Why Could Paul Dirac not Derive the Correct Conclusions from His "Large Number Hypothesis"?

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Abstract: In the beginning of 20 century, some scientists had some doubts to the gravitational constant G as a constant value. In 1937, Pual Dirac, a most imaginative scientist in England, proposed a "large number hypothesis" (LNH). He said: 'The very large numbers of no dimensions appeared in nature are interrelated.' [1] "Any two large numbers of no unit in nature can be linked with simply mathematical operations." [2] According to the hypothesis, he at least derived two important conclusions: (1). The value of gravitational constant G is inversely proportional to the increase in universal time t_b, i.e. $G \propto t_b^{-1}$. (2). The universal mass M_b and number of the universal particles (proton) N_p is proportional to the increase in the square of universal time t_b, i.e. M_b (N_p) $\propto t_b^2$. Obviously, his intention was to give an explanation for our universal expansion discovered by Bubble's law in 1929. However, now it can be verified that above conclusions derived from Dirac's Hypothesis are not right. In this article, according to the theories about black holes (BH), "Our universe was born from the collision and amalgamation of a large amount of minimum gravitational black holes (MGBH) at the Big Bang, and the expansion of our universe would just be the expansion of our universal black hole (UBH)." [4][5][6] the results can be derived in this article : "G is not a variable, but still a constant, and $M_b \propto t_b$." [The Journal of American Science. 2009;5(1):68-73]. (ISSN: 1545-1003).

Key words: Pual Dirac's "large number hypothesis", G is not a variable,

I. According to the idea of Pual Dirac's "large number hypothesis", comparing the static electricity F_e with universal gravitation F_g, taking the hydrogen atom as an example, the mass of proton $m_p = 1.67\times10^{-24}$g, the mass of electron $m_e = 9.11\times10^{-28}$g, the capacity of electron e = - e = 1.602×10^{-19} C, r is the distance between two electrons, G is the gravitational constant, $G = 6.67\times10^{-8}$ $cm^3/s^2{*}g$, $k = 9.0\times10^9$ $N\bullet m^2/C^2$

$F_g = G\, m_p m_e / r^2 = 6.67\times10^{-8}\times1.67\times10^{-24}\times9.11\times10^{-28}/ r^2 = 101\times10^{-60}/ r^2$

$F_e = ke^2/r^2 = 9.0\times10^9\ N\bullet m^2/C^2\times(1.6\times10^{-19}C)^2/ r^2 = 9.0\times10^9\times10^5\times10^4\times (1.6\times10^{-19}C)^2/r^2 = 23\times10^{-20}/ r^2$

Let $\eta = F_e/ F_g = k\, e^2/ G\, m_p m_e = 23\times10^{-20}/101\times10^{-60} = 2.3\times10^{39}$ (1)

Or, $1/\eta = F_g/ F_e = 4{,}348\times10^{-40}$

In above formula (1), only e and –e can be simultaneously adopted, if two e or two –e are adopted, then, $m_p m_e$ in (1) would be changed into m_p^2 or m_e^2 , as a result, η will increase or decrease in 1840 times, and make a big difference with 2.3×10^{39} which was not needed by Pual Dirac's "large number hypothesis (LNH)".

Let the value $\eta = 2.3\times10^{39}$ as a basic standard, Dirac measured and calculated the universal age t_b with the ratio of time t_e which is the time of light passing through the electron radius R_e, he got a value, it was almost equal to $\eta = 2.3\times10^{39}$.
Taking the classical electron radius $R_e = ke^2/ m_e C^2 = (k=1)(4.803\times10^{-10})^2/(9.11\times10^{-28} \times 9\times10^{20}) = 2.8179\times10^{-13}$ cm,
$t_e = R_e/C = e^2/m_eC^3 = 2.8\times10^{-13}/3\times10^{10} = 0.934\times10^{-23}$s, (1a)
Suppose $t_b/t_e = 2.3\times10^{39} = \eta$, αs a result, $t_b = 6.8\times10^8$yrs. (1b)

But that universal age of $t_b = 6.8\times10^8$yrs was not accordance with the observational value in 1937. Steven Wienberg said: "In 1930s and 1940s, the Hubble's constant H_0 was regarded as a bigger number than present. It was about H_0=170km/s/Mly, so, the calculated universal age t_b was corresponding about 20×10^8yrs. If the gravitational brake was considered, the universal age t_b should be less." [3] Let $t_b = 20\times10^8$yrs**,** so,
$\eta_b = t_b/t_e = 6.76\times10^{39} = 2.94(2.3\times10^{39}) = 2.94\eta \approx \eta$. (2)

Therefore, t_b = **20×10^8yrs was approximately needed by Dirac's LNH in 1937.** According to Dirac's Hypothesis, from formulas (1) and (2), Dirac derived his equation,
$k e^2/ G m_p m_e \approx t_b/t_e$ (3)
In formula (3), k, e, m_p ,m_e , and t_e are all constants, he imaginary got a result from (3),
$G \propto t_b^{-1}$ (4)
But now our universal real age t_r is 137×10^8yrs, so. $t_r \approx 7\ t_b$ in 1937. Thus, Dirac's $t_b = 20\times10^8$yrs was still a estimated value, which had much difference with the real universal real age t_r. The result of $G \propto t_b^{-1}$ is not reliable. If G is a variable, from $t_b = 20\times10^8$yrs to $t_r = 137 \times 10^8$yrs, the universal age increased in 7 times, G should correspondingly decrease in 7 times. i.e, $G = 6.67\times10^{-8}cm^3/s^2{*}g/7 = 10^{-8}cm^3/s^2{*}$ g. Why could the variance of G not be measured? Therefore, Dirac did really regard the numerical coincidence as the general law. Really,
$k e^2/G m_p m_e \neq t_b /t_e$ (5)

II. How did Dirac get universal mass M_b and the number of universal particles (proton) $N_p = 10^{78}$, and $N_p = (t_b /t_e)^2$? It was known, that in 1937, Dirac could only get the values of M_b and N_p from Hubble's constant H_0. It is shown above, at that time,
$H_0 \approx 170$km/s/Mly and $t_b \approx 20\times10^8$yrs, so, the universal density,
$\rho_c = 3H_0^2/8\pi G = 5.8\times10^{-28}$ g /cm^3 (6)
$M_b = 4\pi\rho_c R^3/3 = 4\pi\rho_c C^3 t_b^3/3 = 1.649\times10^{55}$ g (7)
$N_p = M_b/1.67\times10^{-24} = 9.87\times10^{78} = (3.14\times10^{39})^2$ (8)

The result below accorded with the need of Pual Dirac's "LNH", N_p should be equal to:
$N_p = (3.14\times10^{39})^2, t_b/t_e = 6.76\times10^{39}, (t_b/t_e)^2 = (2.6\times10^{39})^2, N_p = (t_b/t_e)^2$ **(9)**

Discussion:

A. Though formula (9) might approximately accord with Dirac's requirement of $N_p \propto t_b^2$ in the numerical value, but it is not a general mathematical equality and an equation at all, because only under the conditions of $H_0 \approx 170$km/s/Mly and $G = 6.67\times10^{-8}cm^3/s^2{*}g$, (9) may be tenable and exist. Therefore, the existence of (9) was a pure numerical coincidence. Formula (7) can be directly changed into:

$$\mathbf{M_b} = 4\pi\rho_c R^3/3 = 4\pi(3H_0^2/8\pi G)C^3t_b^3/3 = 4\pi(3H_0^2/8\pi G)C^3t_b/3H_0^2 = \mathbf{C^3\, t_b /2\, G} \quad (10)$$

Formula (10) which is a complete equation has accurately proved that $M_b \propto t_b$. Did Dirac not know formula (10) or wouldn't like to adopt formula (10) ? I think, for the requirement of his "large number hypothesis", Dirac forgot or didn't adopt (10) selectively.

B. If G is a variable due to the need of Dirac's "large number hypothesis", from formula (3),

$$k\, e^2\, t_e /m_p\, m_e = t_b\, G = \text{constant} = 1.4\times10^9\ cm^3/s{*}g \quad (11)$$

From formulas (10), (11) and (1a) and $t_e = ke^2/ m_e C^3 = 0.934\times10^{-23}$s (k=1),

$$\mathbf{M_b = C^3\, t_b^{\,2}/2(k\, e^2\, t_e / m_p m_e) = 1.835\times10^{22}g\times t_b^2} \quad \mathbf{(12)}$$

$$\mathbf{N_p = M_b/\, m_p = [C^3 m_e/2(k\, e^2)] \times [t_b^2/t_e] = (t_b^2/t_e^2)/2 = 1.099\times10^{46}\, t_b^2} \quad \mathbf{(13)}$$

Formula (13) should be derived by Dirac in 1937 from formula (9) and (10) under the condition of Gt_b = constant = 1.4×10^9 $cm^3/s{*}g$. It shows that (9) and (13) are two different ways to get $N_p = (t_b/ t_e)^2$. It can be seen from formula (13) that, though Dirac derived the better result needed by his LNH in 1937, but it can not be verified that our universal real evolution would better accord with the variances of formulas (11), (12) and (13).

C. Now, let us check the correctness of formulas (11) and (13) with the better accurately numerical values of our universal age A_o recently observed and calculated by scientists. According to measurements by the WMAP satellite, the age A_o of the universe to about 1%: $A_o = 13.7\pm 0.13$ billon years can be precisely estimated.[7] Then, from formula (10), the universal real mass at present $M_r = C^3\, t_b /2\, G = 0.875\times10^{56}$g. Of course, the numerical value of $A_o = 137\times10^8$yrs and $M_r = 0.875\times10^{56}$g can be verified by another recent observed numerical value, for example, the better recent observed value of H_o = 73km/s/Mpc, on this value, A_o can be calculated out $A_o = 134\times10^8$yrs, and $M_r = 0.856\times10^{56}$g. According to formulas (11) and (12) to checking Dirac's universal mass $M_b = 1.099\times10^{46}\, t_b^2 m_p = 34.3\times10^{56}$g. As a result: $M_b = 39.2\, M_r$. From formula (11), $G = 1.4\times10^9/\, t_b = 0.324\times10^{-8}$. It can be seen that our universal age from 2×10^9yrs estimated by Dirac in 1937 to 13.7×10^9yrs at present just increased in 13.7/2 = 6.85 times, but the gravitational constant G decreased too much in $6.67\times10^{-8}/0.324\times10^{-8}$ = 20.6 times. Furthermore, if looking back at the moment at Big Bang of our universe, i.e $t_b = 10^{-43}$s, from formula (11), $G = 1.4\times10^{52}$ $cm^3/s^2{*}g$, and M_b at that time, from formula (12), $M_b = 1.835\times10^{-64}$g. So, here $M_b < 10^{-59}$ times of Planck mass which was 10^{-5}g. It is an inevitably absurd results got from Dirac's LNH.

D. In dirac's mind, he might grant the expansion of the universe and the increase in universal mass and atomic numbers (showed as $M_b(N_p) \propto t_b^2$) as if the cell division with the increase in time.

III. In 1937, when Dirac proposed his LNH, he didn't know white dwarfs and neutron stars. What was more, he had no way to know black holes (BH) at that time. Therefore, Dirac's LNH as a research on the hidden mysteries of our universal evolution had very important significance, because decrease in G with increase in t_b could at least give some reason to explain our universal expansion discovered by Hubble's law in 1927. Perhaps, in nature, the very large numbers of no dimensions might have some interrelationship, but formulas (11), (12) and (13) derived from Dirac's LNH are completely wrong. Now, applying the theories about black holes (BH) to research our universal expansive progress from its birth at Big Bang to the present, the progress can be very consistent with the numerical values got from recent observations and theories of BH. Our universe was born from a large number of minimum gravitational black holes (MGBH) at the Big Bang. Now our universe is still a super giant black hole and its last end will finally go to the death as the general black boles. The expansion of our universe would only be the same with the expansion of a giant black hole. Therefore, applying the theory about BH and the newly observed numerical values to explain the law of our universal expansion should be the most effective and reliable. [4][5][6]

The numerical values of the original MGBHs at Big Bang as below: [4][5][6]
mass of a MGBH: $m_b=10^{-5}$g, it is Plank mass, from Schwarzchild solution, $C^2/2 = Gm_b/r_b$,
the completely expanded radius $r_b = 1.5\times10^{-33}$cm, from $t_{bo} = r_b / C$,.
t_{bo} was the time of light passing through radius of MGBH, $t_{bo}=0.5\times10^{-43}$s,
$\mathbf{T_{bo}}$ was the temperature of MGBH, from $\mathbf{T_{bo} = (C^3/4GM_b)\times(h/2\pi\kappa) \approx 0.4\times 10^{-6}M_\theta/M_b}$,
$T_{bo} = 0.65\times10^{32}$k,
proton numbers of MGBH, $n_p = m_b/m_p = 10^{-5}/1.67\times10^{-24} = 0.6\times10^{19}$

Now, the recent observed and calculated numerical values of our universal black holes (UBH) are listed as below:
The precisely age of our UBH, $A_o = 13.7$ billon years, from $C^2/2 = G M_b/R_b = G M_b/ CA_o$,
The mass of our UBH, $M_b = 8.75\times10^{55}$g,
The completely expanded radius of our UBH, $R_b = C A_o = 1.297\times10^{28}$cm,
The time of light passing through radius of UBH, $t_b = A_o = 0.432\times10^{18}$s.
The proton numbers of our UBH, $N_p = 8.75\times10^{55}/1.67\times10^{-24} = 5.23\times10^{79}$,
The temperature of UBH, $T_b = 0.9\times10^{-29}$k

The ratios between above two corresponding items:
The ratio of corresponding mass, $R_m = M_b/m_b = 8.75\times10^{55}/10^{-5} = 8.75\times10^{60}$,
The ratio of corresponding radius, $R_r = R_b / r_b = 1.297\times10^{28}/1.5\times10^{-33} = 8.65\times10^{60}$,
The ratio of corresponding time, $R_t = t_b/t_{bo} = 0.432\times10^{18}/0.5\times10^{-43} = 8.64\times10^{60}$,
The ratio of corresponding temperature, $R_T = T_B/T_{bo} = 0.9\times10^{-29}/0.65\times10^{32} = 13.85\times10^{-60}$,

The ratio of corresponding proton numbers, $R_n = N_p / n_p = 5.23\times10^{79}/0.6\times10^{19} = 8.72\times10^{60}$,

IV. Analyses and conclusions:

A. From almost the same amount of above 5 ratios, it can be seen that, applying the theory about BH and the newly observed numerical values to explain the law of our universal expansion and the increase in mass M_b and proton (atom) numbers N_p is really effective and reliable. The above 5 consistent ratios have also proved that, only under the condition of G = constant, our universal expansive law is surely harmonious, so,

$M_b \propto N_p \propto R_b \propto 1/T_B \propto t_B$ (14)

Dirac's conclusions of "The universal mass M_b and number of the universal particles (protons, atoms) N_p is proportional to the increase in the square of universal time t_b, i.e. $M_b (N_p) \propto t_b^2$, and Gt_b = constant." are not right.

B. Why would the expansion of our universe accord with the expansive law of BH? Schwarzchild solution to General Relative Theory (GRT) is $C^2/2 = GM_b/ R_b$, it is the necessary condition of existence of BHs. From $R_b = CA_0 = Ct_b$, as a result,

$M_b = C^3 t_b /2G$ (15)

Formula (15) derived from BH is completely equal to formula (10) derived from Hubble's law. It clearly indicates that the law of expansion of our universe described by Hubble's law is just the law of expansion of our universal BH.

C. A special BH was indicated out by Hawking in 1971, its mass $M_s = 10^{15}$g. and its particle (proton, atom) numbers are $N_s = M_s/ m_p = 10^{15}/1.67\times10^{-24} = 0.6\times10^{39}$. In addition, the radius r_s of M_s is just equal to the classical electron radius R_e [see formula (1a)], i.e $r_s = R_e \approx 10^{-13}$ cm, then, the time t_s of light passing through r_s is equal to t_e, if according to Dirac's LNH in formula (2), $t_b/t_s = t_b/t_e = 6.76\times10^{39} = 2.94(2.3\times10^{39}) \approx 2.3\times10^{39}$, of course, here let $t_b \approx 20\times10^8$yrs like Dirac in 1937. Therefore, from this special BH M_s, N_p like Dirac's equation can be established from two ways and got into two equations, $N_p = N_s^2$, and $N_p = (t_b/t_s)^2$, because N_s and t_b/t_s are all the same certain value of no dimension of the same special BH. Thus, no matter whether N_s or t_b/t_s is selected into a equation like formula (3) established by Dirac's LNH, formula (15) would be became into the absurd result like Dirac's LNH. Obviously, in case $M_s \neq 10^{15}$g, m_p would become a variable, $m_p \neq 1.67\times10^{-24}$g, $N_s \neq 10^{39}$ and $t_b/t_s \neq 2.3\times10^{39}$.

D. From above calculations and analyses, it has clearly showed that why Dirac's LNH did not derive the correct conclusions. [**1**]. In 1937, nobody knew BH, so, Dirac only knew protons. He considered that our universe was only originated from protons, and the increase in universal mass M_b and atomic numbers N_p would be with the increase in universal time t_b. Thus, Dirac imagined how to measure M_b and N_b with t_b /t_e or t_b. From formula (1) to (9), with the wrong numerical values of H_o=170km/s/Mly and the corresponding $t_b = 20\times10^8$yrs got in 1937, Dirac got two wrong results: Gt_b = constant, and from formula (9), $N_p = (3.14\times10^{39})^2$, $(t_b / t_e) \approx 6.76\times10^{39}$, $(t_b / t_e)^2 = (2.6\times10^{39})^2$, but **our universal real age at present $A_o = 13.7\times10^9$yrs**, according to Dirac's formula (13), $N_{p137} = 20.5\times10^{80} = (4.5\times10^{40})^2$, $t_{b137} / t_e = 4.6\times10^{40}$, so, $(t_{b137} / t_e)^2 = (2.15\times10^{40})^2$. It can be seen that, the ratio $N_p/(t_b / t_e)^2$ from 3.14/2.6 = 1.2 to 4.6/2.15 =2.13 had increased in about 1 time. **[2]. However, Dirac's idea of measuring M_b and N_b with t_b/t_e has still**

had significant. Changing the time t_e of light passing through the electron radius R_e into the time t_{bo} of light passing through r_b of MGBH, according to the theory of BH, the correct result was calculated above, i.e. $\mathbf{R_t = t_b/t_{bo} = 8.64\times10^{60}}$, $\mathbf{R_m = M_b/m_b = 8.75\times10^{60}}$ **and** $\mathbf{R_n = N_p/n_p = 8.72\times10^{60}}$, **then,** $\mathbf{M_b/m_b = N_p/n_p = t_b/t_{bo}}$. **It can be seen that all above numerical ratios calculated by the theory of BH are perfectly consistent and harmonious under the condition of G = constant. It shows again that explaining the expansion of our universe with the theories of BH is completely correct. Owing to no BH and the theory of BH appeared in 1937, Dirac had no way to know** $\mathbf{t_b/t_{bo} = 8.64\times10^{60}}$, **it let Dirac derive the wrong conclusion of** $\mathbf{N_p = (t_b/t_e)^2}$ **from his** $\mathbf{t_b/t_e \approx 10^{39}}$ **got in 1937**. **[3]. Importantly, Dirac's way of establishing a general equation with the coincidence between two special equal large numbers of no dimension would not be an effective, reliable and correct thinking.**

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References:

[1]. Zhengyi Yan, Piwei Wang,Shiwei Jin: Large Number Hypothesis and the structure of matter. bbs.zxxk.com/dispbbs.
[2]. Zonyuan Wu: Dirac and the physical beauty., http://163.20.22.171/science/content/1995/00040304/0018.htm
[3]. Steven Wienberg. The First Three Minutes: Chinese Edition. Foreign Translating company of China. 1999
[4]. Dongsheng Zhang: New Concepts to Big Bang And Black Holes—Both Had No Singularity at All (Part 2). Nature and Science, 3(1), or debate-001, 2004, ISSN:1545-0740, Published by Marsland Company, P.O.Box 753, East Lansing, Michigan, MI 48826 U.S.A. Or http://www.sciencepub.org/nature/debate
[5]. Dongsheng Zhang: New Concepts to Big Bang And Black Holes—Both Had No Singularity at All (Part 1) Nature and Science, 2(4), or debate-001, 2004, ISSN:1545-0740, Published by Marsland Company, P.O.Box 753,East Lansing, Michigan, MI 48826 U.S.A.. Or http://www.sciencepub.org/nature/debate
[6]. Dongsheng Zhang: "New explanations to the accelerating expansion of our universe: It might be caused from the collision between two universal black holes in their early years" http://www.sciencepub.org/nature/0503
[7]. NASA • Webmaster: Britt Griswold • NASA Official: Dr. Gary F. Hinshaw • Page Updated: Tuesday, 04-29-2008. http://map.gsfc.nasa.gov/universe/uni_age.html