15% Increased age of the Universe agrees with explanation of Pioneer Effects by Pseudo-Inverse Dirac Gravitation

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Stanek et al [1] discovered that the age of the Universe is not 13.7 but 15.8 Billion years. We found the age of the Universe to be 16.2 Billion years (submitted to Nature …April 2006) from an evaluation of the Pioneer effect discovered by Anderson et al [2]. This is in full support of the results of Stanek et al [1] and may mutually confirm both results [1] and [2].

Our model with an inverse Dirac gravitation explains the observation of Anderson et al [2] from the motion of space probes Pioneer 10 and Pioneer 11 at distances of 10 to 15 AU from the sun, that during 8 years an *additional acceleration* towards the sun of $a_P = (8\pm3)\times10^{-8}$ cm/s^2 as measured in addition to the standard acceleration. Though it seems to be not finally solved whether this observation is due to experimental problems with the space probes or gravitational disturbances within the planetary system, a number of theories were discussed including dark matter and other possible effects [3]. Consequences by inversion and modifying the Dirac gravitation are presented in the following.

The more precise evaluation of the measurement of the pioneer effect [2] resulted in [3]

$$a_P = (8.74\pm1.33)\times10^{-8} \text{ cm/s}^2 \qquad (1)$$

Though it seems to be not finally solved whether this observation is due to experimental problems needing improvement of accuracy or search for smaller accelerations with the space probes or gravitational disturbances within the planetary system, a number of theories were discussed including dark matter and other internal or external possible effects [3].

Presuming that a temporal change of the gravitation constant G is confirmed and that this change is not a local process within the solar system but that this change may be generally in space, it seems that a consideration of the variation of the gravitation G on time t of the universe as in Dirac's large number theory [4,5] may be interesting to consider and to check in the following the implications of these aspects.

Dirac [2,3] gave good reasons from the lage number hypothesis {see Eq. (4) of Ref. [5]} that the ratio

$$e^2/(Gm_e/m_p) \; = \; \propto t \qquad (2)$$

where the electron charge e and the masses m_e of the electrons and protons m_p was assumed to be really constant. In this case, according to Dirac, the graviation constant G has then to be inversely proportional to the time t of the Universe

$$G = \propto 1/t \qquad (3)$$

Resulting in

$$G_{Dirac} = G_o t_o/t \qquad (4)$$

where t_o is the age of the universe and the gravitation constant $G_o = 6.673\times10^{-8}$ $cm^3g^{-3}s^{-2}$.

The pioneer effect is going into the other direction showing growth of G on t. A simple invesion of the Dirac formulation (4) arrives at a significantly higher age of the universe and cannot be used. We are going to modify this inversion in the following for adjusting with the measurements. This at least would exclude the difficulties with the formulation (1) which were indicated by Teller [6] since we shall have then an increase of the graviation on time with consequences on cosmology avoiding the singularity at the big bang.

Since the error bar of the measurement of a_P (1) is still quite large, we may use rough average numbers in the following. Taking the average increase per year y of the acceleration of a_P we have an annual increase of $a^*=1.062\times10^{-8}$ cm/s^2y. The gravitational acceleration from the sun at 12 AU is $a_s=4.07\times10^{-3}$ cm/s^2. If the additional acceleration would increase linearly, this would mean that there is an annual increase of the gravitation constant G of

$$a^*/a_s = 2.6\times10^{-6} \text{ per year} \qquad (5)$$

This is indeed a small value which would become significant only within one million years, however this is too large for the age of the universe of $t_o=1.628\times10^{10}$ years [7].

Trying an inverse Dirac gravitation but modified by an exponent α,

$$G = G_o(t/t_o)^\alpha \qquad (6)$$

we can fit the measured value (1) with the following time dependence of the gravitation growing on the age of the Universe t_o

$$G = G_o(t/ t_o)^{0.546} \qquad (7)$$

One may speculate how the result (7) would fit much better with the development after the big bang. At the time zero, Dirac's gravitation (2) would be infinite, what is a difficult consequence. In the case of (7) graviation would be zero at t = 0 and growing nearly with the square root on the time but with the singular onset

$$\partial G/\partial t = \infty \text{ at } t = 0, \qquad (8)$$

indicating how important gravitation is at the beginning of the Universe.

All these speculations may have to be modified in the case that the elementary constants h, c and e are not constant from a possible change of the fine structure constant [8] or even of c [9]. It may well be that the result (2) is better fitting with the theory of gravitation based on Dirac's Zitterbewegung [10] which is reproduced from the subrelativistic approximation of the Klein-Gordon equation as an additional term to the Schrödinger equation (see E.T. Jayes in Ref. [11]). The questions relate to the "dark energy" [10] or other whether the laws of nature change with time. The most interesting question is for cosmology where the law of the kind (6) or (7) with an α between 0 and 1 could exclude the singularity of the Dirac gravitation at the big bang and the problems indicated by Teller [6]. Infinite gravitation would be a problem for the motion of photons between masses immediately after the big bang while a zero gravitation (7) at this stage could well be assumed , however only under the condition (8) – possible only if α is between 0 and 1 that there is a singularity kind of creation of gravity. In this case gravity would not be directly associated with any physical quantity [12], see the discussion of Uzan [13] in connection with quantum gravity and the Planck length [14].

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