb. 6, 1804, Northumberland, Pa., U.S.
Known for: Discovery of oxygen

[81] **Hippocrates**
Known for: Medicine

[82] **Pythagoras**
Known for: Pythagorean Theorem

[83] **Benjamin Franklin**
Birth: January 17, 1706, Boston, Massachusetts Bay, British America
Death: April 17, 1790, Philadelphia, Pennsylvania, U.S.
Known for: Electricity

[84] **Leonardo da Vinci**
Birth: April 15, 1452, Anchiano, near Vinci, Republic of Florence [now in Italy]
Death: May 2, 1519, Cloux [now Clos-Luce], France
Known for: Mechanics and Cosmology

[85] **Ptolemy**
Known for: Greco-Roman science

[86] **Joseph-Louis Gay-Lussac**
Birth: Dec. 6, 1778, Saint-Léonard-de-Noblat, France
Death: May 9, 1850, Paris
Known for: Behavior of gases

[87] **Archimedes**
Known for: the Beginning of Science

[88] **Sir Fred Hoyle**
Birth: June 24, 1915, Bingley, Yorkshire [now West Yorkshire], England
Death: Aug. 20, 2001, Bournemouth, Dorset
Known for: Stellar nucleosynthesis

[89] **Norman Ernest Borlaug**
Birth: March 25, 1914, Cresco, Iowa, U.S.
Known for: Green revolution

[90] **Amedeo Avogadro**
Birth: Aug. 9, 1776, Turin, in the Kingdom of Sardinia and Piedmont
Death: July 9, 1856, Turin, Italy
Known for: Molecular Hypothesis of Combining Gases

[91] **Luis W. Alvarez**
Birth: June 13, 1911, San Francisco, Calif., U.S.
Death: Sept. 1, 1988, Berkeley, California
Known for: discovery of many resonance particles (subatomic particles having extremely short lifetimes and occurring only in high-energy nuclear collisions)

[92] **George Gamow**
Birth: March 4, 1904, Odessa, Russian Empire [now in Ukraine]
Death: Aug. 19, 1968, Boulder, Colo., U.S.
Known for: Big Bang Hypothesis

[93] **Francis Collins**
Birth: April 14, 1950, Staunton, Va., U.S.
Known for: Human Genome Project

[94] **Albert Abraham Michelson**
Birth: Dec. 19, 1852, Strelno, Prussia [now Strzelno, Pol.]
Death: May 9, 1931, Pasadena, Calif., U.S.
Known for: Establishment of the speed of light as a fundamental Constant

[95] **Rachel Carson**
Birth: May 27, 1907, Springdale, Pa., U.S.
Death: April 14, 1964, Silver Spring, Md.
Known for: Environmental pollution and the natural history of the sea

[96] **Joseph Lister**
Birth: April 5, 1827, Upton, Essex, England
Death: Feb. 10, 1912, Walmer, Kent
Known for: antiseptic medicine

[97] **Louis Agassiz**
Birth: May 28, 1807, Motier, Switz.
Death: Dec. 14, 1873, Cambridge, Mass., U.S.
Known for: Natural science

[98] **André-Marie Ampère**
Birth: Jan. 22, 1775, Lyon, France
Death: June 10, 1836, Marseille
Known for: Electrodynamics

[99] **Paracelsus**
Birth: Nov. 11 or Dec. 17, 1493, Einsiedeln, Switzerland
Death: Sept. 24, 1541, Salzburg, Archbishopric of Salzburg [now in Austria]

Known for: Der grossen Wundartzney ("Great Surgery Book")

[100] **Edward O. Wilson**

Birth: April 15, 1452, Anchiano, near Vinci, Republic of Florence [now in Italy]

Death: June 10, 1929, Birmingham, Ala., U.S.

Known for: Sociobiology

Space: the potential habitable worlds around ten thousand billion billion stars; ours is just one.

Time: a cosmic history of nearly 14 billion years; life took less than ½ billion years to start here.

"If they not be inhabited, what a waste of space."

: Thomas Carlyle, Scottish Essayist (1795-1881)

In a typical absorption spectral measurement a monochromatic radiation is made to fall on a homogeneous absorbing substance. In such a situation a part of the radiation is reflected, a part is absorbed, and a part is transmitted. The intensity of incident radiation, I is equal to the sum of the intensities of reflected (I'''), absorbed (I') and transmitted (I'') radiation.

$I = I''' + I' + I''$

In most cases of homogeneous nonmetallic substances, such as transparent substances, the loss of radiant intensity due to reflection may not exceed 4%. This fraction can be, and is therefore, usually ignored. Thus, for all practical purposes, we may write:

$I = I' + I''$

If temperature, composition, and other factors including wavelength are kept constant, then the rate of absorption of intensity of incident monochromatic radiation on passage through a homogenous absorbing substance, – dI/dt, where I is the incident radiant intensity and t the time, is directly proportional to the intensity of incident monochromatic radiation, namely, that

$-dI / dt = k\, I$

$d\ln I = -k \cdot dt$

The constant of proportionality, k, appearing in the above equation is called the absorption rate coefficient, and this is a characteristic of the absorbing substance. Further, the negative sign signifies that incident radiant intensity decreases with time. Since at t=0 we have the original intensity I, the intensity I'' at any time t can be found from equation above by integration between these limits. We obtain thus

$\ln (I''/ I) = -k \cdot t$

$\ln (I/ I'') = k \cdot t$

When monochromatic radiation travels in a homogeneous substance of refractive index η a distance ℓ with a velocity (c/ η), then the time taken by radiation is:

$t = \eta\, \ell / c$, where $c = 3\times 10^{10}$ cm/s is the speed of light in vacuum.

The last equation may be written also as

$\log (I / I'') = k''\, \eta\, \ell /c$ in which case $k'' = k /2.303$ is the extinction rate coefficient of the substance. The ratio of the intensities of transmitted and incident radiation gives the transmittance, T, expressed as:

$T = I'' / I$

From the transmittance, one can calculate the quantity known as absorbance. Absorbance is the amount of light absorbed by a substance. It is calculated from T using the following equation:

Absorbance = – log T= log (I / I'')

Absorbance = $k''\, \eta\, \ell /c$

A plot of absorbance versus thickness 'ℓ' is expected to a straight line passing origin with slope = $k''\ \eta\ /c$. When homogeneous solutions of chemical species are considered, it is clearly desirable to modify this expression to include the concentration of absorbing chemical species. Thus, the extinction rate coefficient in above equation is in turn related to the concentration of absorbing chemical species.

$k''= k_M\, C$

where k_M, called the molar extinction rate coefficient, is a proportionality constant determined by the nature of the absorbing chemical species and the wavelength of light used.

Absorbance = $(k_M\, \eta\, \ell /c)\, C$

$k_M = (c / \eta\, \ell\, C) \times$ absorbance

The molar extinction rate coefficient is a measurement of how fast a chemical species absorbs light at a given wavelength. It is an intrinsic property of the chemical species, also a measure of the rate of the electronic transition. The larger the molar extinction rate coefficient, the faster the electronic transition. The absorbance is measured with some form of spectrophotometer. At present spectrophotometers utilizing photoelectric cells are available which give absorbance directly. Once absorbance for a given solution is measured and the thickness of the cell used is known, the molar absorption rate coefficient of the given solution for the given wavelength can readily be calculated by knowing the refractive index of the solution and the concentration of absorbing chemical species. At low concentrations, less than 10^{-3} M, absorbance is linear and proportional to concentration of absorbing chemical species with slope = $k_M\, \eta\, \ell /c$.

A plot of absorbance versus concentration is not always expected to a straight line passing origin.

In practice, the following effects may lead to deviations from linearity:

- Fluorescence and Phosphorescence;
- Light scattering including Raman;
- Photochemical reactions;
- Presence of large amounts of strong electrolytes;
- Non- monochromatic nature of the radiation;

- Changes in refractive index at high analyte concentration;
- Stray light effect;
- Shifts in chemical equilibrium as a function of concentration;
- Complexation, association or dissociation.

According to Beer Lambert's law,

Absorbance = $\varepsilon \ell C$

where ε, called the molar extinction coefficient, is a measurement of how strong a chemical species absorbs light at a given wavelength.

Since Absorbance = $(k_M \eta \ell / c) C$:

$(k_M \eta \ell / c) C = \varepsilon \ell C$

From this it follows that

$k_M \eta / c = \varepsilon$

or

$k_M / \varepsilon = c / \eta$

Since η is always less than c. Therefore:

k_M is > than ε

Which means: rate of absorption is always greater than the strength of absorption.

(k_M / ε) values for liquids at 20 °C (589.29nm)

Benzene	$\eta = 1.501$	$k_M / \varepsilon = 1.99 \times 10^8$
Carbon tetrachloride	$\eta = 1.461$	$k_M / \varepsilon = 2.05 \times 10^8$
Carbon disulfide	$\eta = 1.628$	$k_M / \varepsilon = 1.84 \times 10^8$
Ethanol (ethyl alcohol)	$\eta = 1.361$	$k_M / \varepsilon = 2.204 \times 10^8$
10% Glucose solution in water	$\eta = 1.3477$	$k_M / \varepsilon = 2.22 \times 10^8$
20% Glucose solution in water	$\eta = 1.3635$	$k_M / \varepsilon = 2.200 \times 10^8$
60% Glucose solution in water	$\eta = 1.4394$	$k_M / \varepsilon = 2.08 \times 10^8$
sucrose	$\eta = 1.3344$	$k_M / \varepsilon = 2.24\times 10^8$

Amount of radiant intensity absorbed,

$I' = (I - I'')$

Since $I'' = I \exp(-2.303 k_M \eta \ell C / c)$. Consequently we may write without further hesitation that

$I' = I (1 - \exp(-2.303 k_M \eta \ell C / c))$

The fluorescence intensity (F) is proportional to the amount of radiant intensity absorbed:

$F = I' Q = I \varphi (1 - \exp(-2.303 k_M \eta \ell C / c))$

where φ = fluorescence quantum yield. The fluorescence quantum yield (φ) gives the efficiency of the fluorescence process. It is defined as the ratio of the number of photons emitted to the number of photons absorbed. When $(2.303 k_M \eta \ell C/c) < 0.05$, which can be achieved at low concentrations of analyte, the fluorescence intensity can be expressed as:

$F = (2.303 I \varphi k_M \eta \ell / c) C$

At low concentrations, less than 10^{-5} M, fluorescence intensity is linear and proportional to concentration of analyte with slope = $2.303 I \varphi k_M \eta \ell / c$.

For substances other than solutions the absorbance is given by:

Absorbance = $k'' \eta \ell / c$

When discussing the mass extinction rate coefficient, this equation is rewritten:

Absorbance = $(k_\mu \eta \ell / c) \rho$

where ρ = density of absorbing chemical species and k_μ = mass extinction rate coefficient. The mass extinction rate coefficient is a measurement of how fast a chemical species absorbs light at a given wavelength, per unit mass. The molar extinction rate coefficient is closely related to the mass extinction rate coefficient by the equation:

Molar extinction rate coefficient = mass extinction rate coefficient × molar mass

$k_M = k_\mu \times$ molar mass

At low densities, less than 10^{-3} g /cm^3, absorbance is linear and proportional to density of absorbing chemical species with slope = $k_\mu \eta \ell / c$.

"An experiment is a question which science poses to Nature, and a measurement is the recording of Nature's answer."

--Max Planck

Understanding the natural growth of tumors is of value in the study of tumor progression, along with that it will be supportive for a better assessment of therapeutic response. Patterns of tumor growth can be shaped by a variety of factors, and so cancer biologists have developed different mathematical expressions, or models, to describe tumor growth rate. One of the most basic models of tumor growth rate is the exponential model. The exponential model was introduced by Skipper et al. (1964) and has proven to be well suited to describe the early stages of tumor growth. In clinical studies, where the natural growth of tumor can be preceded for a restricted period, the exponential model is used to describe the growth of tumors. An untreated tumor growth is usually well approximated by an exponential growth model. Some studies have shown that tumor growth rate may descend with time, which results in non-exponential growth model of tumors. A number of non-exponential growth models are available in the literature, among which the Gompertz model is widely used. The Gompertz Model was introduced by Gompertz (1825) and has proven to be well suited to describe the growth of an unperturbed tumor. The current view of tumor kinetics is based on the general assumption that tumor cells grow exponentially. Such kinetics agrees with the early stages of tumor growth. The time it takes for the tumor cells to reach twice its number density, doubling time DT, is of value for quantification of tumor kinetics, along with that it will be supportive for optimization of screening programs, prognostication, optimal scheduling of treatment strategies, and assessment of tumor aggressiveness.

If the tumor volume = V_0 at time t = 0 and

= V at any time t, then according to exponential model

$V = V_0 e^{\alpha t}$, where α is an exponential growth constant characterizing the growth rate of tumor volume. This model implies that the tumor volume can increase indefinitely and the growth rate of tumor is proportional to its volume:

$dV/dt = \alpha V$

Tumor volume doubling time:

$DT_1 = 0.693/\alpha$

According to equation above, the variation of DT_1 with α is:

$dDT_1 / d\alpha = -0.693/\alpha^2$

If the number of tumor cells = N_0 at time t = 0 and

= N at any time t, then according to exponential model:

$N = N_0 e^{\beta t}$, where β is an exponential growth constant characterizing the growth rate of tumor cells.

This model implies that the tumor cells can increase indefinitely and the growth rate of tumor cells is proportional to its number:

$dN/dt = \beta N$

The time it takes for tumor cells to double in number, doubling time DT_2, is represented by the following equation:

$DT_2 = 0.693/\beta$

According to equation above, the variation of DT_2 with β is:

$dDT_2 / d\beta = -0.693/\beta^2$

Further, the ratio dN / dV can be given as per the following expression:

$(d\ln V / d\ln N) = (\alpha/ \beta)$

or

$d\ln V = (DT_2 / DT_1)\, d\ln N$

On integration within the limits of V_0 to V for tumor volume and N_0 to N for number of tumor cells, we get

$\ln (V / V_0) = (DT_2 / DT_1) \ln (N / N_0)$

A plot of $\ln (V / V_0)$ versus $\ln (N / N_0)$ is expected to be a straight line passing through origin with slope = (DT_2 / DT_1). n is the number density of tumor cells, defined as:

n = N/V which on rearranging:

$n \times V = N$

Differentiating with respect to N gives:

$(dn/dN) V + (d\ln V/d\ln N) = 1$

Since $(d\ln V/d\ln N) = (DT_2 / DT_1)$. We have then

$(dn/dN) V + (DT_2 / DT_1) = 1$

or

$(dn/dN) = (DT_1 - DT_2) / V\, DT_1$

or

$(dn/dt) / (dN/dt) = (DT_1 - DT_2) / V\, DT_1$

But $dN/dt = 0.693N/ DT_2$ and hence, we get

$(dn/dt) = 0.693 (DT_1 - DT_2)\, n / DT_2\, DT_1$

or

$(d\ln n) = \{0.693 (DT_1 - DT_2) / DT_2\, DT_1\}\, dt$

On integration within the limits of n_0 to n for number density of tumor cells and 0 to t for the time, we get

$\ln (n/ n_0) = \{0.693 (DT_1 - DT_2) / DT_2\, DT_1\}\, t$

The time it takes for the tumor cells to reach twice its number density, doubling time DT, is of value in the study of tumor progression, along with that it will be supportive for optimal scheduling of treatment strategies. Now, $n = 2n_0$ at t = DT. Therefore, equation above can be rewritten as follows:

$DT = (DT_1 - DT_2) / DT_2\, DT_1$

Assuming that tumor growth is exponential, the following equation is justifiable:

$DT = DT_1\, DT_2/ (DT_1 - DT_2)$, where DT is the time it takes for the tumor cells to reach twice its number density, DT_1 is the time it takes for a tumor to double in volume, and DT_2 is the time it takes for tumor cells to double in number. This equation predicts the following limiting possibilities.

If $DT_1 = DT_2$, then

$DT = \infty$ which means: that it takes an infinitely long time for the tumor cells to reach twice its number density.

And according to the equation: $d\ln V = (DT_2 / DT_1)\, d\ln N$ if $DT_1 = DT_2$ then $d\ln V = d\ln N$ which means: V is proportional to N i.e., number density of tumor cells remains constant.

If $DT_1 = DT_2$, then number density of tumor cells remains constant and it takes an infinitely long time for the tumor cells to reach twice its number density.

If $DT_1 >> DT_2$, then

$DT = DT_2$

i.e., the time it takes for the tumor cells to reach twice its number density equals the time it takes for tumor cells to double in number.

If $DT_2 >> DT_1$, then

$DT = - DT_1$

i.e., because of negative sign the actual value of DT will be = $1 /DT_1$.

The physicist Leo Szilard once announced to his friend Hans Bethe that he was thinking of keeping a diary: "I don't intend to publish. I am merely going to record the facts for the information of God."

"Don't you think God knows the facts?" Bethe asked.

"Yes," said Szilard.

"He knows the facts, but He does not know this version of the facts."

−Hans Christian von Baeyer, Taming the Atom

Chapter 4

A Relativistic Bohr Model

"It was quite the most incredible event that has ever happened to me in my life. It was almost as incredible as if you fired a 15- inch shell at a piece of tissue paper and it came back and hit you. On consideration, I realized that this scattering backward must be the result of a single collision, and when I made calculations I saw that it was impossible to get anything of that order of magnitude unless you took a system in which the greater part of the mass of the atom was concentrated in a minute nucleus. It was then that I had the idea of an atom with a minute massive center, carrying a charge."

- Ernest Rutherford

According to the law that nothing may travel faster than the speed of light – i.e., according to the Albert Einstein's law of variation of mass with velocity (the most famous formula in the world. In the minds of hundreds of millions of people it is firmly associated with the menace of atomic weapons. Millions perceive it as a symbol of relativity theory):

$m = m_0 / (1- v^2/c^2)^{1/2}$

or

$m^2c^2 - m^2v^2 = m_0^2c^2$

That the mass m in motion at speed v is the mass m_0 at rest divided by the factor $(1- v^2/c^2)^{1/2}$ implies: the mass of a particle is not constant; it varies with changes in its velocity.

Differentiating the above equation, we get:

$mv\,dv + v^2dm = c^2dm$

or

$dm\,(c^2 - v^2) = mv\,dv$

In relativistic mechanics (the arguably most famous cult of modern physics, which has a highly interesting history which dates back mainly to Albert Einstein and may be a little earlier to H. Poincaré), we define the energy which a particle possess due to its motion i.e., kinetic energy to be $= dmc^2 = dp \times v$. Therefore:

$dp\,(c^2 - v^2) = mc^2\,dv$

or

$(dp/dt) = mc^2 / (c^2 - v^2)\,(dv/dt)$

Since: $(dp/dt) = F$ (force) and $(dv/dt) = a$ (acceleration), therefore:

$F = mac^2 / (c^2 - v^2)$

(**Note:** For non-relativistic case ($v << c$), the above equation reduces to $F = m_0a$)

Because

$m = m_0 / (1- v^2/c^2)^{1/2}$ or $c^2 / (c^2 - v^2) = m^2/m_0^2$. Therefore:

$F = m^3a / m_0^2$

Bohr Model:

In 1911, fresh from completion of his PhD, the young Danish physicist Niels Bohr left Denmark on a foreign scholarship headed for the Cavendish Laboratory in Cambridge to work under J. J. Thomson on the structure of atomic systems. At the time, Bohr began to put forth the idea that since light could no long be treated as continuously propagating waves, but instead as discrete energy packets (as articulated by Planck and Einstein), why should the classical Newtonian mechanics on which Thomson's model was based hold true? It seemed to Bohr that the atomic model should be modified in a similar way. If electromagnetic energy is quantized, i.e. restricted to take on only integer values of hυ, where υ is the frequency of light, then it seemed reasonable that the mechanical energy associated with the energy of atomic electrons is also quantized. However, Bohr's still somewhat vague ideas were not well received by Thomson, and Bohr decided to move from Cambridge after his first year to a place where his concepts about quantization of electronic motion in atoms would meet less opposition. He chose the University of Manchester, where the chair of physics was held by Ernest Rutherford. While in Manchester, Bohr learned about the nuclear model of the atom proposed by Rutherford. To overcome the difficulty associated with the classical collapse of the electron into the nucleus, Bohr proposed that the orbiting electron could only exist in certain special states of motion - called stationary states, in which no electromagnetic radiation was emitted. In these states, the angular momentum of the electron L takes on integer values of Planck's constant divided by 2π, denoted by $\hbar = h/2\pi$ (pronounced h-bar). In these stationary states, the electron angular momentum can take on values ħ, 2ħ, 3ħ... but never non-integer values. This is known as quantization of angular momentum, and was one of Bohr's key hypotheses. For circular orbits, the position vector of the electron r is always perpendicular to its linear momentum p. The angular momentum $L = p \times r$ has magnitude $L = pr = mvr$ (where $m = m_0 / (1- v^2/c^2)^{1/2}$, m_0 = rest mass of the electron) in this case. Thus Bohr's postulate of quantized angular momentum is equivalent to

$mvr = n\hbar$

where n is a positive integer called principal quantum number. It tells us what energy level the electron occupies. For an electron to orbit the nucleus in the circular orbit of radius r, it should obey the condition:

$Ze^2/4\pi\varepsilon_0r^2 = m^3a / m_0^2$

Since $a = v^2/r$. Therefore:

$Ze^2/4\pi\varepsilon_0r = m^3v^2 / m_0^2$

or

$Ze^2/4\pi\varepsilon_0 = m^2v\,(mvr) / m_0^2$

Since: $mvr = n\hbar$

$Ze^2/4\pi\varepsilon_0 = n\hbar\, m^2v / m_0^2$

or

$v = (Ze^2/ 4\pi\varepsilon_0n\hbar) \times (m_0^2 / m^2)$

Note: for nonrelativistic model (i.e., $v << c$) the above expression reduces to:

$v = (Ze^2/ 4\pi\varepsilon_0n\hbar)$

Expression for radius of the orbit:

Substituting $v = (Ze^2/ 4\pi\varepsilon_0 n\hbar) \times (m_0^2 / m^2)$ in the equation $mvr = n\hbar$, we get:

$r = (4\pi\varepsilon_0 n^2 \hbar^2 / Ze^2) \times (m /m_0^2)$

Note: for nonrelativistic model (i.e., v << c) the above expression reduces to:

$r = (4\pi\varepsilon_0 n^2 \hbar^2 / m_0 Ze^2)$

Expression for potential energy of the electron:

For an electron revolving in the n^{th} orbit of radius r

Potential energy is given by:

E_P = (potential at a distance r from the nucleus) × (-e)

$E_P = (Ze/4\pi\varepsilon_0 r) \times (- e)$ where Z is the atomic number and –e the charge on the electron.

i.e., $E_P = – Ze^2 /4\pi\varepsilon_0 r$

Substituting $r = (4\pi\varepsilon_0 n^2 \hbar^2 / Ze^2) \times (m /m_0^2)$, we get:

$E_P = – m_0^2 Z^2 e^4 /16\pi^2\varepsilon_0^2 n^2 \hbar^2 m$

Note: for nonrelativistic model (i.e., v << c) the above expression reduces to:

$E_P = – m_0 Z^2 e^4 /16\pi^2\varepsilon_0^2 n^2 \hbar^2$

This energy represents the binding energy of the electron. Binding energy of an electron is the minimum energy required to knock out an electron from the atom. It is also denoted by E_B i.e., $E_B = – m_0 Z^2 e^4 /16\pi^2\varepsilon_0^2 n^2 \hbar^2$

If a photon energy hυ is supplied to remove the electron from the n^{th} orbit, then this energy should be $= E_B$ i.e., the condition $h\upsilon = – m_0^2 Z^2 e^4 /16\pi^2\varepsilon_0^2 n^2 \hbar^2 m$ should be satisfied. If hυ is < than $– m_0^2 Z^2 e^4 /16\pi^2\varepsilon_0^2 n^2\hbar^2 m$, then it is impossible to remove an electron from the atom.

$m^2c^2 – m^2v^2 = m_0^2c^2$

Since: $v = (Ze^2/ 4\pi\varepsilon_0 n\hbar) \times (m_0^2 / m^2)$

Therefore, the above equation becomes:

$m^2c^2 – (Z^2e^4 m_0^4/ 16\pi^2\varepsilon_0^2 n^2\hbar^2 m^2) = m_0^2c^2$

or

$m^2c^2 = m_0^2 \{c^2 + Z^2e^4 m_0^2/ 16\pi^2\varepsilon_0^2 n^2\hbar^2 m^2\}$

or

$m^2c^2 / m_0^2 = \{c^2 + Z^2e^4 m_0^2/ 16\pi^2\varepsilon_0^2 n^2\hbar^2 m^2\}$

For non-relativistic case (i.e., v << c)

$m = m_0$

$c^2 = \{c^2 + Z^2e^4 / 16\pi^2\varepsilon_0^2 n^2\hbar^2\}$

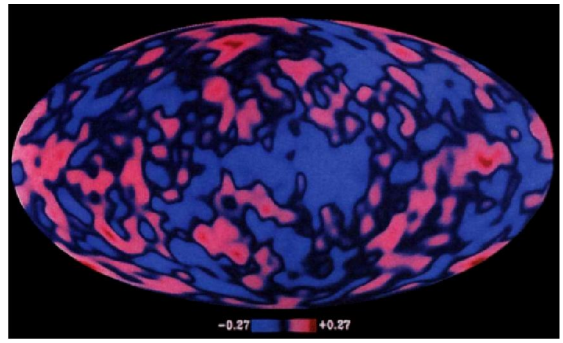
From this it follows that

$Z^2e^4 / 16\pi^2\varepsilon_0^2 n^2\hbar^2 = 0$ (which is an illogical and meaningless result)

Chapter 4

Science in Uncertainty

Note: To many people, mathematics (a mere calculation-- an abstract intellectual activity that began in Greece in the sixth century BC) presents a significant barrier to their understanding of science. Certainly, mathematics has been the language of physics for four hundred years and more, and it is difficult to make progress in understanding the physical world without it.



The full sky map made by the COBE satellite DMR instrument, showing evidence for the wrinkles in time.

Newtonian Laws Of Motion

If a force F acts on a particle of mass m_0 at rest and produces acceleration a in it, then the force is given by Newton's second law (the law that describes the motion of bodies based on the conception of absolute space and time and held sway until Einstein's discovery of special relativity -- postulated by Swiss mathematician and scientist Leonhard Eular after death of Sir Isaac Newton in 1736) which states that the body will accelerate, or change its speed, at a rate that is proportional to the force (For example, the acceleration is twice as great if the force is twice as great): $F = m_0 a$. According to Newton's First Law of Motion, every particle continues 'in state of rest' (v = 0, a=0) when no external force (F=0) acts on it. Under this condition the rest mass of the particle (a measure of quantity of matter in a particle; its inertia or resistance to acceleration in free space) becomes UNDEFINED.

$m_0 = F/a = 0/0$

The equation

$F = m^3a / m_0^2$ on rearranging lead to:

$m = m_0^{2/3} (F/a)^{1/3}$

Suppose no force acts on the particle (i.e., F = 0), then no acceleration is produced in the particle (i.e., a = 0). Under this condition: $m = m_0^{2/3} (0/0)^{1/3}$ i.e., m becomes UNDEFINED. There can be no bigger limitation than this (because m should be $= m_0$ under the condition: F = 0 and a = 0).

Newton's third law of motion as stated in PHILOSOPHIAE NATURALIS PRINCIPIA MATHEMATICA (the most influential book ever written in physics – which rose Newton rapidly into public prominence – he was appointed president of the Royal Society and became the first scientist ever to be knighted):

"To every action there is always an equal and opposite reaction."

Let us consider a boy is standing in front of wooden wall, holding a rubber ball and cloth ball of same mass in the hands. Let the wall is at the distance of 5 feet from the boy.

Let the boy kicks the rubber ball at the wall with some force F.

Action: Boy kicks the rubber ball at the wall from distance of 5 feet.

Reaction: The ball strikes the wall, and comes back to the boy i.e. travelling 5 feet. Now action and reaction is equal and opposite.

Let the same boy kicks the cloth ball at the wall with same force F.

Action: Boy kicks the cloth ball at the wall from distance of 5 feet.

Reaction: The ball strikes the wall, and comes back to the boy i.e. travelling 2.5 feet. Now action and reaction are not equal and opposite. In this case Newton's third law of motion is completely violated.

Protein Ligand Binding

A protein in solution exists in two forms: bound and unbound. Depending on a specific protein's affinity for ligand, a proportion of the protein may become bound to ligands, with the remainder being unbound. If the protein ligand binding is reversible, then a chemical equilibrium will exist between the bound and unbound states, such that:

P (metal) + L (ligand) ↔ PL (protein - ligand complex)

The dissociation constant for this reaction is,

$K = [P] [L] / [PL]$

In this equation $[P] = [P]_T – [PL]$ and $[L] = [L]_T – [PL]$ where $[P]_T$ and $[L]_T$ are the initial total concentrations of the protein and ligand, respectively. The dissociation constant K is a useful way to present the affinity of a protein for its ligand. This is because the number K quickly tells us the concentration of protein that is required to yield a significant amount of interaction with the target ligand. Specifically, when protein concentration equals K, the 50% of the target ligand will exist in the protein ligand complex and 50% of the ligand will remain in the free form [L]. (This holds true under conditions where protein is present in excess relative to ligand). Typically, proteins must display a $K \le 1 \times 10^{-6}$ M for the interaction with their target ligand. When considering the K for proteins, smaller numbers mean better binding. The higher the K value the protein does not bind well to the ligand. At very high ligand concentrations all the protein will be in the form of PL such that

$[P] = 0$

If $[P] = 0$, then

$K = 0$

Since the binding constant $K_B = 1/K$. Therefore: $K_B = 1/0$ i.e., the binding constant becomes UNDEFINED.

Using the equilibrium relationship K [PL] = [L] [P] and substituting,

$[P]_T – [P]$ for [PL], $[L]_T – [PL]$ for [L] and $[P]_T – [PL]$ for [P] Gives:

$K \{[P]_T – [P]\} = \{[L]_T – [PL]\} \{[P]_T – [PL]\}$

$K [P]_T – K [P] = [L]_T [P]_T – [PL] [L]_T – [PL] [P]_T + [PL]^2$ which on rearranging:

$K [P]_T – [L]_T [P]_T + [PL] [P]_T = – [PL] [L]_T + [PL]^2 + K [P]$

$[P]_T \{K – [L]_T + [PL]\} = [PL] \{– [L]_T + [PL]\} + K [P]$

Further, if we substitute $[L]_T = [PL] + [L]$. Then we get

$[P]_T \{K – [PL] – [L] + [PL]\} = [PL] \{–[PL] – [L] + [PL]\} + K [P]$

$[P]_T \{K – [L]\} = – [PL] [L] + K [P]$ which is the same as:

$[P]_T \{K – [L]\} = K [P] – [PL] [L]$

$K – [L] = K \{[P]/ [P]_T\} – \{[PL]/ [P]_T\} [L]$

Labeling $[P] / [P]_T$ as F_{FP} (fraction of free protein) and $[PL] / [P]_T$ as F_{BP} (fraction of bound protein) then above expression turn into

$K – [L] = K F_{FP} – F_{BP} [L]$

Any equation is valid only if LHS = RHS. Hence

If $F_{FP} = F_{BP}=1$, then the LHS = RHS, and the above Equation is true.

If $F_{FP} = F_{BP}\neq1$, then the LHS ≠ RHS, and the above Equation is invalid.

Let us now check the validity of the condition "$F_{FP} = F_{BP} =1$".

As per the protein conservation law,

$[P]_T = [PL] + [P]$

From this it follows that

$1= F_{BP} + F_{FP}$

If we assume $F_{BP} = F_{FP} =1$, we get:

$1 = 2$

The condition $F_{FP} = F_{BP} =1$ is invalid, since 1 doesn't = 2. In fact, the only way it can happen that $K – [L] = K – [L]$ is if both $F_{FP} = F_{BP} =1$. Since $F_{FP} = F_{BP} \neq 1$, Equation $K – [L] = K F_{FP} – F_{BP} [L]$ does not therefore hold well.

CONCLUSION: Using the equilibrium relationship K [PL] = [L] [P] and substituting $[P]_T – [P]$ for [PL], $[L]_T – [PL]$ for [L], $[P]_T – [PL]$ for [P] and simplifying we get the wrong result:

$K – [L] = K F_{FP} – F_{BP} [L]$

Considering the reaction: P + L ↔ PL the change in free energy is given by the equation:

$\Delta G = \Delta G_0 + RT \ln Q$

where R is the gas constant (8.314 J / K / mol), T is the temperature in Kelvin scale, ln represents a logarithm to the base e, ΔG_0 is the Gibbs free energy change when all the reactants and products are in their standard state and Q is the reaction quotient or reaction function at any given time (Q = [PL] / [P] [L]). We may resort to thermodynamics and write for ΔG_0: $\Delta G_0 = - RT \ln K_{eq}$ where K_{eq} is the equilibrium constant for the reaction. If K_{eq} is greater than 1, $\ln K_{eq}$

is positive, ΔG_0 is negative; so the forward reaction is favored. If K_{eq} is less than 1, ln K_{eq} is negative, ΔG_0 is positive; so the backward reaction is favored. It can be shown that

$\Delta G = -RT \ln K_{eq} + RT \ln Q$

The dependence of the reaction rate on the concentrations of reacting substances is given by the Law of Mass Action (which was proposed by Cato Maximilian Guldberg and Peter Waage in 1864, based on the work of Claude Louis Berthollet's ideas about reversible chemical reactions). This law states that the rate of a chemical reaction is directly proportional to the product of the molar concentrations of the reactants at any constant temperature at any given time.

Applying the law of mass action to the forward reaction:

$v_1 = k_1$ [P] [L] where k_1 is the rate constant of the forward reaction.

Applying the law of mass action to the backward reaction:

$v_2 = k_2$ [PL] where k_2 is the rate constant of the backward reaction.

Further, the ratio of v_1 / v_2 yields:

$v_1 / v_2 = (k_1/ k_2)\, Q$.

But equilibrium constant is the ratio of the rate constant of the forward reaction to the rate constant of the backward reaction. And consequently:

$v_1 / v_2 = K_{eq} / Q$.

On taking natural logarithms of above equation we get:

$\ln (v_1 / v_2) = \ln K_{eq} - \ln Q$.

On multiplying by –RT on both sides, we obtain:

$-RT \ln (v_1 / v_2) = - RT \ln K_{eq} + RT \ln Q$

Comparing Equations

$\Delta G = -RT \ln K_{eq} + RT \ln Q$ and

$- RT \ln (v_1 / v_2) = - RT \ln K_{eq} + RT \ln Q$, the Gibbs free energy change is seen to be:

$\Delta G = -RT \ln (v_1 / v_2)$

or

$\Delta G = RT \ln (v_2 / v_1)$.

At equilibrium: $v_1 = v_2$

$\Delta G = 0$

Under this condition RT becomes UNDEFINED i.e.,

RT = 0 / 0

There can be no bigger limitation than this. RT cannot be undefined because R = 8.314 Joules per Kelvin per mole and T → undefined violates the third law of thermodynamics (which states that nothing can reach a state of absolute zero).

From the equation

$\ln (v_1 / v_2) = -\Delta G / RT$

it follows that

$\ln v_1 = -\Delta G^*_1 / RT + \text{constant}$

$\ln v_2 = -\Delta G^*_2 / RT + \text{constant}$

This splitting involves the assumption that reaction in the forward reaction depends only on the change ΔG^*_1in Gibbs energy in going from the initial state to some intermediate state represented by the symbol *; similarly for the backward reaction there is a change ΔG^*_2 in Gibbs energy in going from the product state to the intermediate state. For any reaction, we can therefore write

$\ln v = -\Delta G^* / RT + \text{constant}$

Now, the Eyring approach assumes that we can assume a thermodynamic quasi-equilibrium can exist between reactants A & B and activated complex AB* (which is somewhat similar to a normal molecule with one important difference. It has one degree of vibration that is special. The AB* moves along this special vibrational mode to form product P (or to reform reactant A and B) at a certain stage of the reaction. If this is true, we can solve for constant (because at thermodynamic quasi-equilibrium $\Delta G^* = 0$ and $v = v_{eq}$, where v_{eq} = rate of reaction at thermodynamic quasi-equilibrium)

$\ln v_{eq} = 0 + \text{constant}$

Substituting the value of constant, we get:

$\ln v = -\Delta G^* / RT + \ln v_{eq}$

or

$v = v_{eq}\, e^{-\Delta G^* / RT}$

Since $v = k_r C_A C_B$ (where k_r = rate constant for a given reaction (A + B → P), C_A & C_B = concentrations of reactants A & B). Therefore:

$k_r C_A C_B = v_{eq}\, e^{-\Delta G^* / RT}$

By thermodynamics, we know that

$\Delta G^* = \Delta G0 + RT \ln(C^*/ C_A C_B)$

Where:

ΔG^* = Gibbs free energy of activation, $\Delta G0$ = standard Gibbs free energy of activation, R = universal gas constant (8.314 J/K/mol), T = temperature in Kelvin and C* = concentration of activated complex AB*.

From this it follows that:

$C_A C_B = C^*\, e^{-\Delta G^* / RT}\, e^{-\Delta G0 / RT}$

Substituting the value of $C_A C_B$ in the equation: $k_r C_A C_B = v_{eq}\, e^{-\Delta G^* / RT}$, we get:

$k_r C^* = v_{eq}\, e^{-\Delta G0 / RT}$

Since $v_{eq} = k_2 C^*_{eq}$ (where: k_2 = rate constant for product formation and C^*_{eq} = concentration of AB* at thermodynamic quasi-equilibrium). Therefore:

$k_r = k_2 (C^*_{eq} /C^*)\, e^{-\Delta G0 / RT}$

But the expression in the existing literature of transition theory (which also widely referred to as activated complex theory -- has achieved widespread acceptance as a tool for the interpretation of chemical reaction rates − developed in 1935 by Eyring and by Evans and Polanyi) -- which pictures a reaction between A and B as proceeding through the formation of an activated complex, AB*, in a rapid pre-equilibrium – which falls apart by unimolecular decay into products, P, with a rate constant k_2) is:

$k_r = k_2\, e^{-\Delta G0 / RT}$

Since $e^{-\Delta G0 / RT} = K^*$ (where K^* is the equilibrium constant for the formation of activated complex). Therefore:

$k_r = k_2 K^*$

Taking natural logarithm of the above equation we get:

$\ln k_r = \ln k_2 + \ln K^*$

Differentiating the above equation we get:

$d\ln k_r = d\ln k_2 + d\ln K^*$

which is the same as:

$d\ln k_r /dT = d\ln k_2/dT + d\ln K^*/dT$

Since:

$d\ln k_r /dT = E_a / RT^2$

$d\ln K^*/dT = \Delta H^*/ RT^2$

(where: E_a = energy of activation and ΔH^* = standard enthalpy of activation).

Therefore:

$E_a/ RT^2 = d\ln k_2/dT + \Delta H^*/ RT^2$

It is experimentally observed that for reactions in solution,

$E_a = \Delta H^*$

Hence,

$d\ln k_2/dT = 0$

Since $k_2 = (\kappa k_B T/h)$ where κ is the transmission coefficient (i.e., the fraction of activated complex crossing forward to yield the products), k_B and h are the Boltzmann's constant and Planck's constant respectively, T is the temperature in kelvin.

Therefore:

$d\ln\kappa /dT + d\ln T/dT = 0$

or

$d\ln\kappa = - d\ln T$

Integrating over dlnk from κ_1 to κ_2, and over dlnT from T_1 to T_2:

$\ln (\kappa_1 / \kappa_2) = \ln (T_2 / T_1)$

Taking $\ln^{-1}$ on both sides we get:

$(\kappa_1 / \kappa_2) = (T_2 / T_1)$

Which means: κ_1 is proportional to $1/ T_1$ and κ_2 is proportional to $1/ T_2$.

In general, κ is proportional to 1/ T which means: higher the temperature, lower the value of transmission coefficient. Lower the value of transmission coefficient, the fraction of the concentration of activated complex crossing forward to yield the products will be less. Lesser the concentration of activated complex crossing forward to yield the products, slower is the rate of reaction.

CONCLUSION: with the increase in temperature, the rate of reaction decreases.

EXPERIMENTAL OBSERVATION: The rate of reaction always increases with temperature. But in the case of enzyme catalyzed reactions, the rate increases with temperature up to certain level (corresponding to optimum temperature) after which the rate decreases with the increase in temperature.

Note: In the absence of information to the contrary, κ is assumed to be about 1. κ =1 implies no activated complex reverts back to the reactants (i.e., the activated complex always proceeds to products and never reverts back to reactants) and this assumption nullifies the description of equilibrium between the activated complex and the reactants and invalidates the quasi or rapid pre-equilibrium assumption.

Compton Effect

In physics, we define the kinetic energy of an object to be equal to the work done by an external impulse to increase velocity of the object from zero to some value v. That is,

$KE = J \times v$

Impulse applied to an object produces an equivalent change in its linear momentum. The impulse J may be expressed in a simpler form:

$J = \Delta p = p_2 - p_1$

where p_2 = final momentum of the object = mv and p_1 = initial momentum of the object = 0 (assuming that the object was initially at rest).

Impulse = mv

$KE = mv^2$

In relativistic mechanics, we define the total energy of a particle to be equal to the sum of its rest mass energy and kinetic energy. That is, Total energy = rest energy + kinetic energy

$mc^2 = m_0c^2 + KE$

Solving $KE = mv^2$ we get:

$m = m_0/ (1- v^2/c^2)$

But according to Albert Einstein's law of variation of mass with velocity,

$m = m_0 / (1- v^2/c^2)^{½}$

$m = m_0/ (1- v^2/c^2)^{½}$ implies transverse mass

$m = m_0/ (1- v^2/c^2)^{3/2}$ implies longitudinal mass

$m = m_0/ (1- v^2/c^2) \rightarrow ?$

But according to the above equations: When v=c, m approaches infinity and if v>c, then m becomes imaginary i.e., these equations restrict body to move with speed equal or more than c.

Draft of letter from Bohr to Heisenberg, never sent.

In the handwriting of Niels Bohr's assistant, Aage Petersen.

Undated, but written after the first publication, in 1957, of the Danish translation of Robert Jungk, Heller als Tausend Sonnen, the first edition of Jungk's book to contain Heisenberg's letter

Dear Heisenberg,

I have seen a book, "Stærkere end tusind sole" ["Brighter than a thousand suns"] by Robert Jungk, recently published in Danish, and I think that I owe it to you to tell you that I am greatly amazed to see how much your memory has deceived you in your letter to the author of the book, excerpts of which are printed in the Danish edition [1957].

Personally, I remember every word of our conversations, which took place on a background of extreme sorrow and tension for us here in Denmark. In particular, it made a strong impression both on Margrethe and me, and on everyone at the Institute that the two of you spoke to, that you and Weizsäcker expressed your definite conviction that Germany would win and that it was therefore quite foolish for us to maintain the hope of a different outcome of the war and to be reticent as regards all German offers of cooperation. I also remember quite clearly our conversation in my room at the Institute, where in vague terms you spoke in a manner that could only give me the firm impression that, under your leadership, everything was being done in Germany to develop atomic weapons and that you said that there was no need to talk about details since you were completely familiar with them and had spent the past two years working more or less exclusively on such preparations. I listened to this without speaking since [a] great matter for mankind was at issue in which, despite our personal friendship, we had to be regarded as representatives of two sides engaged in mortal combat. That my silence and gravity, as you write in the letter, could be taken as an expression of shock at your reports that it was possible to make an atomic bomb is a quite peculiar misunderstanding, which must be due to the great tension in your own mind. From the day three years earlier when I realized that slow neutrons could only cause fission in Uranium 235 and not 238, it was of course obvious to me that a bomb with certain effect could be produced by separating the uraniums. In June 1939 I had even given a public lecture in Birmingham about uranium fission, where I talked about the effects of such a bomb but of course added that the technical preparations would be so large that one did not know how soon they could be overcome. If anything in my behaviour could be interpreted as shock, it did not derive from such reports but rather from the news, as I had to understand it, that Germany was participating vigorously in a race to be the first with atomic weapons.

Besides, at the time I knew nothing about how far one had already come in England and America, which I learned only the following year when I was able to go to England after being informed that the German occupation force in Denmark had made preparations for my arrest.

All this is of course just a rendition of what I remember clearly from our conversations, which subsequently were naturally the subject of thorough discussions at the Institute and with other trusted friends in Denmark. It is quite another matter that, at that time and ever since, I have always had the definite impression that you and Weizsäcker had arranged the symposium at the German Institute, in which I did not take part myself as a matter of principle, and the visit to us in order to assure yourselves that we suffered no harm and to try in every way to help us in our dangerous situation.

This letter is essentially just between the two of us, but because of the stir the book has already caused in Danish newspapers, I have thought it appropriate to relate the contents of the letter in confidence to the head of the Danish Foreign Office and to Ambassador Duckwitz.

Compton Effect-- An effect published in the Physical Review that explained the x-ray shift by attributing particle-like momentum to light quanta – discovered by American physicist Arthur Compton in early 1920s at Washington University in St. Louis, which amply confirmed the particle behavior of photons at a time when the corpuscular nature of light suggested by photoelectric effect was still being debated. This effect is suggested that when an x-ray quantum of energy hυ and a momentum h/ λ interacts with an electron in an atom, which is treated as being at rest with momentum = 0 and energy equal to its rest energy, m_0c^2. The symbols h, υ, and λ are the standard symbols used for Planck's constant, the photon's frequency, its wavelength, and m_0 is the rest mass of the electron. In the interaction, the x- ray photon is scattered in the direction at an angle θ with respect to the photon's incoming path with momentum h/λ_s and energy $h\upsilon_s$. The electron is scattered in the direction at an angle φ with respect to the photon's incoming path with momentum mv and energy mc^2 (where m is the total mass of the electron after the interaction). The phenomenon of Compton scattering may be analyzed as an elastic collision of a photon with a free electron using relativistic mechanics. Since the energy of the photons (661. 6 keV) is much greater than the binding energy of electrons (the most tightly bound electrons have a binding energy less than 1 keV), the electrons which scatter the photons may be considered free electrons. Because energy and momentum must be conserved in an elastic collision, we can obtain the formula for the wavelength of the scattered photon, λ_s as a function of scattering angle θ: $\lambda_s = \{(h/m_0c) \times (1-\cos\theta) + \lambda\}$ where λ is the wavelength of the incident photon, c is the speed of light in vacuum and (h/m_0c) is λ_C the Compton wavelength of the electron (which characterizes the length scale at which the wave property of an electron starts to show up. In an interaction that is characterized by a length scale larger than the Compton wavelength, electron behaves classically (i.e., no observation of wave nature). For interactions that occur at a length scale comparable than the Compton wavelength, the wave nature of the electron begins to take over from classical physics).

$\lambda_s = \lambda_C (1- \cos\theta) + \lambda$

$\lambda_C = (\lambda_s - \lambda) / (1- \cos\theta)$

It has been experimentally observed that for $\theta = 0^o$ there is no change in wavelength of the incident photon (i.e., $\lambda_s = \lambda$). Under this condition the Compton wavelength of the electron (which is $= 2.42 \times 10^{-12}$ m) becomes undefined i.e.,

$\lambda_C = 0/0$.

The rate of transfer of photon energy to the electron i.e., $-$ (dE/dt), is given by the relation: $-(dE/dt) = h\upsilon^2$, where $E = h\upsilon$. But $\upsilon = c/\lambda$. Therefore:

$d\lambda = c \times dt$

Integrating over $d\lambda$ from λ (the wavelength of the incident photon) to λ_s (the wavelength of the scattered photon), and over dt from zero to t:

$(\lambda_s - \lambda) = c \times t$

Since $\lambda_s - \lambda = h/m_0c \times (1- \cos\theta)$ – which Arthur Compton derived in his paper "A Quantum Theory of the Scattering of x-rays by Light Elements" by assuming that each scattered x-ray photon interacted with only one electron. Therefore:

$t = h/m_0c^2 \times (1- \cos\theta)$

For $\theta = 0^o$: $t = 0$ (i.e., scattering process is instantaneous at $\theta = 0^o$). Under this condition h/m_0c^2 becomes undefined i.e., $h/m_0c^2 = 0/0$.

Velocities of recoil of the scattering electrons have not been experimentally determined. This is probably because the electrons which recoil in the process of the scattering of x-ray photons have not been observed. However, velocity of recoil of the scattering electrons can be calculated using the

- Law of Conservation of Energy.
- Law of Conservation of Momentum.

The conservation of energy merely equates the sum of energies before and after scattering i.e., the energy of the x-ray photon, $h\upsilon$, and the rest energy of the electron, m_0c^2, before scattering is equal to the energy of the scattered x-ray photon, $h\upsilon_s$, and the total energy of the electron, mc^2, after scattering i.e.,

$h\upsilon + m_0c^2 = h\upsilon_s + mc^2$

or

$(h\upsilon - h\upsilon_s) = mc^2 - m_0c^2$

But according to law of variation of mass with velocity (which states that mass and energy are "only different expressions of the same thing," even though mass is a relativistic invariant, i.e., a four-dimensional scalar, while energy is the fourth component of a four-dimensional vector),

$mc^2 = m_0c^2 / (1- v^2/c^2)^{½}$

Therefore:

$(h\upsilon - h\upsilon_s) = m_0c^2 \{1 / (1- v^2/c^2)^{½} - 1\}$

For $\theta = 90^o$

$h\upsilon = 28.072 \times 10^{-36}$ Joules, $h\upsilon_s = 27.226 \times 10^{-36}$ Joules

Therefore:

$(28.072 \times 10^{-36} - 27.226 \times 10^{-36}) = m_0c^2 \{1 / (1- v^2/c^2)^{½} - 1\}$

$(28.072 \times 10^{-36} - 27.226 \times 10^{-36}) = 81.9 \times 10^{-15} \times \{1 / (1- v^2/c^2)^{½} - 1\}$

$(28.072 - 27.226) \times 10^{-36} = 81.9 \times 10^{-15} \times \{1/ (1- v^2/c^2)^{½} - 1\}$

$(0.846 \times 10^{-36} / 81.9 \times 10^{-15}) + 1 = 1/ (1- v^2/c^2)^{½}$

$[1.0329 \times 10^{-23} + 1] = 1/ (1- v^2/c^2)^{½}$

Since: $1.0329 \times 10^{-23} <<<< 1$. Therefore: $[1.0329 \times 10^{-23} + 1] \approx 1$

$1 = 1/ (1- v^2/c^2)^{½}$

From this it follows that

v = 0 (illogical and meaningless result because v = 0.04 c – which is shown below).

The principle of the conservation of momentum accordingly demands that the momentum of recoil of the scattering electron shall equal the vector difference between the momenta of these photons. The momentum of the electron, $p_e = m_0cv/ (c^2 - v^2)^{½}$, is thus given by the relation

$m_0^2 c^2v^2/ (c^2 - v^2) = p^2 + p_s^2 - 2pp_s \cos\theta$

Solving $p^2 = (h / \lambda)^2 = 87.553 \times 10^{-48}$ J^2s^2/m^2, $p_s^2 = (h / \lambda_s)^2 = 82.355 \times 10^{-48}$ J^2s^2/m^2 and $\theta = 90^o$, we get:

$m_0^2 c^2v^2/ (c^2 - v^2) = (p^2 + p_s^2)$

$m_0^2 c^2v^2/ (c^2 - v^2) = (87.553 + 82.355) \times 10^{-48}$

$m_e^2 c^2v^2/ (c^2 - v^2) = 169.908 \times 10^{-48}$ J^2s^2/m^2

But $m_0^2c^2 = 745.29 \times 10^{-46}$ J^2. Therefore:

$v^2/ (c^2 - v^2) = (169.908 \times 10^{-48} / 745.29 \times 10^{-46}) = 2.279 \times 10^{-3}$

$v^2 = 2.279 \times 10^{-3}c^2 - 2.279 \times 10^{-3}v^2$

$v^2 (1 + 2.279 \times 10^{-3}) = 2.279 \times 10^{-3}c^2$

From this it follows that

v = 0.04c

From the experimental data of the Compton Effect we know that:

For the scattering angle $\theta = 135^o$ and the wavelength of the incident photon 0.0709nm, the wavelength of the scattered photon was found to be 0.0749nm.

For the scattering angle $\theta = 90^o$ and the wavelength of the incident photon 0.0709nm, the wavelength of the scattered photon was found to be 0.0731nm.

For the scattering angle $\theta = 45^o$ and the wavelength of the incident photon 0.0709nm, the wavelength of the scattered photon was found to be 0.0715nm.

For the scattering angle $\theta = 135^o$ and the wavelength of the incident photon 0.0709nm, the wavelength of the scattered photon was found to be 0.0749nm.

The energy of the incident photon $E = hc/\lambda = (6.625 \times 10^{-34} \times 3 \times 10^8) / 0.0709 \times 10^{-9} = 280.324 \times 10^{-17}$ J.

The energy of the incident photon $E_s = hc/\lambda_s = (6.625 \times 10^{-34} \times 3 \times 10^8) / 0.0749 \times 10^{-9} = 265.353 \times 10^{-17}$ J.

From the law of conservation of energy,

$E + m_0c^2 = E_s + mc^2$

$mc^2 - m_0c^2 = (E - E_s) = 14.971 \times 10^{-17}$ J.

Which on rearranging we get:

$mc^2 = m_0c^2 + 14.971 \times 10^{-17}$ J.

$mc^2 = (9.1 \times 10^{-31} \times 9 \times 10^{16})$ J $+ 14.971 \times 10^{-17}$ J $= 82.049 \times 10^{-15}$ J

$m = 82.049 \times 10^{-15} / c^2 = 9.1165 \times 10^{-31}$kg … (1)

From the law of conservation of momentum,

$p_e^2 = p^2 + p_s^2 - 2p\,p_s \cos\theta$

$p = h/\lambda = 6.625 \times 10^{-34} / 0.0709 \times 10^{-9} = 93.441 \times 10^{-25}$ Js/m

$p_s = h/\lambda_s = 6.625 \times 10^{-34} / 0.0749 \times 10^{-9} = 88.451 \times 10^{-25}$ Js/m

$\theta = 135^o$

$p_e^2 = 28243.06 \times 10^{-50}$ J ^{2}s ^{2}/m^2

$p_e = 168.0567 \times 10^{-25}$ Js /m

In physics, we find out that momentum is mass multiplied by velocity. Special relativity (which overturned the understanding of space and time: space and time cannot be thought of as universal concepts experienced identically by everyone but they are malleable constructs whose form and appearance depends on one's state of motion) has something to say about momentum. In particular, special relativity gets its $(1- v^2/c^2)^{½}$ factor into the momentum mix like this: $p_e = m_0v / (1- v^2/c^2)^{½}$. For non-relativistic case: v << c. Therefore, we have

$p_e = m_0v$

Suppose the particle is brought to rest, then ($v = 0$, $p_e = 0$). Under this condition the rest mass of the particle becomes undefined i.e.,

$m_0 = p_e/v = 0/0$

There can be no bigger limitation than this because m_0 cannot be undefined (it is always well defined).

However, substituting $m = 9.1165 \times 10^{-31}$kg and $p_e = 168.0567 \times 10^{-25}$ Js /m in the equation $p_e = mv$, we get:

$v = 18.434 \times 10^6$ m/s

Substituting this value in the equation $m = m_0 / (1 - v^2/c^2)^{½}$, we get:

$m = 9.1172 \times 10^{-31}$kg … (2)

From (1)

$m = 9.1165 \times 10^{-31}$kg

From (2)

$m = 9.1172 \times 10^{-31}$kg

Difference $= 7 \times 10^{-4}$

For the scattering angle θ = 90° and the wavelength of the incident photon 0.0709nm, the wavelength of the scattered photon was found to be 0.0731nm.

The energy of the incident photon $E = hc/\lambda = (6.625 \times 10^{-34} \times 3 \times 10^8) / 0.0709 \times 10^{-9} = 280.324 \times 10^{-17}$ J.

The energy of the incident photon $E_s = hc/\lambda_s = (6.625 \times 10^{-34} \times 3 \times 10^8) / 0.0731 \times 10^{-9} = 271.887 \times 10^{-17}$ J.

From the law of conservation of energy,

$E + m_0c^2 = E_s + mc^2$

$mc^2 - m_0c^2 = (E - E_s) = 8.437 \times 10^{-17}$ J.

Which on rearranging we get:

$mc^2 = m_0c^2 + 8.437 \times 10^{-17}$ J

$mc^2 = (9.1 \times 10^{-31} \times 9 \times 10^{16})$ J $+ 8.437 \times 10^{-17}$J

$mc^2 = 81.984 \times 10^{-15}$ J

$m = 81.984 \times 10^{-15} / c^2 = 9.10933 \times 10^{-31}$kg … (1)

From the law of conservation of momentum,

$p_e^2 = p^2 + p_s^2 - 2pp_s\cos\theta$

$p = h/\lambda = 6.625 \times 10^{-34} / 0.0709 \times 10^{-9} = 93.441 \times 10^{-25}$ Js/m

$p_s = h/\lambda_s = 6.625 \times 10^{-34} / 0.0731 \times 10^{-9} = 90.629 \times 10^{-25}$ Js/m

$\theta = 90^o$

$p_e^2 = 16944.83 \times 10^{-50}$ J ^{2}s ^{2}/m^2

$p_e = 130.172 \times 10^{-25}$ Js /m

Substituting $m = 9.10933 \times 10^{-31}$kg and $p = 130.172 \times 10^{-25}$ Js /m in the equation $p_e = mv$, we get:

$v = 14.2899 \times 10^6$ m/s

Substituting this value in the equation $m = m_0 / (1 - v^2/c^2)^{½}$, we get:

$m = 9.11033 \times 10^{-31}$kg … (2)

From (1)

$m = 9.10933 \times 10^{-31}$kg

From (2)

$m = 9.11033 \times 10^{-31}$kg

Difference $= 1 \times 10^{-3}$

For the scattering angle θ = 45° and the wavelength of the incident photon 0.0709nm, the wavelength of the scattered photon was found to be 0.0715nm.

The energy of the incident photon $E = hc/\lambda = (6.625 \times 10^{-34} \times 3 \times 10^8) / 0.0709 \times 10^{-9} = 280.324 \times 10^{-17}$ J.

The energy of the incident photon $E_s = hc/\lambda_s = (6.625 \times 10^{-34} \times 3 \times 10^8) / 0.0715 \times 10^{-9} = 277.972 \times 10^{-17}$ J.

From the law of conservation of energy,

$E + m_0c^2 = E_s + mc^2$

$mc^2 - m_0c^2 = (E - E_s) = 2.352 \times 10^{-17}$ J.

Which on rearranging we get:

$mc^2 = m_0c^2 + 2.352 \times 10^{-17}$ J.

$mc^2 = (9.1 \times 10^{-31} \times 9 \times 10^{16})$ J $+ 2.352 \times 10^{-17}$ J

$mc^2 = 81.923 \times 10^{-15}$ J

$m = 81.923 \times 10^{-15} / c^2 = 9.10255 \times 10^{-31}$kg … (1)

From the law of conservation of momentum,

$p_e^2 = p^2 + p_s^2 - 2pp_s\cos\theta$

$p = h/\lambda = 6.625 \times 10^{-34} / 0.0709 \times 10^{-9} = 93.441 \times 10^{-25}$ Js/m

$p_s = h/\lambda_s = 6.625 \times 10^{-34} / 0.0715 \times 10^{-9} = 92.657 \times 10^{-25}$ Js/m

$\theta = 45^o$

$p_e^2 = 5072.386 \times 10^{-50}\ J^2s^2/m^2$

$p_e = 71.220 \times 10^{-25}$ Js/m

Substituting $m = 9.10255 \times 10^{-31}$kg and $p = 71.220 \times 10^{-25}$ Js/m in the equation $p_e = mv$, we get:

$v = 7.824 \times 10^6$ m/s

Substituting this value in the equation $m = m_0 / (1 - v^2/c^2)^{1/2}$, we get:

$m = 9.10034 \times 10^{-31}$kg … (2)

From (1)

$m = 9.10255 \times 10^{-31}$kg

From (2)

$m = 9.10034 \times 10^{-31}$kg

Difference $= 2.21 \times 10^{-3}$

CONCLUSION:

For the scattering angle $\theta = 135^o$:

$m = 9.1165 \times 10^{-31}$kg … (1)

$m = 9.1172 \times 10^{-31}$kg … (2)

$m = 9.1165 \times 10^{-31}$kg … (1) is **less than** $m = 9.1172 \times 10^{-31}$kg … (2)

For the scattering angle $\theta = 90^o$:

$m = 9.10933 \times 10^{-31}$kg … (1)

$m = 9.11033 \times 10^{-31}$kg … (2)

$m = 9.10933 \times 10^{-31}$kg … (1) is **less than** $m = 9.11033 \times 10^{-31}$kg … (2)

However,

For the scattering angle $\theta = 45^o$:

$m = 9.10255 \times 10^{-31}$kg … (1)

$m = 9.10034 \times 10^{-31}$kg … (2)

$m = 9.10255 \times 10^{-31}$kg … (1) is **greater than** $m = 9.10034 \times 10^{-31}$kg … (2) But WHY? The question lingers, unanswered until now.

As we know that:

$KE = mv^2$

But $KE = E - E_s$. Therefore:

$mv^2 = E - E_s$

or

$p_e^2v^2 = (E - E_s)^2$

or

$p_e^2v^2 = E^2 + E_s^2 - 2\,E\,E_s$

But

$p_e^2 = p^2 + p_s^2 - 2pp_s\cos\theta$

or

$p_e^2c^2 = E^2 + E_s^2 - 2\,E\,E_s\cos\theta$

Therefore:

$p_e^2v^2 / p_e^2c^2 = (E^2 + E_s^2 - 2\,E\,E_s) / (E^2 + E_s^2 - 2\,E\,E_s\cos\theta)$

or

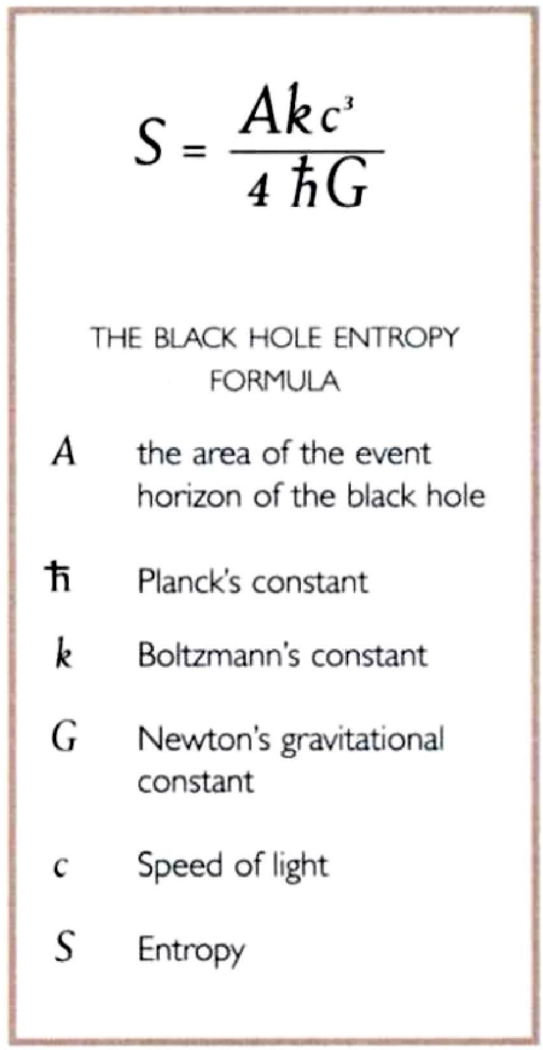
$v^2/c^2 = (E^2 + E_s^2 - 2\,E\,E_s) / (E^2 + E_s^2 - 2\,E\,E_s\cos\theta)$

From the above equation it is clear that if $\theta = 0^o$ then $v = c$ (which is a wrong and meaningless result because when $\theta = 0^o$ there is no change in frequency / wavelength of the incident photon i.e., absorption of photon energy does not take place then how can the electron be accelerated to the velocity $v = c$).

"Science is uncertain. Theories are subject to revision; observations are open to a variety of interpretations, and scientists quarrel amongst themselves. This is disillusioning for those untrained in the scientific method, who thus turn to the rigid certainty of the Bible instead. There is something comfortable about a view that allows for no deviation and that spares you the painful necessity of having to think."

— Isaac Asimov

We know that virtual photon is to electromagnetism; why not to gravity?



Nuclear Density

Mass of the neutron, $m_{neutron} = 1.6750 \times 10^{-27}$ kg

Mass of the proton, $m_{Proton} = 1.6726 \times 10^{-27}$ kg

$M_{neutron} / m_{Proton} = 1.00143$

Nuclear density = mass of the nucleus / its volume

$\rho_{Nucleus} = M/V$

But

$M = (Zm_{Proton} + Nm_{neutron})$

$V = (4/3)\,\pi r_0^3 A$

(where: Z = number of protons in the nucleus, N = number of neutrons in the nucleus, $R_0 = 1.2 \times 10^{-15}$m, A = Z +N)

Therefore:

$\rho_{Nucleus} = 3m_{Proton}\,(Z + 1.00143N) / 4\pi r_0^3 A$

Which on rearranging:

$A = (3m_{Proton} / 4\pi\, R_0^3 \rho_{Nucleus})\, Z + (3.00429m_{Proton} / 4\pi\, R_0^3 \rho_{Nucleus})\, N$

Since A = (Z + N):

$(Z + N) = (3m_{Proton} / 4\pi r_0^3 \rho_{Nucleus})\, Z + (3.00429m_{Proton} / 4\pi r_0^3 \rho_{Nucleus})\, N$

Any equation is valid only if LHS = RHS. Hence the above equation is valid only if Z + N = Z +N.

Z + N = Z +N is achieved only if $\rho_{Nucleus}$ attains 2 values i.e.,

$\rho_{Nucleus} = 3m_{Proton} / 4\pi\, R_0^3$ and $\rho_{Nucleus} = 3.00429m_{Proton} / 4\pi\, R_0^3$ at the same time. But how $\rho_{Nucleus}$ can attain 2 values at the same time? It's highly impossible.

Hawking Radiation

"The area formula for the entropy — or number of internal states — of a black hole suggests that information about what falls into a black hole may be stored like that on a record, and played back as the black hole evaporates."

"There is no escape from a black hole in classical theory, but quantum theory enables energy and information to escape."

: Stephen Hawking

When stars are born, they form from existing gas dust of large amount of gas (mostly hydrogen). This is called interstellar matter. When cloud of interstellar matter crosses the spiral arm of a galaxy, it begins to form clumps. The gravitational forces within the clumps cause them to contract, forming protostar. The center of a protostar may reach a temperature of a several million of degree Celsius. At this high temperature, a fusion reaction begins. The energy released by this reaction prevents the protostar to contract. Thus, a star has been formed. There are so many stages of a star from its birth to death. The black hole is the final stage of dying star having masses 5 times the solar mass – 20 times the solar mass i.e., the star shrink to a certain critical radius, the gravitational field at the surface becomes so strong that the light cones are bent inward so much that light can no longer escape to reach a distant observer. Thus if light cannot escape, neither can anything else; everything is dragged back by the gravitational field. However, slow leakage of radiation from a black hole is allowed by quantum field effects near the event horizon (the boundary of a black hole where gravity is just strong enough to drag light back, and prevent it escaping) which will carry away energy, which mean that the black hole will lose mass and get smaller. In turn, this will mean that its temperature will rise and the rate of emission of radiation will increase (giving off x-rays and gamma rays, at a rate of about ten million Megawatts, enough to power the world's electricity supply). It is named after the renowned English physicist Stephen Hawking, who provided a theoretical argument for its existence in 1974).

The rate of loss of energy of a black hole in the form of Hawking radiation (which make black hole to glow like a piece of hot metal) is given by the equation:

$-\,dMc^2/dt = \hbar c^6/\, 15360\pi G^2 M^2$

Since the black hole temperature $T = (\hbar c^3 / 8\pi GMk_B)$. Therefore:

$dT/dt = (k_B^3 G\pi^2/30\hbar c^5)\, T^4$

or

$dT/dt = bt^4$

where: $b = (k_B^3 G\pi^2/30\hbar c^5) = 1.629 \times 10^{-65}$ Kelvin^{-3} second^{-1}

On rearranging:

$dt\, T^{-4} = b \times dt$

which on integration we get:

$-\,1/\,3T^3 = bt + \text{constant}$

$T = T_1$ (initial temperature of the black hole) when t = 0

$-\,1/\,3T_1^3 = b\,(0) + \text{constant}$

$-\,1/\,3T_1^3 = \text{constant}$

Solving for constant we get:

$-1/\,3T^3 = bt - 1/\,3T_1^3$

$T = T_2$ when t = half of the evaporation time i.e., $t_{ev}/2$ (where t_{ev} = evaporation time of the black hole).

$-1/\,3T_2^3 = bt_{ev}/2 - 1/\,3T_1^3$

or

$1/\,3T_2^3 = 1/\,3T_1^3 - bt_{ev}/2$

For a black hole of initial mass = one solar mass (i.e., $M = 2 \times 10^{30}$kg):

$t_{ev} = 6.7396 \times 10^{74}$ s

$T_1 = 6.156 \times 10^{-8}$ K

$1/\,3\,T_2^3 = 1/3 \times (6.156 \times 10^{-8})^3 - (1.629 \times 10^{-65} \times 3.369 \times 10^{74})$

$1/\,3\,T_2^3 = 1.4288 \times 10^{21} - 5.4894 \times 10^{9}$

or

$T_2 = 6.156 \times 10^{-8}$ K

From the above calculation it is clear that: $T_1 = T_2$ i.e., temperature of the black hole when t = 0 is equal to the temperature of the black hole when t= $t_{ev}/2$. This means: T remains constant throughout the evaporation process.

If T remains constant throughout the evaporation process, then from the equation:

$T = \hbar c^3/\, 8\pi GMk_B$

M must remain constant throughout the evaporation process. But how can M remain constant because M varies throughout the evaporation process because the black hole loses its mass throughout its evaporation process.

A virtual-particle pair has a wave function that predicts that both particles will have opposite spins. But if one particle falls into the black hole, it is impossible to predict with certainty the spin of the remaining particle.

− S. W. Hawking

Black holes have no Hair, says no hair Theorem: Wait, What? Characterizing the black hole

The answer is then simple.

Mass, Charge and Angular momentum.

As photon travel near the event horizon of a black hole they can still escape being pulled in by gravity of a black hole (which is created when particularly massive star use up all its fuel and collapse inwardly to form super-dense object, much smaller than the original star. Only very large star end up as black hole. Smaller star don't collapse that far; it often end up as neutron star instead) by traveling at a vertical direction known as exit cone. A photon on the boundary of this cone will not completely escape the gravity of the black hole. Instead it orbits the black hole. For a photon of mass m orbiting the black hole, the necessary centripetal force mv^2/r is provided by the force of gravitation between the black hole and the photon GMm/r^2. Therefore:

$$mv^2/r = GMm/r^2$$

where: m = mass of the photon orbiting the black hole of mass M in a circular orbit of radius r and G is the gravitational constant.

Since photon always travels with a speed equal to c. Therefore:

$$v = c$$

$$mc^2/r = GMm/r^2$$

or

$$r = GM/c^2$$

Since $R_G = 2GM/c^2$ (where R_G = radius of the black hole). Therefore:

$$r = R_G/2$$

WHICH MEANS:

$r < R_G$ i.e., photon orbit exist inside the black hole.

The photon orbit of radius r always exists in the space surrounding an extremely compact object such as a black hole. Hence r should be > R_G. Therefore, it is clear that the condition $mv^2/r = GMm/r^2$ not always holds well. However, the image we often see of photons as a tiny bit of light circling a black hole in well-defined circular orbit of radius $r = 3GM/c^2$ (where G = Newton's universal constant of gravitation, c = speed of light in vacuum and M = mass of the black hole) is actually quite interesting.

The angular velocity of the photon orbiting the black hole is given by:

$$\omega = c/r.$$

For circular motion the angular velocity is the same as the angular frequency. Thus

$$\omega = c/r = 2\pi c/\lambda$$

or

$$\lambda = 2\pi r$$

Since Einstein's $E=mc^2$ relates mass to energy and Planck's $E = h\upsilon$ energy to the frequency of light waves, therefore, by combining the two, photon mass should have a wave-like incarnation as well (exhibit interference phenomena - the telltale sign of waves). The De Broglie wavelength λ associated with the photon of mass m orbiting the black hole is given by Planck's constant divided by the photon's momentum): $\lambda= h/mc$. Therefore: $r = \hbar/mc$, where ħ is the reduced Planck constant (since ħ is so small, the resulting photon wavelength is similarly minuscule compared with everyday scales - that is why the wavelike character of photon is directly apparent only upon careful microscopic investigation). The photon must satisfy the condition $r = \hbar/mc$ much like an electron moving in a circular orbit. Since this condition forces the photon to orbit the hole in a circular orbit.

$$r = 3GM/c^2 = \hbar/mc$$

or

$$3GM/c^2 = \hbar/mc$$

or

$$3mM = (\text{Planck mass})^2$$

Because of this condition the photons orbiting the small black hole carry more mass than those orbiting the big black hole. For a black hole of one Planck mass (M = Planck mass),

$$m = 1/3 \times \text{Planck mass}$$

Since a black hole possess a nonzero temperature (no matter how small) the most basic and well-established physical principles would require it to emit radiation, much like a glowing poker. Therefore: the maximum energy an emitted radiation photon can possess is given by the equation:

L_{max} = 2.821 k_BT (where k_B = Boltzmann constant and T = black hole temperature = $\hbar c^3$ / $8\pi GM$).

$L_{max} = 2.821\ k_BT$

or

$L_{max} = 2.821\ (\hbar c^3 / 8\pi GM)$

which on rearranging:

$GM / c^2 = 2.821\ (\hbar c / 8\pi L_{max})$

Since $3GM/c^2 = \hbar/mc$. Therefore:

$\hbar/ 3mc= 2.821\ (\hbar c / 8\pi L_{max})$

or

$mc^2 = 2.968L_{max}$

which means: $mc^2 > L_{max}$

If a photon with energy mc^2 orbiting the black hole can't slip out of its influence, and so how can a Hawking radiation photon with maximum energy $L_{max} < mc^2$ is emitted from the event horizon of the Schwarzschild black hole (the edge of a black hole; the boundary of the region from which it is not possible to escape to infinity)?

$F_{Gravity}$ = force of gravitation experienced by the radiation photon at the surface of the black hole and F_{Photon} = force which moves the radiation photon.

$F_{Gravity} = GMm/ R_G^2$ and $F_{Photon} = mc^2 / \lambda$ (where G = Newton's universal constant of gravitation, c = speed of light in vacuum and M = mass of the black hole, m and λ = mass and wavelength of the radiation photon, $R_G = 2GM/c^2$ (the radius of the black hole).

$F_{Gravity} / F_{Photon} = c^2 \lambda/4GM$

In MOST PHYSICS literature the energy of an emitted radiation photon is given by the equation: $L = k_BT$ (where k_B = Boltzmann constant and T = black hole temperature).

$L = k_BT = (\hbar c^3 / 8\pi GM)$

By Planck's energy-frequency relationship:

$L = hc/\lambda$

Hence:

$hc/\lambda = (\hbar c^3 / 8\pi GM)$ which on rearranging:

$\lambda= 16\pi^2GM/c^2$

Solving for λ in the equation ($F_{Gravity} / F_{Photon} = c^2 \lambda/4GM$) we get:

$F_{Gravity} / F_{Photon} = 16\pi^2/ 4 = 39.43$

$F_{Gravity} = 39.43\ F_{Photon}$

Which means: $F_{Gravity} > F_{Photon}$

If the photon wants to detach from the surface of the black hole − (which is called its horizon, because someone outside the horizon can't see what happens inside. That's because seeing involves light, and no light can get out of a black hole) − it should obey the condition:

$F_{Gravity} = F_{Photon}$

$GMm/R_G{}^2 = mc^2/\lambda$

(where R_G = radius of the black hole = $2GM/c^2$)

i.e., $\lambda = 2\ R_G$ (wavelength of the photon should be twice the radius of the black hole) or $F_{Photon} > F_{Gravity}$. Because $F_{Gravity}$ is > F_{Photon}, it is hard to claim the emission of radiation photon from the Schwarzschild black hole. However, Hawking radiation (a quantum phenomenon that leads to the eventual evaporation of an isolated black hole) has not been observed after over two decades of searching. Despite its strong theoretical foundation (i.e., it is widely regarded as one of the first real steps toward a quantum theory of gravity and allows physicists to define the entropy of a black hole), the existence of this effect is still in question and we have indirect observational evidence for this effect, and that evidence comes from the early universe. And looking at the unusual nature of Hawking radiation; it may be natural to question if such radiation exists in nature or to suggest that it is merely a theoretical solution to the hidden world of quantum gravity. However, if Schwarzschild black hole (which is indeed black body, absorbing everything that falls on them) does not emit any radiation, then it will continue to grow by absorbing surrounding matter and radiation. This would mean that the black hole would gain energy (and therefore mass by $E=Mc^2$). Because $Mc^2 = -3.33U$, the gravitational binding energy becomes more negative with the increase in energy Mc^2 of the black hole to shrink the black hole in size. And if we regard the nature of gravitational force so developed is similar to inter-molecular force. The gravitational force is attractive up to some extent [i.e., it is attractive until the distance between the constituents of the black hole is greater than or equal to the optimum distance (x A°)] and when distance between the constituents of the black hole becomes < than x A° it turns to a strong repulsive force. As the gravitational binding energy of the black hole become more negative, the distance between the constituents of the black hole decreases. As long as the distance between the constituents of the black hole is optimum, there is no considerable repulsion between the constituents. When the distance between the constituents of the black hole is further decreased i.e., the distance between the constituents of the black hole becomes < than x A° and then at this stage, the singularity of the black hole may explode with unimaginable force, propelling the compressed matter into space. This matter then may condense into the stars, planets, and satellites that make up solar systems like our own. But perhaps not very scientific since no observational evidence available but still a nice mind exercise. However, if this is confirmed by observation, it will be the successful conclusion of a search going back more than 3,000 years. We will have found the grand design that we hope we will feel cheated that we hadn't known about them until now − which no longer leaves omnipotent God (who play a central role in the operations of the universe and in the lives of humans) pretty much on the bench of philosophers and theologians for a long, long time −

no need to offer an explanation for questions like: "What was God doing before the divine creation? Was he preparing hell for people who asked such questions?"

Would the tidal forces kill an astronaut?

Since gravity weakens with distance, the earth pulls on your head with less force than it pulls on your feet, which are a meter or two closer to the earth's center. The difference is so tiny we cannot feel it, but an astronaut near the surface of a black hole would be literally torn apart.

The entropy of the black hole is given by the equation: $S_{BH} = c^3 k_B A / 4\hbar G$, where c = speed of light in vacuum, k_B = Boltzmann constant, ħ = Planck's constant, G = gravitational constant and A = area of the event horizon.

Since $A = 4\pi R_g^2 = 4\pi (2GM/c^2)^2$. Therefore:

$S_{BH} = 4\pi k_B GM^2 / \hbar c$

Differentiating the above equation we get:

$dS_{BH} = (8\pi k_B GM / \hbar c)\, dM$

$dS_{BH} = (8\pi k_B GM / \hbar c^3)\, dMc^2$

But $T = \hbar c^3/8\pi k_B GM$. Therefore:

$T \times dS_{BH} = dMc^2$

The rate of increase of black hole energy due to the absorption of energy from the surroundings is given by the equation:

$R_1 = dMc^2 /dt = T \times (dS_{BH} /dt)$

Suppose black hole absorbs no energy from the surroundings, then

$R_1 = 0$

(dS_{BH} /dt) which is the rate of increase of black hole entropy = 0

$T = \{R_1 / (dS_{BH} /dt)\} = 0/0$ i.e., in order to maintain a well-defined temperature black hole must absorb energy from the surroundings.

As we know that: mass energy of the black hole is = the twice its entropic energy

$Mc^2 = 2\, T \times S_{BH}$

Differentiating the above equation we get: $dMc^2 = 2\, (T \times dS_{BH} + dT \times dS_{BH})$

Since $T \times dS_{BH} = dMc^2$. Therefore:

$dMc^2 = 2\, (dT \times S_{BH}) + 2dMc^2$

$- dMc^2 = 2\, (S_{BH} \times dT)$

The rate of decrease of black hole energy due to the emission of energy in the form of Hawking radiation is given by the equation:

$R_2 = - dMc^2 /dt = 2S_{BH} \times (dT /dt)$

Suppose black hole emits no radiation, then

$R_2 = 0$

(dT /dt) which is the rate of increase of black hole temperature = 0

$S_{BH} = \{R_2 / 2\, (dT /dt)\} = 0/0$ i.e., in order to maintain a well-defined entropy black hole must emit energy in the form of Hawking radiation.

Taking natural logarithm of the equation $S_{BH} = 4\pi k_B GM^2 / \hbar c$ we get:

$\ln S_{BH} = \ln (4\pi k_B G / \hbar c) + 2\ln M$

Differentiating the above equation we get: $d\ln S_{BH} = 2d\ln M$

Since M is proportional to 1/ T. Therefore:

$d\ln S_{BH} = - 2d\ln T$

$dS_{BH}/S_{BH} = -2\, (dT/T)$

On rearranging we get:

$T \times dS_{BH} = -2\, (dT \times S_{BH})$

$T \times (dS_{BH} /dt) = -2\, S_{BH} \times (dT /dt)$ which can also be rewritten as:

$R_1 = - R_2$

From above equation it clear that R_1 is = R_2. But, because of the negative sign the actual value of R_1 is = 1/ R_2.

Are Neutrinos Massless?

If not they could contribute significantly to the mass of the universe.

Dear "Dr.Science," I hear that scientists have now made antiprotons and antielectrons… My question is: if you mixed antiprotons with antielectrons, could you make anti-oxygen? If so, could it be used to put out combustion, rather than supporting it?

Yours,

Curious Harris.

Hmmmmmmmmmmmm??

Hummmmmm…

?

Hummmmmm

mmmmmmmmmmmmmmmmmmmmmm

Dear Curious Harris.

Unfortunately, Dr. Science is currently unable to provide a response to your recent query….

I think your question might have blocked his brain.

"Our quest for knowledge would have been much simpler if all the mathematical indeterminates like 0/0, 1/0, etc. would have been well-defined."

For non-relativistic case ($v << c$) the expression for kinetic energy is: $KE = m_0v^2/2$ (which still apply, as long as the speeds involved are significantly less than the speed of light, c), where m_0 is the rest mass of a body moving non-relativistically with a velocity $v << c$ (which we can apply it to a car. By giving the car more and more kinetic energy, we can pick out whatever speed v that we want). Suppose the body is brought to rest, then ($v = 0$, $KE = 0$). Under this condition the rest mass of the body becomes UNDEFINED i.e.,

$m_0 = 2KE/v^2 = (2 \times 0) /0 = 0/0$

There can be no bigger limitation than this. Rest mass cannot be undefined because rest mass is a physical property of the body.

Did you know that simulation of the map of the cosmic microwave background that is being obtained by NASA's Microwave Anisotropy Probe (MAP) shows that the CMB is not perfectly smooth. But has Ripples in it.

If we measure the change in temperature on the Kelvin scale, then the change in kinetic energy is given by a simple equation: $\Delta KE = 3/2 \times k_B \Delta T$, where k_B is called Boltzmann's constant (which is = 1.380 × 10 to the power of – 23 Joules per Kelvin)

Suppose $\Delta T \rightarrow 0$, then

$\Delta KE = 0$

Under this condition the Boltzmann's constant 'k_B' becomes UNDEFINED i.e.,

$k_B = (2 \times 0) / (3 \times 0) = 0/0$

There can be no bigger limitation than this. Boltzmann's constant cannot be undefined because $k_B = 1.380 \times 10^{-23}$ J/ K.

$G_{\alpha\beta} = (8\pi G/c^4)\, T_{\alpha\beta}$

$G_{\alpha\beta} \rightarrow$ curvature of space

$T_{\alpha\beta} \rightarrow$ distribution of mass/ energy

$(8\pi G/c^4) \rightarrow$ constant

But WHY?

Maybe because matter and energy warp time and cause the time dimension to mix with the space?

The quantity of electric charge flowing through the filament of an incandescent bulb is given by:

q = current × time

or

$q = I \times t$

If N is the number of electrons passing through the filament in the same time then

$q = Ne$

or

$I \times t = Ne$

or

$e = \{I / (N/t)\}$

where: e is the electron charge = -1.602×10^{-19} Coulombs and (N / t) = rate of flow of electrons. Suppose no electrons flow through the filament of an incandescent bulb, then

$I = 0$ and $(N/t) = 0$

Under this condition the electron charge becomes UNDEFINED i.e.,

$e = 0/0$

"Actually, everything that can be known has a Number; for it is impossible to grasp anything with the mind or to recognize it without this."− PHILOLAUS, C. 470 – C. 385 BC.

The change in energy ΔE is related to the change in mass Δm by the Einstein famous equation (which has entered into one's mental frameworks due to its large impact thus gaining the status of more than a mere equation):

$\Delta E = \Delta mc^2$

Suppose $\Delta m = 0$, then

$\Delta E = 0$

Under this condition the speed of light squared i.e., c^2 becomes UNDEFINED i.e.,

$c^2 = 0/0$

There can be no bigger limitation than this. c^2 cannot be undefined because $c^2 = 9 \times 10^{16}\ m^2/ s^2$.

The change in energy ΔE is related to the change in frequency (i.e., number of oscillations per second) Δυ by the Planck's energy frequency relationship (which is a wonderful formula, because it tells us what change in frequency really means: it's just change in energy in a new guise):

$\Delta E = h\Delta\upsilon$

Suppose $\Delta\upsilon = 0$, then

$\Delta E = 0$

Under this condition the Planck's constant becomes UNDEFINED i.e., h = 0/0. There can be no bigger limitation than this. h cannot be undefined because h is = 6.625 × 10 to the power of –34 Js.

"So far as we know. All the fundamental laws of physics, like Newton's Equations, are reversible. Then where does irreversibility come from? It comes from order going to disorder. But we do not understand this until we know the origin of order."

--Richard Feynman

When a charged electron accelerates, it radiates away energy in the form of electromagnetic waves. For velocities that are small relative to the speed of light, the total power radiated is given by the Larmor formula:

$P = (e^2 / 6\pi\varepsilon_0 c^3)\, a^2$ where e is the charge on the electron and a is the acceleration of the electron, ε_0 is the absolute permittivity of free space; c is the speed of light in vacuum. If a = 0, then P = 0. Under this condition $(e^2 / 6\pi\varepsilon_0 c^3)$ becomes UNDEFINED i.e.,

$(e^2 / 6\pi\varepsilon_0 c^3) = 0/0$

Did you know that:

By analyzing the stellar spectrum, one can determine both the temperature of a star and the composition of its atmosphere.

Electric and magnetic forces are far stronger than gravity, but remain unnoticeable because every macroscopic body contain almost equal numbers of positive and negative electrical charges (i.e., the electric and magnetic forces nearly cancel each other out).

The gigantic instrument constructed by Raymond Davis Jr. and Masatoshi Koshiba to detect neutrinos from the Sun confirmed the prediction that the Sun is powered by nuclear fusion.

The Unruh temperature, derived by William Unruh in 1976, is the effective temperature experienced by a uniformly accelerating observer in a vacuum field. It is given by: $T_{Unruh} = (\hbar a/2\pi ck_B)$, where a is the acceleration of the observer, k_B is the Boltzmann constant, ħ is the reduced Planck constant, and c is the speed of light in vacuum. Suppose the acceleration of the observer is zero (a = 0), then

$T_{Unruh} = 0$

Under this condition ($\hbar/2\pi ck_B$) becomes UNDEFINED i.e., ($\hbar/2\pi ck_B$) = 0/0.

The change in entropy of the photon gas ΔS is related to the change in number of photons ΔN by the equation: $\Delta S = 3.6\ k_B \Delta N$. Suppose there is no change in number of photons (i.e., ΔN = 0), then

ΔS = 0

Under this condition the Boltzmann's constant 'k_B' (which is = 1.380 × 10 $^{-23}$ J/K) becomes UNDEFINED i.e., $k_B = 0 / (3.6 \times 0) = 0/0$.

The energy required to lift a body of weight 'w' up to a height of h meter is mgh i.e., E = wh. If h = 0, then the energy required to lift a body of weight w will be zero (i.e., E = 0). Under this condition the weight of the body 'w' becomes UNDEFINED i.e., w = 0/0.

There can be no bigger limitation than this. 'w' cannot be undefined because weight is a physical property of the body.

"I believe in God. It makes no sense to me to assume that the universe and our existence is just a cosmic accident, that life emerged due to random physical processes in an environment which simply happened to have the right properties."

: Antony Hewish (1974 Nobel Prize in Physics for his discovery of pulsars)

W = F × S × cosφ, where W = work, F = force, S = displacement and φ is angle between force and displacement. For an electron moving in a circular orbit,

$F = mv^2/r$ and $S = r\theta$

$W = mv^2 \times \theta \times \cos\varphi$

For one complete revolution

θ = 2π

$W = 2\pi\ mv^2\cos\varphi$

For an electron moving in a circular orbit, force and displacement are perpendicular to each other (i.e., $\varphi = 90^o$). Now under the condition ($\varphi = 90^o$):

W = 0

$m = W / 2\pi v^2\cos\varphi = 0 / (2\pi v^2 \times 0)$

m = 0/0 i.e., mass becomes UNDEFINED.

A Warning To All Oxygen Breathing Humans

"IF YOU MEET SOMEONE FROM ANOTHER PLANET AND HE HOLDS OUT HIS LEFT HAND, DON'T SHAKE IT. HE MIGHT BE MADE OF ANTIMATTER. YOU WOULD BOTH DISAPPEAR IN A TREMENDOUS FLASH OF LIGHT."

--STEPHEN HAWKING

In 1923 French physicist Louis de Broglie suggested that the wave-particle duality applied not only to light but to matter as well (mid-1920s proof came from the work of Clinton Davisson and Lester Germer: electrons [were found to] exhibit interference phenomena – the telltale sign of waves). Since Einstein's $E = mc^2$ relates mass to energy, that [since] Planck and Einstein related energy to the frequency of waves i.e., E = hυ, [that] therefore, by combining the two,

$h\upsilon = mc^2$ (this relation is applicable only for relativistic particle and for non-relativistic particle $mv^2/2 = h\upsilon$)

A small change in the frequency of the wave (Δυ) is followed by a small change in the mass (Δm) i.e.,

$hd\upsilon = dmc^2$

If dυ = 0, then

dm = 0

h $/c^2$ = dm/dυ = 0/0 i.e., h $/c^2$ becomes UNDEFINED.

"Science is a game — but a game with reality, a game with sharpened knives … If a man cuts a picture carefully into 1000 pieces, you solve the puzzle when you reassemble the pieces into a picture; in the success or failure, both your intelligences compete. In the presentation of a scientific problem, the other player is the good Lord. He has not only set the problem but also has devised the rules of the game — but they are not completely known, half of them are left for you to discover or to deduce. The experiment is the tempered blade which you wield with success against the spirits of darkness — or which defeats you shamefully. The uncertainty is how many of the rules God himself has permanently ordained, and how many apparently are caused by your own mental inertia, while the solution generally becomes possible only through freedom from its limitations."

— Erwin Schrödinger.

If not for a force called gravity, we would all go zinging off into outer space.

The change in number of moles dn is related to the change in number of molecules dN by the Avogadro constant L:

dn = dN/L

If dN = 0, then

dn = 0

Under this condition the Avogadro's constant (the number of particles in a mole, 6.022 × 10 ^{23}) becomes UNDEFINED i.e.,

L = 0/0.

There can be no bigger limitation than this (because Avogadro's constant is = 6.022 × 10 ^{23} particles).

The density of solute ρ is related to its concentration C by the equation: ρ = M × C, where M is a constant for a given solute and it is termed the molecular mass. Now under the condition (C = 0):

ρ = 0

M = ρ /C = 0/0 i.e., the molecular mass of the solute becomes undefined. There can be no bigger limitation than this. M cannot be undefined because molecular mass is a physical property of the solute.

Atom: Why can't you possibly measure where I am and how fast I'm moving at the same time?

Physicist: $\Delta x \, \Delta p \geq \hbar$ prevents me from doing so.

"Scientific views end in awe and mystery, lost at the edge in uncertainty, but they appear to be so deep and so impressive that the theory that it is all arranged as a stage for God to watch man's struggle for good and evil seems inadequate."

--Richard Feynman

Note: Gamma ray bursts may happen when a neutron star falls into another neutron star or black hole. The resulting explosion sends out particles and radiation all over the spectrum.

According to Faraday's law (introduced by British physicist and chemist Michael Faraday), the amount of a substance deposited on an electrode in an electrolytic cell is directly proportional to the quantity of electricity that passes through the cell. Faraday's law can be summarized by: n = q / ZF, where n is the number of moles of the substance deposited on an electrode in an electrolytic cell, q is the quantity of electricity that passes through the cell, F = 96485 C/ mol is the Faraday constant and z is the valency number of ions of the substance. Suppose no electricity passes through the cell (q = 0), the amount of the substance deposited on an electrode in an electrolytic cell is 0 (i.e., n= 0). Under this condition

q = 0, n = 0

F = q / (z × n) = 0 / (z × 0) = 0/0 i.e., Faradays constant (which is = 96485 Coulombs per mole) becomes Undefined.

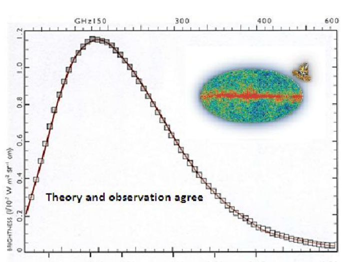
Did you know that the static on your television is caused by radiation left over from the Big Bang?

If a quantity of heat Q is added to a system of mass m, then the added heat will go to raise the temperature of the system by ΔT = Q/Cm where C is a constant called the specific heat capacity (A system's heat capacity per kilogram – which is the measure of how much heat a system can hold). ΔT = Q/Mc which on rearranging: m = Q / (C × ΔT). Suppose no heat is added to the system (Q = 0), then

ΔT = 0

m = 0/ (C × 0) = 0/0 i.e., the mass of a system becomes UNDEFINED.

The faster you move,
The shorter and the heavier you are.
And that is the THEORY OF RELATIVITY.



MEASUREMENT OF THE SPECTRUM OF MICROWAVE BACKGROUND indicates that the cosmic microwave background radiation is characteristic of that from a hot body.

"In a scientific sense, earthquakes are unpredictable. But that does not mean that you can't predict things about them." —PETER SAMMONDS

"To suppose that the eye… could have been formed by natural selection, seems, I freely confess, absurd in the highest possible degree." − Charles Darwin

Entropy (a thermodynamic quantity -- first introduced by the German physicist Rudolf Clausius (1822--1888) -- a measure of untidiness in a system and a measure of how much information a system contains) is defined as

$S = k_B \ln \{\text{number of states}\}$

which, for N particles of the same type, will be

$S = k_B \ln \{(\text{no of one-particle states})^N\}$

$S = k_B N \ln \{\text{a not-too-big number}\}$

$S = k_B N$

This means: the more particles, the more disorder. If no particles (i.e., N = 0), then no disorder (i.e., S = 0). Now under this condition: $k_B = S / N = 0/0$ i.e., Boltzmann's constant 'k_B' (which is = 1.380×10^{-23} J/K) becomes UNDEFINED.

Note: The universe is expanding because the energy of expansion which is (which is proportional to MH^2R^2 is greater than the gravitational binding energy of the universe (which is proportional to $-GM^2/R$). M = mass and R = radius of the universe. H = Hubble constant and G = Gravitational constant.

If the energy of expansion is less than the gravitational binding energy of the universe, the universe will stop expanding and collapse and if the energy of expansion is equal to the gravitational binding energy of the universe, the universe will neither expand nor contracts.

Λ The Cosmological Constant was My GREATEST Mistake? : Albert Einstein

Cosmic Gall by John Updike

Neutrinos, they are very small. They have no charge and have no mass and do not interact at all. The earth is just a silly ball to them, through which they simply pass, like dust maids down a drafty hall or photons through a sheet of glass. They snub the most exquisite gas, ignore the most substantial wall, cold-shoulder steel and sounding brass, insult the stallion in his stall, and, scorning barriers of class, infiltrate you and me! Like tall and painless guillotines, they fall down through our heads into the grass. At night, they enter at Nepal and pierce the lover and his lass from underneath the bed—you call it wonderful; I call it crass.

$(a^2 - b^2) = (a+b)(a-b)$

Which on rearranging:

$(a^2 - b^2) / (a - b) = (a+b)$

If a= b=1, then

0/0 = 2 (illogical and meaningless result).

$\tan\theta = \sin\theta / \cos\theta$ which on rearranging:

$\cos\theta = \sin\theta / \tan\theta$

If $\theta = 0^o$, then

$1 = 0/0$ (illogical and meaningless result).

Absorbance = − log (Transmittance)

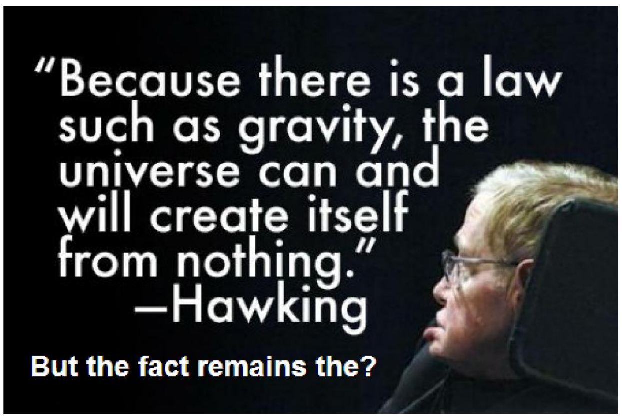
Absorbance = − 2.303 × ln (Transmittance)

If Transmittance = 1 (i.e., no light passed through the solution is absorbed), then Absorbance = 0. Now under this condition:

Absorbance / ln (Transmittance) = − 2.303 take the form

$0/\ln 1 = -2.303$

$0/0 = -2.303$ (illogical and meaningless result).



We can ask what happens when an electron jumps from one energy level to another. If the electron jumps down in energy, then it sheds the excess energy by emitting a photon. The photon's energy is the difference between the electron's energy before it jumped and after i.e.,

$E_{photon} = h\upsilon = E_2 - E_1$

But E_1 = electron's energy before it jumped = $-(2\pi^2 m_e e^4 / n_1^2 h^2)$ and E_2 = electron's energy after it jumped = $-(2\pi^2 m_e e^4 / n_2^2 h^2)$

Therefore:

$h\upsilon = (2\pi^2 m_e e^4 / h^2)[1/n_1^2 - 1/n_2^2]$

Suppose $h\upsilon = 0$, then

$0 = (2\pi^2 m_e e^4 / h^2)[1/n_1^2 - 1/n_2^2]$

From this it follows that

$n_1 = n_2$

Now under the condition ($h\upsilon = 0$, $n_1 = n_2$):

$(2\pi^2 m_e e^4 / h^2) = h\upsilon / [1/n_1^2 - 1/n_2^2] = 0/0$ i.e., $(2\pi^2 m_e e^4 / h^2)$ becomes UNDEFINED.

What is our physical place in the universe?

Present 13.8 billion years after the Big Bang

We can only see the surface of the sky where light was scattered.

"Science itself, no matter whether it is the search for truth or merely the need to gain control over the external world, to alleviate suffering, or to prolong life, is ultimately a matter of feeling, or rather, of despite—the desire to know or the desire to realize."

--Louis Victor de Broglie

Is the density of the Black Hole: $0.1253c^6/\pi G^3M^2$ or $0.00585c^6/\pi G^3M^2$?

The density of the black hole is given by the expression: $\rho = 3M/4\pi R_G^3$, where M is the mass and R_G is the radius of the black hole.

Since $R_G = 2GM/c^2$. Therefore:

$\rho = 3c^6/24\pi G^3M^2$

or

$\rho = 0.1253c^6/\pi G^3M^2$

According to Stefan – Boltzmann-Schwarzschild – Hawking black hole radiation power law, the rate of change in a black hole's energy is:

$P = \epsilon \times \sigma \times T^4 \times (4\pi R_G^2)$

or

$P = 1 \times (\pi^2 k_B^4 / 60\hbar^3c^2) \times (\hbar c^3/8\pi GM)^4 \times (16\pi G^2M^2/c^4)$

or

$P = \hbar c^6/15360\pi G^2M^2$

Mario Rabinowitz discovered the simplest possible representation for the rate of change in a black hole's energy in terms of black hole density ρ:

$P = G\rho\hbar/90$

or

$P = \hbar c^6/15360\pi G^2M^2 = G\rho\hbar/90$

or

$\rho = 90c^6/15360\pi G^3M^2$

or

$\rho = 0.00585c^6/\pi G^3M^2$

Conclusion:

Two results for the density of the black hole:

$\rho = 0.1253c^6/\pi G^3M^2$

$\rho = 0.00585c^6/\pi G^3M^2$

Is the Life time of our power house the sun: 2.63×10^{18} or 3.98×10^{20} seconds?

1. We can summarize the nuclear reaction occurring inside the sun, irrespective of pp or CNO cycle, as follows: 4 protons → 1 helium nucleus + 2 positrons + E, where E is the energy released in the form of radiation. Approximately it is 25 MeV ≈ 40×10^{-13}J.

Let's calculate age of the sun according to nuclear considerations.

Inside the sun, we have $N_{Protons}$ (say), which can be calculated as follows

$N_{Protons} = M / m_{Proton} = 2 \times 10^{30} / 1.672 \times 10^{-27} = 1.196 \times 10^{57}$, where M = mass of the sun and m_{Proton} = mass of the proton. Hence, the number of fusion reactions inside the sun is

$N_{Reactions} = 1.196 \times 10^{57} / 4 = 2.99 \times 10^{56}$

So, star has the capacity of releasing

$0.196 \times 10^{56} \times 40 \times 10^{-13} = 1.19 \times 10^{45}$ J

The rate of loss of energy of the sun in the form of radiation i.e., power radiated by the sun, $P = 4.52 \times 10^{26}$ J/s, the sun has the capacity to shine for

$t = 1.19 \times 10^{45} / 4.52 \times 10^{26} = 2.63 \times 10^{18}$ seconds.

2. Let us consider,

$N_{Protons} = M / m_{Proton}$

or

$M = N_{Protons} \times m_{Proton}$

Differentiating this with respect to time, we get

$(dM/dt) = m_{Proton} \times (dN_{Protons} /dt)$

This can also be written as:

$-(dMc^2/dt) = m_{Proton}c^2 \times -(dN_{Protons} /dt)$

Since $-(dMc^2/dt) = P = 4.52 \times 10^{26}$ J/s and $m_{Proton}c^2 = 15.04 \times 10^{-11}$ J. Therefore:

$-(dN_{Protons} /dt) = (4.52 \times 10^{26} / 15.04 \times 10^{-11})$

or

$-(dN_{Protons} /dt) = 3.005 \times 10^{36}$ protons per second

0.196×10^{36} protons are utilized per second to release energy in the form of radiation.

0.196×10^{36} protons → one second

1.196×10^{57} protons → t seconds

$t = 1.196 \times 10^{57}/3.005 \times 10^{36} = 3.98 \times 10^{20}$ seconds.

1.196×10^{57} protons are utilized per 3.980×10^{20} seconds to release energy in the form of radiation. Therefore, the sun has the capacity to shine for 3.98×10^{20} seconds.

Conclusion:

Two results for the LIFE TIME of the sun:

$t = 2.63 \times 10^{18}$ seconds

$t = 3.98 \times 10^{20}$ seconds

Did you know that:

Niels Bohr imagined the atom as consisting of electron waves of wavelength $\lambda = h/mv$ endlessly circling atomic nuclei. In his picture, only orbits with circumferences corresponding to an integral multiple of electron wavelengths could survive without destructive interference (i.e., $r = n\hbar/mv$ could survive without destructive interference).

As mercury repeatedly orbits the sun, the long axis of its elliptical path slowly rotates, coming full circle roughly every 360,000 years.

Because the square of the time it takes for the planet to complete one revolution around the sun is proportional to the cube of its average distance from the sun, the mercury move rapidly in its orbit and Venus, Earth and Mars move progressively less rapidly about the sun and the outer planets such as Jupiter, Saturn, Uranus, Neptune and Pluto move stately and slow.

Newton rings is a phenomenon in which an interference pattern is created by the reflection of light between two surfaces — a spherical surface and an adjacent flat surface. It is named after Isaac Newton, who first studied them in 1717.

Quantum mechanics says that the position of a particle is uncertain, and therefore that there is some possibility that a particle will be within an energy barrier rather than outside of it. The process of moving from outside to inside without traversing the distance between is known as quantum tunneling, and it is very important for the fusion reactions in stars like the Sun.

The three kinematic equations that describe an object's motion are:

$d = ut + ½ at^2$

$v^2 = u^2 + 2ad$

$v = u + at$

There are a variety of symbols used in the above equations. Each symbol has its own specific meaning. The symbol d stands for the displacement of the object. The symbol t stands for the time for which the object moved. The symbol a stands for the acceleration of the object. And the symbol v stands for the final velocity of the object, u stands for the initial velocity of the object.

Assuming the initial velocity of the object is zero (u = 0):

$d = ½ at^2$

$v^2 = 2ad$

$v = at$

Since velocity is equal to displacement divided by time (i.e., v =d / t):

$a = 2d /t^2$

$a = d / 2t^2$

$a = d / t^2$

Conclusion: 3 different results for a.

Note: Small amounts of antimatter constantly rain down on Earth in the form of Cosmic rays and energetic particles from space

The rest masses of proton and neutron are regarded as fundamental physical constants in existing physics and it is believed that they are invariant.

Rest mass of proton plus neutron = 1.007825 + 1.008665 = 2.01649 u.

But inside the deuteron nucleus, it is experimentally confirmed that

rest mass of proton plus neutron = 2.01410 u i.e., rest mass of proton plus neutron inside the nucleus has decreased from 2.01649 u to 2.01410 u. The rest masses of neutrons and protons are fundamental constants only if they remain same universally (inside and outside the nucleus). Failure to meet universal equality proves that the rest masses of neutrons and protons are Variant.

Decoding the quantum mechanics to find the solution to the Schrödinger equation for the hydrogen atom in arbitrary electric and magnetic fields-- If we can, we know everything about the system.

Violation of the foundation of the fundamental theory of the twentieth century. Nevertheless, it is now completely accepted by the scientific community, and its predictions have been verified in countless applications.

If a PART mc^2 of the photon energy is absorbed by the electron at rest, then the absorbed energy mc^2 manifests as the Kinetic energy KE of the electron and the momentum mc of the absorbed photon manifests as the momentum p of the electron. Therefore, the equation

$KE = \Delta p \times v$

where $\Delta p = p_2 - p_1$, p_2 = final momentum of the electron = p and p_1 = initial momentum of the electron = 0 (since the electron was initially at rest)

Becomes:

$mc^2 = mc \times v$

From this it follows that

$v = c$

The idea which states that nothing with mass can travel at the speed of light is a cornerstone of Albert Einstein's special theory of relativity, which claims that observers in relative motion will have different perceptions of distance and of time (and gives explanations for the behavior of objects near the speed of light, such as time dilation and length contraction) which itself forms the fundamental precept of modern physics. If the electron recoils with a velocity v=c, then the basic laws of physics have to be rewritten.

Note:

$6 \times 0 = 0$

$2 \times 0 = 0$

$0 = 0$

$6 \times 0 = 2 \times 0$

$6 / 2 = 0/0$ i.e., $6 / 2 \rightarrow$ UNDEFINED.

There can be no bigger limitation than this because 6/2 is 3 not 0/0.

For a source moving at angle $\theta = 0^o$ towards the stationary observer, the relativistic Doppler effect equation is given by:

$\upsilon_{observed} = \upsilon_{emitted} \times \{(1 + v/c) / (1 - v/c)\}^{½}$

From this it follows that

$(\upsilon_{observed} / \upsilon_{emitted}) - 1 = \{(1 + v/c) / (1 - v/c)\}^{½} - 1$

$(\upsilon_{observed} - \upsilon_{emitted}) / \upsilon_{emitted} = \{(1 + v/c) / (1 - v/c)\}^{½} - 1$

Since redshift $z = (\upsilon_{emitted} - \upsilon_{observed}) / \upsilon_{emitted}$. Therefore:

$-z = \{(1 + v/c) / (1 - v/c)\}^{½} - 1$

$(1- z) = \{(1 + v/c) / (1 - v/c)\}^{½}$

On squaring we get:

$(1- z)^2 = (1 + v/c) / (1 - v/c)$

$(1- z)^2 (1 - v/c) = (1 + v/c)$

$(1- z)^2 - v/c\,(1- z)^2 = 1 + v/c$

On rearranging:

$(1- z)^2 - 1 = v/c\,\{(1- z)^2 + 1\}$

If v = c (some quasars or other heavenly bodies may attain the velocity v = c due to the Hubble expansion of space), then

$(1- z)^2 - 1 = (1- z)^2 + 1$ i.e., LHS ≠ RHS, which is never justified.

"Get your facts first, and then you can distort them as you please."

− MARK TWAIN

Decoding The Universe Since 1905

Atom → nucleus → proton → quark

So, particle physics finished……

Or is it not?

If it is not, then what completes the particle physics?

"For the first half of geological time our ancestors were bacteria. Most creatures still are bacteria, and each one of our trillions of cells is a colony of bacteria."

—RICHARD DAWKINS

Einstein's desk as shot after Einstein's death in 1955

For a source moving at angle $\theta = 0^o$ away from the stationary observer, the relativistic Doppler Effect equation is given by:

$\upsilon_{observed} = \upsilon_{emitted} \times \{(1 - v/c) / (1 + v/c)\}^{½}$

Since the force which moves the photon is given by: $F = h\upsilon^2/ c$, where h is the Planck's constant, υ is the frequency of the photon. Therefore:

$F_{observed} = F_{emitted} \times \{(1 - v/c)^2 / (1 - v^2/c^2)\}$

If v = c (some quasars or other heavenly bodies may attain the velocity v = c), then $F_{observed} = 0/0$.

The equation $F_{observed} = F_{source} \times \{(1 - v/c)^2 / (1 - v^2/c^2)\}$ can also be written as:

$F_{observed} = F_{emitted} \times \{(1 - v/c) / (1 + v/c)\}$

If v = c, then $F_{observed} = 0$.

CONCLUSION: The same equation (in unsolved and solved forms) under similar conditions ($v \rightarrow c$) gives different results i.e. ($F_{observed} \rightarrow 0/0$ and $F_{observed} \rightarrow 0$), which is never justified.

Conclusion

The word "certainty" in the Game of Science is a misleading term. The above arguments confirm the Richard Feynman's statement: "Scientific knowledge is a body of statements of varying degrees of certainty -- some most unsure, some nearly sure, none absolutely certain." In fact, science can never establish "truth" or "fact" in the sense that the investigation of scientific equations provides unwitting support for the assertion that science is dogmatically correct. If a plausible scientific model or an equation consistent with all existing knowledge can be found, then the above claim fails. That model or equation need not be proven to be correct, just not proven to be incorrect. In the end, all of our scientific implications are an attempt to make sense of this fabulous and fleeting existence we find ourselves in. However, science is guided by natural law; has to be explained by reference to natural law; testable against the empirical world; its conclusions are tentative, that is, are not necessarily the final word; it can be falsifiable.

Nobel Prizes in physics

"If I have a thousand ideas and only one turns out to be good, I am satisfied."

--Alfred Nobel

The Nobel Prize in Physics 2015

Takaaki Kajita and Arthur B. McDonald

"for the discovery of neutrino oscillations, which shows that neutrinos have mass"

The Nobel Prize in Physics 2014

Isamu Akasaki, Hiroshi Amano and Shuji Nakamura

"for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources"

The Nobel Prize in Physics 2013

François Englert and Peter W. Higgs

"for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider"

The Nobel Prize in Physics 2012

Serge Haroche and David J. Wineland

"for ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems"

The Nobel Prize in Physics 2011

Saul Perlmutter, Brian P. Schmidt and Adam G. Riess

"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae"

The Nobel Prize in Physics 2010

Andre Geim and Konstantin Novoselov

"for groundbreaking experiments regarding the two-dimensional material graphene"

The Nobel Prize in Physics 2009

Charles Kuen Kao

"for groundbreaking achievements concerning the transmission of light in fibers for optical communication"

Willard S. Boyle and George E. Smith

"for the invention of an imaging semiconductor circuit - the CCD sensor"

The Nobel Prize in Physics 2008

Yoichiro Nambu

"for the discovery of the mechanism of spontaneous broken symmetry in subatomic physics"

Makoto Kobayashi and Toshihide Maskawa

"for the discovery of the origin of the broken symmetry which predicts the existence of at least three families of quarks in nature"

The Nobel Prize in Physics 2007

Albert Fert and Peter Grünberg

"for the discovery of Giant Magnetoresistance"

The Nobel Prize in Physics 2006

John C. Mather and George F. Smoot

"for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation"

The Nobel Prize in Physics 2005

Roy J. Glauber

"for his contribution to the quantum theory of optical coherence"

John L. Hall and Theodor W. Hänsch

"for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique"

The Nobel Prize in Physics 2004

David J. Gross, H. David Politzer and Frank Wilczek

"for the discovery of asymptotic freedom in the theory of the strong interaction"

The Nobel Prize in Physics 2003

Alexei A. Abrikosov, Vitaly L. Ginzburg and Anthony J. Leggett

"for pioneering contributions to the theory of superconductors and super fluids"

The Nobel Prize in Physics 2002

Raymond Davis Jr. and Masatoshi Koshiba

"for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos"

Riccardo Giacconi

"for pioneering contributions to astrophysics, which have led to the discovery of cosmic X-ray sources"

The Nobel Prize in Physics 2001

Eric A. Cornell, Wolfgang Ketterle and Carl E. Wieman

"for the achievement of Bose-Einstein condensation in dilute gases of alkali atoms, and for early fundamental studies of the properties of the condensates"

The Nobel Prize in Physics 2000

"for basic work on information and communication technology"

Zhores I. Alferov and Herbert Kroemer

"for developing semiconductor heterostructures used in high-speed- and opto-electronics"

Jack S. Kilby

"for his part in the invention of the integrated circuit"

The Nobel Prize in Physics 1999

Gerardus 't Hooft and Martinus J.G. Veltman

"for elucidating the quantum structure of electroweak interactions in physics"

The Nobel Prize in Physics 1998

Robert B. Laughlin, Horst L. Störmer and Daniel C. Tsui

"for their discovery of a new form of quantum fluid with fractionally charged excitations"

The Nobel Prize in Physics 1997

Steven Chu, Claude Cohen-Tannoudji and William D. Phillips

"for development of methods to cool and trap atoms with laser light"

The Nobel Prize in Physics 1996

David M. Lee, Douglas D. Osheroff and Robert C. Richardson

"for their discovery of super fluidity in helium-3"

The Nobel Prize in Physics 1995

"for pioneering experimental contributions to lepton physics"

Martin L. Perl

"for the discovery of the tau lepton"

Frederick Reines

"for the detection of the neutrino"

The Nobel Prize in Physics 1994

"for pioneering contributions to the development of neutron scattering techniques for studies of condensed matter"

Bertram N. Brockhouse

"for the development of neutron spectroscopy"

Clifford G. Shull

"for the development of the neutron diffraction technique"

The Nobel Prize in Physics 1993

Russell A. Hulse and Joseph H. Taylor Jr.

"for the discovery of a new type of pulsar, a discovery that has opened up new possibilities for the study of gravitation"

The Nobel Prize in Physics 1992

Georges Charpak

"for his invention and development of particle detectors, in particular the multiwire proportional chamber"

The Nobel Prize in Physics 1991

Pierre-Gilles de Gennes

"for discovering that methods developed for studying order phenomena in simple systems can be generalized to more complex forms of matter, in particular to liquid crystals and polymers"

The Nobel Prize in Physics 1990

Jerome I. Friedman, Henry W. Kendall and Richard E. Taylor

"for their pioneering investigations concerning deep inelastic scattering of electrons on protons and bound neutrons, which have been of essential importance for the development of the quark model in particle physics"

The Nobel Prize in Physics 1989

Norman F. Ramsey

"for the invention of the separated oscillatory fields method and its use in the hydrogen maser and other atomic clocks"

Hans G. Dehmelt and Wolfgang Paul

"for the development of the ion trap technique"

The Nobel Prize in Physics 1988

Leon M. Lederman, Melvin Schwartz and Jack Steinberger

"for the neutrino beam method and the demonstration of the doublet structure of the leptons through the discovery of the muon neutrino"

The Nobel Prize in Physics 1987

J. Georg Bednorz and K. Alexander Müller

"for their important break-through in the discovery of superconductivity in ceramic materials"

The Nobel Prize in Physics 1986

Ernst Ruska

"for his fundamental work in electron optics, and for the design of the first electron microscope"

Gerd Binnig and Heinrich Rohrer

"for their design of the scanning tunneling microscope"

The Nobel Prize in Physics 1985

Klaus von Klitzing

"for the discovery of the quantized Hall effect"

The Nobel Prize in Physics 1984

Carlo Rubbia and Simon van der Meer

"for their decisive contributions to the large project, which led to the discovery of the field particles W and Z, communicators of weak interaction"

The Nobel Prize in Physics 1983

Subramanyan Chandrasekhar

"for his theoretical studies of the physical processes of importance to the structure and evolution of the stars"

William Alfred Fowler

"for his theoretical and experimental studies of the nuclear reactions of importance in the formation of the chemical elements in the universe"

The Nobel Prize in Physics 1982

Kenneth G. Wilson

"for his theory for critical phenomena in connection with phase transitions"

The Nobel Prize in Physics 1981

Nicolaas Bloembergen and Arthur Leonard Schawlow "for their contribution to the development of laser spectroscopy"

Kai M. Siegbahn

"for his contribution to the development of high-resolution electron spectroscopy"

The Nobel Prize in Physics 1980

James Watson Cronin and Val Logsdon Fitch

"for the discovery of violations of fundamental symmetry principles in the decay of neutral K-mesons"

The Nobel Prize in Physics 1979

Sheldon Lee Glashow, Abdus Salam and Steven Weinberg

"for their contributions to the theory of the unified weak and electromagnetic interaction between elementary particles, including, inter alia, the prediction of the weak neutral current"

The Nobel Prize in Physics 1978

Pyotr Leonidovich Kapitsa

"for his basic inventions and discoveries in the area of low-temperature physics"

Arno Allan Penzias and Robert Woodrow Wilson

"for their discovery of cosmic microwave background radiation"

The Nobel Prize in Physics 1977

Philip Warren Anderson, Sir Nevill Francis Mott and John Hasbrouck van Vleck

"for their fundamental theoretical investigations of the electronic structure of magnetic and disordered systems"

The Nobel Prize in Physics 1976

Burton Richter and Samuel Chao Chung Ting

"for their pioneering work in the discovery of a heavy elementary particle of a new kind"

The Nobel Prize in Physics 1975

Aage Niels Bohr, Ben Roy Mottelson and Leo James Rainwater

"for the discovery of the connection between collective motion and particle motion in atomic nuclei and the development of the theory of the structure of the atomic nucleus based on this connection"

The Nobel Prize in Physics 1974

Sir Martin Ryle and Antony Hewish

"for their pioneering research in radio astrophysics: Ryle for his observations and inventions, in particular of the aperture synthesis technique, and Hewish for his decisive role in the discovery of pulsars"

The Nobel Prize in Physics 1973

Leo Esaki and Ivar Giaever

"for their experimental discoveries regarding tunneling phenomena in semiconductors and superconductors, respectively"

Brian David Josephson

"for his theoretical predictions of the properties of a super current through a tunnel barrier, in particular those phenomena which are generally known as the Josephson effects"

The Nobel Prize in Physics 1972

John Bardeen, Leon Neil Cooper and John Robert Schrieffer

"for their jointly developed theory of superconductivity, usually called the BCS-theory"

The Nobel Prize in Physics 1971

Dennis Gabor

"for his invention and development of the holographic method"

The Nobel Prize in Physics 1970

Hannes Olof Gösta Alfvén

"for fundamental work and discoveries in magnetohydrodynamics with fruitful applications in different parts of plasma physics"

Louis Eugène Félix Néel

"for fundamental work and discoveries concerning antiferromagnetism and ferrimagnetism which have led to important applications in solid state physics"

The Nobel Prize in Physics 1969

Murray Gell-Mann

"for his contributions and discoveries concerning the classification of elementary particles and their interactions"

The Nobel Prize in Physics 1968

Luis Walter Alvarez

"for his decisive contributions to elementary particle physics, in particular the discovery of a large number of resonance states, made possible through his development of the technique of using hydrogen bubble chamber and data analysis"

The Nobel Prize in Physics 1967

Hans Albrecht Bethe

"for his contributions to the theory of nuclear reactions, especially his discoveries concerning the energy production in stars"

The Nobel Prize in Physics 1966

Alfred Kastler

"for the discovery and development of optical methods for studying Hertzian resonances in atoms"

The Nobel Prize in Physics 1965

Sin-Itiro Tomonaga, Julian Schwinger and Richard P. Feynman

"for their fundamental work in quantum electrodynamics, with deep-ploughing consequences for the physics of elementary particles"

The Nobel Prize in Physics 1964

Charles Hard Townes, Nicolay Gennadiyevich Basov and Aleksandr Mikhailovich Prokhorov

"for fundamental work in the field of quantum electronics, which has led to the construction of oscillators and amplifiers based on the maser-laser principle"

The Nobel Prize in Physics 1963

Eugene Paul Wigner

"for his contributions to the theory of the atomic nucleus and the elementary particles, particularly through the discovery and application of fundamental symmetry principles"

Maria Goeppert Mayer and J. Hans D. Jensen

"for their discoveries concerning nuclear shell structure"

The Nobel Prize in Physics 1962

Lev Davidovich Landau

"for his pioneering theories for condensed matter, especially liquid helium"

The Nobel Prize in Physics 1961

Robert Hofstadter

"for his pioneering studies of electron scattering in atomic nuclei and for his thereby achieved discoveries concerning the structure of the nucleons"

Rudolf Ludwig Mössbauer

"for his researches concerning the resonance absorption of gamma radiation and his discovery in this connection of the effect which bears his name"

The Nobel Prize in Physics 1960

Donald Arthur Glaser

"for the invention of the bubble chamber"

The Nobel Prize in Physics 1959

Emilio Gino Segrè and Owen Chamberlain

"for their discovery of the antiproton"

The Nobel Prize in Physics 1958

Pavel Alekseyevich Cherenkov, Il´ja Mikhailovich Frank and Igor Yevgenyevich Tamm

"for the discovery and the interpretation of the Cherenkov effect"

The Nobel Prize in Physics 1957

Chen Ning Yang and Tsung-Dao (T.D.) Lee

"for their penetrating investigation of the so-called parity laws which has led to important discoveries regarding the elementary particles"

The Nobel Prize in Physics 1956

William Bradford Shockley, John Bardeen and Walter Houser Brattain

"for their researches on semiconductors and their discovery of the transistor effect"

The Nobel Prize in Physics 1955

Willis Eugene Lamb

"for his discoveries concerning the fine structure of the hydrogen spectrum"

Polykarp Kusch

"for his precision determination of the magnetic moment of the electron"

The Nobel Prize in Physics 1954

Max Born

"for his fundamental research in quantum mechanics, especially for his statistical interpretation of the wavefunction"

Walther Bothe

"for the coincidence method and his discoveries made therewith"

The Nobel Prize in Physics 1953

Frits Zernike

"for his demonstration of the phase contrast method, especially for his invention of the phase contrast microscope"

The Nobel Prize in Physics 1952

Felix Bloch and Edward Mills Purcell

"for their development of new methods for nuclear magnetic precision measurements and discoveries in connection therewith"

The Nobel Prize in Physics 1951

Sir John Douglas Cockcroft and Ernest Thomas Sinton Walton

"for their pioneer work on the transmutation of atomic nuclei by artificially accelerated atomic particles"

The Nobel Prize in Physics 1950

Cecil Frank Powell

"for his development of the photographic method of studying nuclear processes and his discoveries regarding mesons made with this method"

The Nobel Prize in Physics 1949

Hideki Yukawa

"for his prediction of the existence of mesons on the basis of theoretical work on nuclear forces"

The Nobel Prize in Physics 1948

Patrick Maynard Stuart Blackett

"for his development of the Wilson cloud chamber method, and his discoveries therewith in the fields of nuclear physics and cosmic radiation"

The Nobel Prize in Physics 1947

Sir Edward Victor Appleton

"for his investigations of the physics of the upper atmosphere especially for the discovery of the so-called Appleton layer"

The Nobel Prize in Physics 1946

Percy Williams Bridgman

"for the invention of an apparatus to produce extremely high pressures, and for the discoveries he made therewith in the field of high pressure physics"

The Nobel Prize in Physics 1945

Wolfgang Pauli

"for the discovery of the Exclusion Principle, also called the Pauli Principle"

The Nobel Prize in Physics 1944

Isidor Isaac Rabi

"for his resonance method for recording the magnetic properties of atomic nuclei"

The Nobel Prize in Physics 1943

Otto Stern

"for his contribution to the development of the molecular ray method and his discovery of the magnetic moment of the proton"

The Nobel Prize in Physics 1942

No Nobel Prize was awarded this year. The prize money was with 1/3 allocated to the Main Fund and with 2/3 to the Special Fund of this prize section.

The Nobel Prize in Physics 1941

No Nobel Prize was awarded this year. The prize money was with 1/3 allocated to the Main Fund and with 2/3 to the Special Fund of this prize section.

The Nobel Prize in Physics 1940

No Nobel Prize was awarded this year. The prize money was with 1/3 allocated to the Main Fund and with 2/3 to the Special Fund of this prize section.

The Nobel Prize in Physics 1939

Ernest Orlando Lawrence

"for the invention and development of the cyclotron and for results obtained with it, especially with regard to artificial radioactive elements"

The Nobel Prize in Physics 1938

Enrico Fermi

"for his demonstrations of the existence of new radioactive elements produced by neutron irradiation, and for his related discovery of nuclear reactions brought about by slow neutrons"

The Nobel Prize in Physics 1937

Clinton Joseph Davisson and George Paget Thomson

"for their experimental discovery of the diffraction of electrons by crystals"

The Nobel Prize in Physics 1936

Victor Franz Hess

"for his discovery of cosmic radiation"

Carl David Anderson

"for his discovery of the positron"

The Nobel Prize in Physics 1935

James Chadwick

"for the discovery of the neutron"

The Nobel Prize in Physics 1934

No Nobel Prize was awarded this year. The prize money was with 1/3 allocated to the Main Fund and with 2/3 to the Special Fund of this prize section.

The Nobel Prize in Physics 1933

Erwin Schrödinger and Paul Adrien Maurice Dirac

"for the discovery of new productive forms of atomic theory"

The Nobel Prize in Physics 1932

Werner Karl Heisenberg

"for the creation of quantum mechanics, the application of which has, inter alia, led to the discovery of the allotropic forms of hydrogen"

The Nobel Prize in Physics 1931

No Nobel Prize was awarded this year. The prize money was allocated to the Special Fund of this prize section.

The Nobel Prize in Physics 1930

Sir Chandrasekhara Venkata Raman

"for his work on the scattering of light and for the discovery of the effect named after him"

The Nobel Prize in Physics 1929

Prince Louis-Victor Pierre Raymond de Broglie

"for his discovery of the wave nature of electrons"

The Nobel Prize in Physics 1928

Owen Willans Richardson

"for his work on the thermionic phenomenon and especially for the discovery of the law named after him"

The Nobel Prize in Physics 1927

Arthur Holly Compton

"for his discovery of the effect named after him"

Charles Thomson Rees Wilson

"for his method of making the paths of electrically charged particles visible by condensation of vapour"

The Nobel Prize in Physics 1926

Jean Baptiste Perrin

"for his work on the discontinuous structure of matter, and especially for his discovery of sedimentation equilibrium"

The Nobel Prize in Physics 1925

James Franck and Gustav Ludwig Hertz

"for their discovery of the laws governing the impact of an electron upon an atom"

The Nobel Prize in Physics 1924

Karl Manne Georg Siegbahn

"for his discoveries and research in the field of X-ray spectroscopy"

The Nobel Prize in Physics 1923

Robert Andrews Millikan

"for his work on the elementary charge of electricity and on the photoelectric effect"

The Nobel Prize in Physics 1922

Niels Henrik David Bohr

"for his services in the investigation of the structure of atoms and of the radiation emanating from them"

The Nobel Prize in Physics 1921

Albert Einstein

"for his services to Theoretical Physics, and especially for his discovery of the law of the photoelectric effect"

The Nobel Prize in Physics 1920

Charles Edouard Guillaume

"in recognition of the service he has rendered to precision measurements in Physics by his discovery of anomalies in nickel steel alloys"

The Nobel Prize in Physics 1919

Johannes Stark

"for his discovery of the Doppler effect in canal rays and the splitting of spectral lines in electric fields"

The Nobel Prize in Physics 1918

Max Karl Ernst Ludwig Planck
"in recognition of the services he rendered to the advancement of Physics by his discovery of energy quanta"
The Nobel Prize in Physics 1917
Charles Glover Barkla
"for his discovery of the characteristic Röntgen radiation of the elements"
The Nobel Prize in Physics 1916
No Nobel Prize was awarded this year. The prize money was allocated to the Special Fund of this prize section.
The Nobel Prize in Physics 1915
Sir William Henry Bragg and William Lawrence Bragg
"for their services in the analysis of crystal structure by means of X-rays"
The Nobel Prize in Physics 1914
Max von Laue
"for his discovery of the diffraction of X-rays by crystals"
The Nobel Prize in Physics 1913
Heike Kamerlingh Onnes
"for his investigations on the properties of matter at low temperatures which led, inter alia, to the production of liquid helium"
The Nobel Prize in Physics 1912
Nils Gustaf Dalén
"for his invention of automatic regulators for use in conjunction with gas accumulators for illuminating lighthouses and buoys"
The Nobel Prize in Physics 1911
Wilhelm Wien
"for his discoveries regarding the laws governing the radiation of heat"
The Nobel Prize in Physics 1910
Johannes Diderik van der Waals
"for his work on the equation of state for gases and liquids"
The Nobel Prize in Physics 1909
Guglielmo Marconi and Karl Ferdinand Braun
"in recognition of their contributions to the development of wireless telegraphy"
The Nobel Prize in Physics 1908
Gabriel Lippmann
"for his method of reproducing colors photographically based on the phenomenon of interference"
The Nobel Prize in Physics 1907
Albert Abraham Michelson
"for his optical precision instruments and the spectroscopic and metrological investigations carried out with their aid"
The Nobel Prize in Physics 1906
Joseph John Thomson
"in recognition of the great merits of his theoretical and experimental investigations on the conduction of electricity by gases"
The Nobel Prize in Physics 1905
Philipp Eduard Anton von Lenard
"for his work on cathode rays"
The Nobel Prize in Physics 1904
Lord Rayleigh (John William Strutt)
"for his investigations of the densities of the most important gases and for his discovery of argon in connection with these studies"
The Nobel Prize in Physics 1903
Antoine Henri Becquerel
"in recognition of the extraordinary services he has rendered by his discovery of spontaneous radioactivity"
Pierre Curie and Marie Curie, née Sklodowska
"in recognition of the extraordinary services they have rendered by their joint researches on the radiation phenomena discovered by Professor Henri Becquerel"
The Nobel Prize in Physics 1902
Hendrik Antoon Lorentz and Pieter Zeeman
"in recognition of the extraordinary service they rendered by their researches into the influence of magnetism upon radiation phenomena"
The Nobel Prize in Physics 1901
Wilhelm Conrad Röntgen
"in recognition of the extraordinary services he has rendered by the discovery of the remarkable rays subsequently named after him"

The History of the Universe in 100 words or less

Big Bang Explosion in which our universe was born – Inflation in which the Grand Unified Force was separated into the Four Forces of Nature as We Now Know Them, and the Universe started to Expand to Many Times Its Original Size in a Very Short Period of Time – Rapid expansion in which the universe cooled, though not Quite as Quickly -- PARTICLE-ANTIPARTICLE ANNIHILATION in which All the Antiparticles in the Universe Annihilated Almost All the Particles, Creating a Universe Made Up of Matter and Photons and no antimatter -- DEUTERIUM AND HELIUM PRODUCTION in which Many of the Protons and Neutrons in the Early Universe Combined to Form Heavy Hydrogen and Helium -- RECOMBINATION in which Electrons Combined with Hydrogen and Helium Nuclei, Producing Neutral Atoms -- GALAXY FORMATION in which the Milky Way Galaxy was Formed -- TURBULENT FRAGMENTATION in which a Giant Cloud of Gas Fragments broke into Smaller Clouds, which later Became Protostars -- MASSIVE STAR FORMATION in which a Massive Star was Formed -- STELLAR EVOLUTION in which Stars Evolved and Eventually Died-- IRON PRODUCTION in which Iron was Produced in the Core of a Massive Star, Resulting in a

Disaster called SUPERNOVA EXPLOSION in Which a Massive Star Ended Its Life by Exploding -- STAR FORMATION in which the Sun was Formed-- PLANETARY DIFFERENTIATION in which the Planet Earth was Formed-- VOLATILE GAS EXPULSION in which the Atmosphere of the Earth was Produced -- MOLECULAR REPRODUCTION in which Life on Earth was created -- PROTEIN CONSTRUCTION in which Proteins were built from Amino Acids -- FERMENTATION in which Bacteria Obtained Energy from Their Surroundings -- CELL DIFFERENTIATION in which Eukaryotic Life had a beginning -- RESPIRATION in which Eukaryotes Evolved to Survive in an Atmosphere with Increasing Amounts of Oxygen -- MULTICELLULAR ORGANISMS CREATION In Which Organisms Composed of Multiple Cells emerged -- SEXUAL REPRODUCTION in Which a New Form of Reproduction Occurred and with the invention of sex, two organisms exchanged whole paragraphs, pages and books of their DNA helix, producing new varieties for the sieve of natural selection. And the natural selection was a choice of stable forms and a rejection of unstable ones. And the variation within a species occurred randomly, and that the survival or extinction of each organism depended upon its ability to adapt to the environment. And organisms that found sex uninteresting quickly became extinct -- EVOLUTIONARY DIVERSIFICATION in which the Diversity of Life Forms on Earth Increased Greatly in a Relatively Short Time -- TRILOBITE DOMINATION

In Which Trilobites (an extremely successful subphylum of the arthropods that were at the top of the food chain in Earth's marine ecosystems for about 250 million years) Ruled the Earth --

LAND EXPLORATION In Which Animals First Venture was Onto Land – COMET COLLISION in which a Comet smashed the Earth -- DINOSAUR EXTINCTION In Which the Dinosaurs Died -- MAMMAL EXPANSION in which Many Species of Mammals was Developed -- HOMO SAPIENS MANIFESTATION In Which our caveman ancestors Appeared – LANGUAGE ACQUISITION in which something called curiosity ensued which triggered the breath of perception and our caveman ancestors became conscious of their existence and they learned to talk and they Developed Spoken Language -- GLACIATION in which a Thousand-Year Ice Age Began --- INNOVATION in which Advanced Tools were Widely made and Used -- RELIGION In Which a Diversity of Beliefs emerged --- ANIMAL DOMESTICATION in which Humans Domesticated Animals -- FOOD SURPLUS PRODUCTION In Which Humans Developed and promoted Agriculture -- INSCRIPTION In Which Writing was Invented and it allowed the communication of ideas -- WARRING NATIONS In Which Nation Battled Nation for Resources --- EMPIRE CREATION AND DESTRUCTION In Which the First Empire in Human History Came and went --- CIVILIZATION In Which Many and Sundry Events Occurred -- CONSTITUTION In Which a Constitution was Written -- INDUSTRIALIZATION in Which Automated Manufacturing and Agriculture Revolutionized the World --- WORLD CONFLAGRATIONS In Which Most of the World was at War --- FISSION EXPLOSIONS In Which Humans Developed Nuclear Weapons -- COMPUTERIZATION In Which Computers were Developed --- SPACE EXPLORATION In Which Humans Began to Explore Outer Space --- POPULATION EXPLOSION In Which the Human Population of the Earth Increased at a Very Rapid Pace --SUPERPOWER CONFRONTATION In Which Two Powerful Nations Risked it All -- INTERNET EXPANSION In Which a Network of Computers Developed -- RESIGNATION In Which One Human Quitted His Job --- REUNIFICATION In Which a Wall went Up and Then Came Down --- WORLD WIDE WEB CREATION In Which a New Medium was Created --- COMPOSITION In Which a Book was Written --- EXTRAPOLATION In Which Future Events were Discussed.

The connection between energy and mass, known as mass-energy equivalence, was immortalized in Einstein's famous equation $E_0 = m_0c^2$, where E_0 stands for rest mass energy, m0 stands for intrinsic mass and c is a constant (which happens to be equal to the speed of light). Actually, $E_0 = m_0c^2$ is just the simplest case scenario, that for a particle or mass at rest. For a particle in motion, with a velocity v, the equation becomes:

$E = m_0c^2 / (1- v^2/c^2)^{½}$ which is the same as: $m= m_0 / (1- v^2/c^2)^{½}$ where m = mass of the moving particle.

$m^2c^2 = m_0^2c^2 + m^2v^2$

On differentiating the above equation, we have:

$dmc^2 = dmv^2 + dvvm$

$dm = dvvm / (c^2- v^2)$

Since $dmc^2/dt = F v$ (where F = force and v = velocity). Therefore: $F = mac^2/ (c^2- v^2)$ (For non-relativistic case: v is << than c. Then the above equation reduces to Newton's classical equation: $F = m_0a$)

The above equation on rearranging yields:

$m= Fc^2 - Fv^2 / ac^2$

If v = c then

m = 0

But according to the Albert Einstein's law of variation of mass with velocity $m= m_0 / (1- v^2/c^2)^{½}$

If v = c then

m becomes infinite

Conclusion: Two different results for m (i.e., m = 0 and m = infinity) when v = c.

Did you know that: Elusive Pupating Observation of the ripples in the fabric of space-time called gravitational waves from Colliding Massive spinning Black Holes 100 Years after Einstein's Prediction by LIGO opens a New Window on the Universe providing the direct proof evidence for the existence of the strangest and most fascinating objects called black holes and accomplishes an ambitious goal of the beginning of a new era: The field of gravitational wave astronomy.

The gravitational potential energy is -GMm/r and gravitational force is GMm/r^2. Similarly gravitational binding energy of a star is - $3GM^2/5R$ and gravitational binding force is $3GM^2/5R^2$

$F_B = 3GM^2/5R^2$

In empty space, the photon moves at c (the speed of light) and its energy and mass are related by $E = mc^2$, where m and E are the mass and energy of the photon and if Planck Einstein equation is true, the energy of the quanta is proportional to its frequency i.e., E = hυ (where h is the constant of proportionality called the Planck constant)

$E \times E = mc^2 \times h\upsilon$

$E^2 = mc^2 \times h\upsilon$

Since

$\upsilon \times c = a$

and $hc = 2\pi M_{planck}^2$ G. Therefore:

$E^2 = 2\pi\ M_{planck}^2\ Gm\ a$

$E^2 = 2\pi M_{planck}^2\ \mu\ a$

where a is acceleration of the photon mass, M_{planck} is the Planck mass, G is the Newtonian gravitational constant and μ = Gm is the gravitational parameter for photon.

$E = 2.5M_{planck}\ (\mu\ a)^{½}$

The letter which describes Einstein re-iterating the primacy of his great space-time theory

"Dear Sir: I see from your letter of April 17th that the attempt of my last publication was not reported in an adequate way. I have not questioned there that space should be at as a four dimensional continuum. The question is only whether the relevant theoretical concepts describing physical properties of this space can or will be functions of four variables. If, f.i., the relevant entity is something like the distance of two points which are not infinitesimal near to each other, then such distance has to be a function of the coordinates of two points. This means a function of eight variables. I have investigated the possibilities of this kind in the last years but my respective results seem to me not very encouraging. For the time being I have returned to ordinary differential equations [from General Relativity] with dependent variables being simply functions of the four coordinates [space-time]. What the future has in store for us nobody can foretell. It is a question of success."

$F = mac^2/\ (c^2 - v^2)$

Since particle velocity v is related to the phase velocity v_P by the equation: $vv_P = c^2$. Therefore the above equation takes the form:

$F = mav_P\ /\ (v_P - v)$

Which on rearrangement gives: $v_P\ (F - ma) = Fv$

If F is very much greater than ma i.e., F>>ma then $v_P = v$ is achieved. Only for massless particles like photons the condition $v_P = v$ is achieved. Hence: force which moves the photon is very much greater than its mass times its acceleration i.e., F is >> than mc^2/λ (since photon acceleration a is = c^2/λ). But according to the existing scientific data, we determine the force which moves the photon by of dividing its energy mc^2 by its wavelength λ i.e., $F = mc^2/\lambda$.

Which is right?

$F >> mc^2/\lambda$ or $F = mc^2/\lambda$

The question lingers. But the answer is beyond our reach until now.

The gravitational binding force that confines the mass M of the star to the radius R is given by the equation:

$F_B = 3GM^2/5R^2$

The gravitational binding pressure of the star is given by the relation:

$P_{GB} = F_B/4\pi R^2 = 3GM^2/20\ \pi R^4$

According to linear density model, the core pressure of a star of mass M and radius R is given by the equation:

$P_c = 5GM^2/4\ \pi R^4$

But the ratio P_B/P_C gives:

$P_{GB}\ /P_C = 0.12$

or

$P_{GB} = 0.12P_C$

which means:

P_{GB} is < than P_C

The photon acceleration is given by the equation:

$a = c \times \upsilon$

(where υ = frequency of the wave associated with the photon and c = speed of light in vacuum)

Note: since c is constant, a and υ are equivalent and are the two different forms of the same thing.

For other elementary particles like electron, c is replaced by v

Then:

$a = v \times \upsilon$

Since $\upsilon = v_P/\lambda$ (where v_P = phase velocity and λ = wavelength of the electron). Therefore:

$a = vv_P/\lambda$

Since for relativistic particles: $vv_P = c^2$. Therefore:

$a = c^2/\lambda$ (which means: a depends only on λ)

For non-relativistic particles: $v_P = v/2$

Therefore:

$a = v^2/2\lambda$ (which means: a not only depends on λ but also on v)

Did you know that:

For the Earth, the Gravitational Binding Energy is about $2x10^{32}$ Joules, or about 12 days of the Sun's total energy output!

The average energy per photon is k_BT. Since the average energy per photon is proportional to the temperature, and the energy of a photon is directly related to its frequency, $E = h\upsilon$, one can see that

$h\upsilon = k_BT$

Since photon entropy is $3.6k_B$. Therefore: $3.6h\upsilon = TS$ (which means: entropic energy of the photon is 3.6 times its intrinsic energy)

The gravitational binding pressure of the star is given by the equation:

$P_{GB} = 3GM^2/20\ \pi R^4$

If the radius of the star becomes $=2GM/c^2$ then

$P_{GB} = 3c^8/320\ \pi G^3M^2$

Then the star becomes the black void in space called the black hole.

The mass of the nucleus is given by the equation:

$M = [Zm_P + (A-Z)\ m_N] - \Delta M$

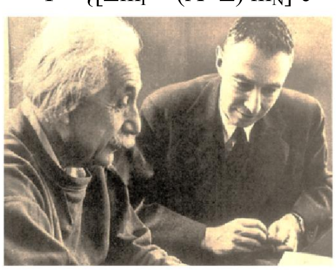
Where: Z denote atomic number, A denote atomic mass number, m_P & m_N denote the rest mass of the proton and the neutron, ΔM denote the mass defect of the nucleus.

The force that confines the energy Mc^2 of the nucleus to radius R is given by the equation:

$F = Mc^2/R = \{[Zm_P + (A-Z)\ m_N]\ c^2 - \Delta Mc^2\} / R$

Since nuclear radius $R = R_0\ A^{1/3}$ (R_0 = 1.6 Fermi meter) and $\Delta Mc^2 = E_{NB}$ (nuclear binding energy). Therefore:

$F = \{[Zm_P + (A-Z)\ m_N]\ c^2 - E_{NB}\} / R_0\ A^{1/3}$



Albert Einstein and J. Robert Oppenheimer at Caltech in 1939. They probably were, at that moment, discussing the prevention of black holes by neutron-star formation.

Hydrostatic equilibrium:

The Radiation pressure produced by the photons emitted from the star exactly balances the inward gravitational binding pressure. Such an equilibrium stage of the star is called hydrostatic equilibrium and the star enters the main sequence strip. At this stage, we say a new cosmic energy engine that produce heat, light, ultraviolet rays, x-rays, and other forms of radiation is born.

Radiation pressure: $P_R = 4\sigma T^4/c$

Inward gravitational binding pressure: $P_{GB} = 3GM^2/20\pi R^4$

Since stellular luminosity $L = 4\pi\sigma T^4R^2$. Therefore:

$P_R = L/c\pi R^2$

For hydrostatic equilibrium stage to be achieved:

P_R should $= P_{GB}$

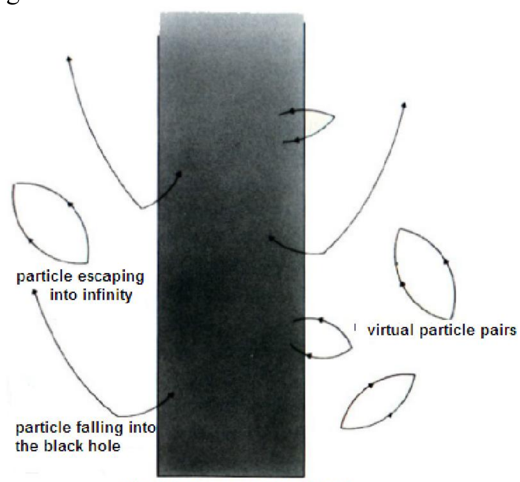
$L/c\pi R^2 = 3GM^2/20\pi R^4$

From this it follows that:

$L = 0.2\ F_B \times c$

(which means: when stellular luminosity L is = 0.2 times the product of gravitational binding force of star and the speed of light in vacuum, then hydrostatic equilibrium is attained).

"When I conceived the first basic ideas of wave mechanics in 1923–24, I was guided by the aim to perform a real physical synthesis, valid for all particles, of the coexistence of the wave and of the corpuscular aspects that Einstein had introduced for photons in his theory of light quanta in 1905." – De Broglie.



Black hole (event Horizon)

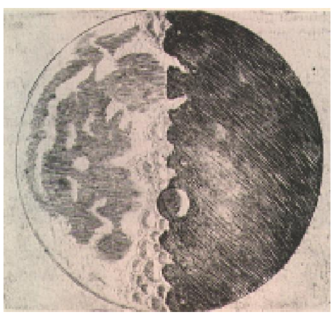
Bibliography

1. Physics I For Dummies Paperback- June 17, 2011 by Steven Holzner.
2. Physics II For Dummies Paperback- July 13, 2010 by Steven Holzner.
3. Basic Physics by Nair.
4. Beyond Newton and Archimedes by Ajay Sharma.
5. Einstein, Newton and Archimedes GENERALIZED (detailed interviews) by Ajay Sharma.
6. http://en.wikipedia.org/wiki/ Gravitational wave.
7. Teaching the photon gas in introductory physics by HS Leffa.
8. Hand Book of Space Astronomy and Astrophysics by Martin V. Zombeck.
9. Astrophysical concepts by Martin Harwit.
10. Ma H. The Nature of Time and Space. Nat Sci 2003; 1(1):1-11.

11. What is the Strength of Gravity? Victor Stenger (Excerpted from The Fallacy of Fine Tuning, 2011).
12. Stephen W. Hawking, A Brief History of Time: From the Big Bang to Black Holes (New York: Bantam, 1988).
13. Defending The Fallacy of Fine-Tuning by Victor J. Stenger.
14. Victor J. Stenger, The Comprehensible Cosmos: Where Do the Laws of Physics Come From? (Amherst, NY: Prometheus Books, 2006).
15. Sharma, A Physics Essays Volume 26, 2013.
16. Cockcraft J D, and Walton, E.T.S Nature 129 649 (30 April 1932).
17. http://www.nobelprize.org/nobel_prizes/physics/laureates/1951/cockcroft-lecture.pdf.
18. Newton, Isaac Mathematical Principles of Natural Philosophy, London, 1727, translated by Andrew Motte from the Latin.
19. A.L.Erickcek, M Kamionkowski and Sean Carroll, Phys. Rev D 78 123520 2008.
20. Sharma, A. Concepts of Physics (2006).
21. Fadner, W. L. Am. J. Phys. Vol. 56 No. 2, February 1988.
22. Einstein, A. Annalen der Physik (1904 & 1907).
23. Arthur Beiser, Concepts of Modern Physics, 4th edition (McGraw-Hill International Edition, New York, 1987).
24. MISCONCEPTIONS ABOUT THE BIG BANG by Charles H. Lineweaver and Tamara M. Davis.
25. BEYOND EINSTEIN: from the Big Bang to Black Holes (prepared by The Structure and Evolution of the Universe Roadmap Team).
26. Alternatives to the Big Bang Theory Explained (Infographic) By Karl Tate.
27. The Origin of the Universe by S.W. Hawking.
28. The Beginning of Time by S.W. Hawking.
29. A Universe from Nothing by Lawrence M. Krauss.
30. Evolution: A Theory in Crisis by Michael Denton.
31. The Origin and Creation of the Universe: A Reply to Adolf Grunbaum by WILLIAM LANE CRAIG.
32. Weisskopf, Victor [1989]: 'The Origin of the Universe' New York Review of Books.
33. The Grand Design by Stephen Hawking and Leonard Mlodinow.
34. M. Planck, The Theory of Radiation, Dover (1959) (translated from 1906).
35. Black Holes and Baby Universes and Other Essays by S.W. Hawking.
36. David Griffiths, Introduction to elementary particles, Wiley, 1987. ISBN 0471-60386-4.
37. Feynman, Leighton, and Sands, The Feynman Lectures on Physics, Addison-Wesley, Massachusetts, 1964. ISBN 0-201-02117-X.
38. D.A. Edwards, M.J. Syphers, An introduction to the physics of high energy accelerators, Wiley, 1993. ISBN 0-471-55163-5.
39. The Universe: the ultimate free lunch by Victor J Stenger (1989).
40. A Case Against the Fine-Tuning of the Cosmos by Victor J. Stenger.
41. A Quantum Theory of the Scattering of X-rays by Light Elements by Arthur. H Compton (1923).
42. Derive the mass to velocity relation by William J. Harrison (the general science journal).
43. BLACK HOLE MATH by National Aeronautics and Space Administration (NASA).
44. The Gravitational Radius of a Black Hole by Ph.M. Kanarev.
45. The Gravitational Red-Shift by R.F.Evans and J.Dunning-Davies.
46. Matter, Energy, Space and Time: Particle Physics in the 21st Century by Jonathan Bagger (2003).
47. Quarks, Leptons and the Big Bang by Jonathan Allday.
48. String Theory FOR Dummies by Andrew Zimmerman Jones with Daniel Robbins.
49. Einstein, String Theory, and the Future by Jonathan Feng.
50. Cosmos by Carl Sagan.
51. The Theory of Everything by S.W. Hawking.
52. A Briefer History of Time by Stephen Hawking and Leonard Mlodinow.
53. The Grand Design by Stephen Hawking and Leonard Mlodinow.
54. The Grandfather Paradox: What Happens If You Travel Back In Time To Kill Your Grandpa? Written by Motherboard.
55. Hawking SW1993 Black Holes and Baby Universes (New York: Bantam).
56. The human health effects of DDT... by MP Longnecker (1997).
57. Side Effects of Drugs Annual: A worldwide yearly survey of new data and... edited by Jeffrey K. Aronson.
58. Unstoppable Global Warming: Every 1,500 Years by Siegfried Fred Singer, Dennis T. Avery (2007).
59. Acid Rain by Louise Petheram (2002).
60. Eutrophication: Causes, Consequences, Correctives; Proceedings of a Symposium edited by National Academy of Sciences (U.S.).
61. What's wrong with food irradiation?
62. (https://www.organicconsumers.org/old_articles/Irrad/irradfact.php).

63. Ammonia: principles and industrial practice by Max Appl (1999).
64. An Edible History of Humanity by Tom Standage (2012).
65. Relativity: The Special and General Theory by Albert Einstein (1916).
66. Neutrinos: Ghosts of the Universe by Don Lincoln.
67. The Feynman Lectures on Physics (Volume I, II and III) by Richard Feynman.
68. The Evolution of the Universe edited by David L. Alles.
69. The Universe: Size, Shape, and Fate by Tom Murphy (2006).
70. Paul J. Steinhardt & Neil Turok (2007). Endless Universe: Beyond the Big Bang. New York: Doubleday.
71. Carroll, Sean (2010). From Eternity to Here. New York: Dutton.
72. Astronomy for beginners by Jeff Becan.
73. PARALLEL WORLDS: A JOURNEY THROUGH CREATION, HIGHER DIMENSIONS, AND THE FUTURE OF THE COSMOS by Michio Kaku.
74. Steven Weinberg, The First Three Minutes, 2nd ed., Basic Books, 1988.
75. Hugh Ross, Creation and the Cosmos, NavPress, 1998.
76. A Short History of Nearly Everything by Bill Bryson (2003).
77. The Universe in a Nutshell by Stephen W. Hawking (2001).
78. On the Radius of the Neutron, Proton, Electron and the Atomic Nucleus by Sha YinYue.
79. What Energy Drives the Universe? − Andrei Linde.
80. Endless Universe by Paul J. Steinhardt and Neil Turok.
81. Greene, Brian. Elegant Universe. New York: Vintage, 2000.
82. Davies, Paul. The Last Three Minutes. New York: Basic Books, 1994.
83. Lederman, Leon M., and David N. Schramm. From Quarks to the Cosmos. New York: W. H. Freeman, 1989.
84. Singh, Simon. Big Bang. New York: HarperCollins, 2004.
85. Greene, Brian. Fabric of the Cosmos. New York: Vintage, 2005.
86. FUNDAMENTAL UNSOLVED PROBLEMS IN PHYSICS AND ASTROPHYSICS by Paul S. Wesson.
87. Griffiths, D. 1987. Introduction to Elementary Particles. Harper and Row, New York.
88. What is the Strength of Gravity? Victor Stenger Excerpted from The Fallacy of Fine Tuning (2011).
89. PHYSICS OF THE IMPOSSIBLE by Michio Kaku.
90. E I N S T E I N ' S COSMOS by Michio Kaku.
91. Steven Weinberg, The Quantum Theory of Fields, Volume II: Modern Applications (Cambridge, UK: Cambridge University Press, 1996), ISBN 0521550025, LCCN 95002782, bibcode: 1996qtf..book.....W.
92. Steven Weinberg, The Quantum Theory of Fields, Volume II: Modern Applications (Cambridge, UK: Cambridge University Press, 1996), ISBN 0521550025, LCCN 95002782, bibcode: 1996qtf..book.....W.
93. A Tour of the Universe by Jack Singal.
94. Davies P (ed) 1989 The New Physics (Cambridge: Cambridge University Press).
95. The Gravitational Universe by Prof. Dr. Karsten Danzmann; Horgan, John. The End of Science. Reading, Mass.: Addison-Wesley, 1996.
96. The Origin of the Universe and the Arrow of Time by Sean Carroll; Weinberg, Steve. Dreams of a Final Theory: The Search for Fundamental Laws of Nature. New York: Pantheon Books, 1992.
97. Robert M. Wald, Quantum Field Theory in Curved Space-time and Black Hole Thermodynamics (Chicago, Ill.: University of Chicago Press, 1994), ISBN 0226870251, LCCN 94011065.
98. Adams, Douglas. The Hitchhiker’s Guide to the Galaxy. New York: Pocket Books, 1979; Tyson, Neil de Grasse. The Sky Is Not the Limit. New York: Doubleday, 2000.
99. Chemistry For Dummies Paperback- May 31, 2011 by John T. Moore
100. Protein-Ligand Binding by MK Gilson.
101. Gribbin J 1986 In Search of the Big Bang (London: Heinemann).
102. Guth A H and Steinhardt P 1984 The inflationary universe Scientific American.
103. GOD: THE FAILED HYPOTHESIS (How Science Shows That God Does Not Exist) by VICTOR J. STENGER (2007).
104. The Physics of God and the Quantum Gravity Theory of Everything by James Redford (2012).
105. The 100 Most Influential Scientists of All Time (edited by KARA ROGERS, Senior Editor, Biomedical Sciences (2010).
106. THE SELFISH GENE by Richard Dawkins.
107. THE BLIND WATCHMAKER by Richard Dawkins.
108. The Little Book of String theory by Steven S. Gubser (2010).

109. Nobel Lecture: From the Big Bang to the Nobel Prize and beyond by John C. Mather.
110. It Must Be Beautiful: Great Equations of Modern Science by Graham Farmelo.
111. Notes on Weinberg: The First Three Minutes by John R. Boccio
112. The Physics of God and the Quantum Gravity Theory of Everything by James Redford.
113. ATKINS' PHYSICAL CHEMISTRY by Peter Atkins & Julio de Paula.
114. BLACK HOLES, WORMHOLES & TIME M ACHINES by Jim Al-Khalili.
115. Krauss L M 1989 The Fifth Essence: The Search for Dark Matter in the Universe (New York: Basic).
116. Rindler W 1996 Introduction to Special Relativity (Oxford: Oxford University Press).
117. HYPERSPACE: A Scientific Odyssey Through Parallel Universes, Time Warps, and the Tenth Dimension by Kaku.
118. Change in Energy of Non-Spinning Black Holes w.r.t. the Change in Mass by Dipo Mahto, Rama Nand Mehta, Neeraj Pant, and Raj Kumar Sah.
119.



Galileo's drawing of the Moon

Physics Glossary

Absolute zero: The lowest possible temperature T, at which substances contain no heat energy Q.

Acceleration: The rate at which the speed of an object is changing and it is given by the equation a = dv/dt.

Anthropic principle: We see the universe the way it is because if it were different we would not be here to observe it through a gigantic telescopes pointing deep into the immense sky -- merely stating that the constants of nature must be tuned to allow for intelligence (otherwise we would not be here). Some believe that this is the sign of a cosmic creator. Others believe that this is a sign of the multiverse.

Antiparticle: Each type of matter particle has a corresponding antiparticle – first predicted to exist by P. A. M. Dirac. When a particle collides with its antiparticle, they annihilate, leaving only pure energy in the form of discrete bundle (or quantum) of electromagnetic (or light) energy called photons.

Atom: The basic unit of ordinary matter, made up of a tiny nucleus (consisting of positively charged protons and electrically neutral neutrons --which obey the strong interactions) surrounded by orbiting negatively charged weakly interacting particles called the electrons.

Big bang: The singularity at the beginning of the universe. The titanic explosion that created the universe, sending the galaxies hurtling in all directions. When the universe was created, the temperature was extremely hot, and the density of material was enormous i.e., infinite. The big bang took place 13.7 billion years ago, according to the WMAP satellite. The afterglow of the big bang is seen today as the cosmic background microwave radiation (of temperature 2.7 degrees above absolute zero). There are three experimental "proofs" of the big bang: the redshift of the galaxies, the cosmic background microwave radiation, and nucleosynethsis of the elements.

Big crunch: The singularity at the end of the universe i.e., The final collapse of the universe. If the density of matter is large enough (Omega-- The parameter that measures the average density of matter in the universe--being larger than 1), then there is enough matter in the universe to reverse the original expansion and cause the universe to recollapse. Temperatures rise to infinity at the instant of the big crunch.

Big freeze: The end of the universe when it reaches near absolute zero. The big freeze is probably the final state of our universe, because the sum of Omega and Lambda is believed to be 1.0, and hence the universe is in a state of inflation. There is not enough matter and energy to reverse the original expansion of the universe, so it will probably expand forever.

Big Bang nucleosynthesis: The production of deuterium, ^{3}He and ^{4}He (the latter to about 25% mass fraction) in the first 500 to 1000 sec of the early universe. These light isotopes, plus measurable amounts of ^{7}Li and trace amounts of elements B, Be, are the result of non-equilibrium nuclear reactions as the universe cooled to about 10^8K. Heavier isotopes were produced in stellar nucleosynthesis

Black hole: A region of space-time from which nothing, not even light, can escape, because gravity is so strong and escape velocity equals the speed of light. Because the speed of light is the ultimate velocity in the universe, this means that nothing can escape a black hole, once an object has crossed the event horizon. Black holes can be of various sizes. Galactic black holes, lurking in the center of galaxies and quasars, can weight millions to billions of solar masses. Stellar black holes are the remnant of a dying star, perhaps originally up to forty times the mass of our Sun. Both of these black holes have been identified with our instruments. Mini–black holes may also exist, as predicted by theory, but they have not yet been seen in the laboratory conditions.

Casimir effect: The attractive pressure between two flat, parallel metal plates placed very near to each other in a vacuum. The pressure is due to a reduction in the usual number of virtual particles in the space between the plates. This tiny effect has been measured in the laboratory. The Casimir effect may be used as the energy to drive a time machine or wormhole, if its energy is large enough.

Chandrasekhar limit: The maximum possible mass of a stable cold star (i.e., 1.4solar masses), above which it must collapse into a black hole.

Conservation of energy: The law of science that states that energy (or its equivalent in mass) can neither be created nor destroyed i.e., they never change with time. For example, the conservation of matter and energy posits that the total amount of matter and energy in the universe is a constant.

Coordinates: Numbers that specify the position of a point in 4 dimensional space- time.

Cosmological constant: A mathematical parameter (which measures the amount of dark energy in the universe) introduced by Albert Einstein to give space-time an inbuilt tendency to expand. At present, the data supports density parameter + cosmological constant = 1, which fits the prediction of inflation for a flat universe. Cosmological constant, which was once thought to be zero, is now known to determine the ultimate destiny of the universe.

Cosmology: The study of the universe as a whole.

COBE: The Cosmic Observer Background Explorer satellite.

Dark matter: Invisible Matter usually found in a huge halo around galaxies, clusters, and possibly between clusters, that cannot be observed directly but can be detected by its gravitational effect and they does not interact with light. As much as 90 percent of the mass of the universe may be in the form of dark matter and they makes up 23 percent of the total matter/energy content of the universe. According to string theory, dark matter may be made of subatomic particles, such as the neutralino, which represent higher vibrations of the superstring.

Duality: A correspondence between apparently different theories that lead to the same physical results.

Einstein-Rosen bridge: A thin tube of space-time linking two black holes.

Electric charge: A property of a particle by which it may repel (or attract) other particles that have a charge of similar (or opposite) sign.

Electromagnetic force: The force of electricity and magnetism that arises between particles with electric charge; the second strongest of the four fundamental forces -- which obeys Maxwell's equations.

Electron: A negatively charged subatomic particle with negative electric charge that orbits the nucleus of an atom and determines the chemical properties of the atom.

Electroweak unification energy: The energy (around 100 GeV) above which the distinction between the electromagnetic force and the weak force disappears.

Elementary particle: A particle that, it is believed fundamental building block of Nature, cannot be subdivided and are not composed of other simpler particles.

Event: A point in space-time, specified by its time and place.

Event horizon: The boundary of a black hole. The point of no return, often called the horizon.

Exclusion principle: The idea that two identical spin-1/2 particles cannot have (within the limits set by the uncertainty principle) both the same position and the same velocity. This means that two electrons cannot occupy precisely the same point with the same properties, so that there is a net force pushing the electrons apart (in addition to electrostatic repulsion).

Field: Something that exists throughout 4 dimensional fabric of space -time, as opposed to a particle that exists at only one point at a time.

Frequency: For a wave, the number of complete cycles per second.

Gamma rays: Electromagnetic rays of very short wavelength, produced in radio-active decay or by collisions of elementary particles.

General relativity: Einstein's theory of gravity based on the idea that the laws of science should be the same for all observers, no matter how they are moving. It explains the force of gravity in terms of the curvature of a four-dimensional space-time; so that the curvature of space-time gives the illusion that there is a force of attraction called gravity. It has been verified experimentally to better than 99.7 percent accuracy and predicts the existence of black holes and the expanding universe. The theory, however, break down at the center of a black hole or the instant of creation, where the theory predicts nonsense. To explain these phenomena, one must resort to a theory of subatomic physics.

Geodesic: The shortest (or longest) path between two points.

Grand unification energy: The energy above which, it is believed, the electro-magnetic force, weak force, and strong force become indistinguishable from each other.

Grand unified theory (GUT): A theory which unifies the electromagnetic, strong, and weak forces (but not gravity). The proton is not stable in these theories and can decay into positrons. GUT theories are inherently unstable (unless one adds super symmetry). GUT theories also lack gravity. (Adding gravity to GUT theories makes them diverge with infinities.)

Imaginary time: Time measured using imaginary numbers.

Inflation: The theory which states that the universe underwent an incredible amount of superliminal expansion at the instant of its birth.

Hyperspace: Dimensions higher than four.

Light cone: A surface in space-time that marks out the possible directions for light rays passing through a given event.

Light year): The distance light travels in one year, or approximately 5.88 trillion miles (9.46 trillion kilometers).

Telescope used by Galileo to look at Jupiter, 1609

LIGO: The Laser Interferometry Gravitational-Wave Observatory, based in Washington state and Louisiana, which is the world's largest gravity wave detector.

LISA: The Laser Interferometry Space Antenna- which is a series of three space satellites using laser beams to measure gravity waves. It is sensitive enough to confirm or disprove the inflationary theory and possibly even string theory.

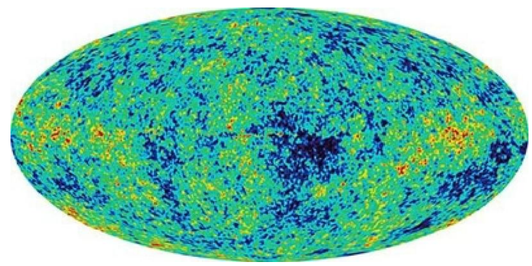
Magnetic field: The field responsible for magnetic forces, now incorporated along with the electric field, into the electromagnetic field.

Muon: A subatomic particle identical to the electron but with a much larger mass. It belongs to the second redundant generation of particles found in the Standard Model.

Mass: The quantity of matter in a body; its inertia, or resistance to acceleration.

Microwave background radiation: The remnant radiation (with a temperature of about 2.7 degrees K) from the glowing of the hot early universe (big bang), now so greatly red-shifted that it appears not as light but as microwaves (radio waves with a wavelength of a few centimeters). Tiny deviations in this background radiation give scientists valuable data that can verify or rule out many cosmological theories.

The Universe's "baby picture" WMAP's map of the temperature of the microwave background radiation shows tiny variations (of few micro degrees) in the 3K background. Hot spots show as red, cold spots as dark blue.



Naked singularity: A space-time singularity not surrounded by a black hole.

Neutrino: An extremely light (possibly massless) subatomic particle that react very weakly with other particles and may penetrate several light-years of lead without ever interacting with anything and is affected only by the weak force and gravity.

Neutron: A neutral subatomic particle, very similar to the proton, which accounts for roughly half the particles in an atomic nucleus.

Neutron star: A cold collapsed star consisting of a solid mass of neutrons —which is usually about 10 to 15 miles across-- supported by the exclusion principle repulsion between neutrons. If the mass of the neutron stars exceeds (3-4 solar masses) i.e., if the number of neutrons becomes $\geq 5.9\times 10^{57}$, then the degenerate neutron pressure will not be large enough to overcome the gravitational contraction and the star collapses into the next stage called black holes.

No boundary condition: The idea that the universe is finite but has no boundary.

Nuclear fusion: The process by which two nuclei collide and coalesce to form a single, heavier nucleus.

Nucleus: The tiny core of an atom, which is roughly 10^{-13} cm across, consisting only of protons and neutrons, held together by the strong force.

Particle accelerator: A machine -- based in Geneva, Switzerland -- that, using electromagnets, can accelerate moving charged particles, giving them more energy.

Phase: For a wave, the position in its cycle at a specified time: a measure of whether it is at a crest, a trough, or somewhere in between.

Photon: A quantum of light (which was first proposed by Einstein to explain the photoelectric effect—that is, the fact that shining light on a metal results in the ejection of electrons).

Planck's quantum principle: The idea that light (or any other classical waves) can be emitted or absorbed only in discrete quanta, whose energy E is proportional to their wavelength λ (i.e., $E = hc/\lambda$).

Positron: The (positively charged) antiparticle of the electron.

Primordial black hole: A black hole created in the very early universe.

Negative energy: Energy that is less than zero.

Proton: A positively charged subatomic particle, very similar to the neutron, that accounts for roughly half the particles in the nucleus of most atoms. They are stable, but Grand Unification theory predicts that they may decay over a long period of time.

Pulsar: A rotating neutron star that emits regular pulses of radio waves.

Quantum: The indivisible unit in which waves may be emitted or absorbed.

Quark: A subatomic particle that makes up the proton and neutron and feels the strong force. Three quarks make up a proton or neutron, and a quark and antiquark pair makes up a meson.

Quantum chromodynamics (QCD): The theory that describes the interactions of quarks and gluons.

Quantum mechanics: The theory developed from wave equations, Planck's quantum principle and Heisenberg's uncertainty principle. No deviation from quantum mechanics has ever been found in the laboratory. Its most advanced version today is called quantum field theory, which combines special relativity and quantum mechanics. A fully quantum mechanical theory of gravity, however, is exceedingly difficult.

Quasar: Quasi-stellar object. They are huge galaxies that were formed shortly after the gigantic explosion called the big bang.

Quantum foam: Tiny, foam like distortions of 4 dimensional fabric of space-time at the level of the Planck length.

Radioactivity: The spontaneous breakdown of one type of atomic nucleus into another.

Red shift: The reddening or decrease in frequency of light from a star that is moving away from us, due to the Doppler effect.

Singularity: A point in space-time at which the space-time curvature becomes infinite – which represent a breakdown of general relativity, forcing the introduction of a quantum theory of gravity.

Singularity theorem: A theorem that states that the universe must have started with a singularity.

Space-time: The four-dimensional space whose points are events.

Spatial dimension: Any of the three dimensions that are space like – that is, any except the time dimension.

Special relativity: Einstein's 1905 theory based on the idea that the laws of science should be the same for all observers, no matter how they are moving, in the absence of gravitational phenomena. Consequences include: time slows down, mass increases, and distances shrink the faster you move. Also, matter and energy are related via $E = mc^2$. One consequence of special relativity is the atomic bomb.

Spectrum: The different colors or component frequencies that make up a wave. By analyzing the spectrum of starlight, one can determine that stars are mainly made of hydrogen and helium.

Spin: An internal property of elementary particles.

Stationary state: One that is not changing with time.

Supernova: An exploding star. They are so energetic that they can sometimes outshine a galaxy.

String theory: A theory of physics based on tiny vibrating strings, such that each particle is described as a wave on a string. It is the only theory that can combine gravity with the quantum theory, making it the leading candidate for a theory of everything.

Strong force: The strongest of the four fundamental forces, with the shortest range of all. It holds the quarks together within protons and neutrons, and holds the protons and neutrons together to form atoms.

Steady state theory The theory which states that the universe had no beginning but constantly generates new matter as it expands, keeping the same density.

Uncertainty principle: The principle, formulated by Heisenberg, that one can never be exactly sure of both the position and the velocity of a particle; the more accurately one knows the one, the less accurately one can know the other.

$\Delta x \, \Delta p \geq h/2\pi$

$\Delta E \, \Delta t \geq h/2\pi$

Virtual particle: In quantum mechanics, a particle that briefly dart in and out of the vacuum but can never be directly detected, but whose existence does have measurable effects. They violate known conservation laws but only for a short period of time, via the uncertainty principle.

Wave/particle duality: The concept in quantum mechanics that there is no distinction between waves and particles; particles may sometimes behave like waves, and waves like particles.

Wavelength: For a wave, the distance between two adjacent troughs or two adjacent crests.

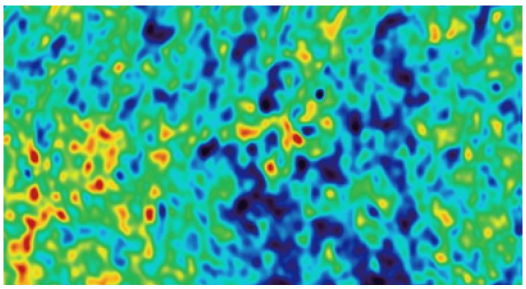
Weak force: The second weakest of the four fundamental forces – which is carried by the W- and

Z-bosons- that makes possible nuclear decay. It affects all matter particles, but not force-carrying particles.

Weight: The force exerted on a body by a gravitational field. It is proportional to, but not the same as, its mass.

White dwarf: A stable cold star consisting of lower elements such as oxygen, lithium, carbon, and so forth, supported by the exclusion principle repulsion between electrons.

Wormhole: A passageway between two universes or a thin tube of space-time connecting distant regions of the universe. Wormholes might also link to parallel or baby universes and could provide the possibility of time travel.



An image of quantum fluctuations blown up to the size of the universe

Einstein's first letter to President Roosevelt:

…In the course of the last four months it has been made probable - through the work of Joliot in France as well as Fermi and Szilard in America - that it may become possible to set up a nuclear chain reaction in a large mass of uranium, by which vast amounts of power and large quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future…

This new phenomenon would also lead to the construction of bombs, and it is conceivable - though much less certain - that extremely powerful bombs of a new type may thus be constructed. A single bomb of this type, carried by boat and exploded in a port, might very well destroy the whole port together with some of the surrounding territory…

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizsäcker, is attached to the Kaiser-Wilhelm-Institute in Berlin where some of the American work on uranium is now being repeated.

Yours very truly,

Albert Einstein

August 2nd, 1939

Note: if a photon of mass m moves a distance dx against the gravitational field, then the work done by the photon against the gravitational field is given by the equation: $W = hd\upsilon = - F \times dx$, where F = force which moved the photon mass (which is given by mc^2/λ) and the negative sign implies work is done against gravity.

$$hd\upsilon = -(mc^2/\lambda) \times dx$$

Since $mc^2 = h\upsilon$ and $(hd\upsilon / h\upsilon) = z$ (gravitational redshift). Therefore:

$$z = -dx / \lambda$$

4/6/2016