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A Theory of Evolving Natural Constants Based on the Unification of General Theory of Relativity and Dirac's Large Number Hypothesis

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Abstract: Taking Dirac's large number hypothesis as true, we have shown [Commun. Theor. Phys. (Beijing, China) 42 (2004) 703] the inconsistency of applying Einstein's theory of general relativity with fixed gravitation constant G to cosmology, and a modified theory for varying G is found, which reduces to Einstein's theory outside the gravitating body for phenomena of short duration in small distances, thereby agrees with all the crucial tests formerly supporting Einstein's theory. The modified theory, when applied to the usual homogeneous cosmological model, gives rise to a variable cosmological tensor term determined by the derivatives of G, in place of the cosmological constant term usually introduced ad hoc. Without any free parameter the theoretical Hubble's relation obtained from the modified theory seems not in contradiction to observations, as Dr. Wang's preliminary analysis of the recent data indicates [Commun. Theor. Phys. (Beijing, China) 42 (2004) 703]. As a complement to Commun. Theor. Phys. (Beijing, China) 42 (2004) 703 we shall study in this paper the modification of electromagnetism due to Dirac's large number hypothesis in more detail to show that the approximation of geometric optics still leads to null geodesics for the path of light, and that the general relation between the luminosity distance and the proper geometric distance is still valid in our theory as in Einstein's theory, and give the equations for homogeneous cosmological model involving matter plus electromagnetic radiation. Finally we consider the impact of the modification to quantum mechanics and statistical mechanics, and arrive at a systematic theory of evolving natural constants including Planck's $\hbar$ as well as Boltzmann's k_B by finding out their cosmologically combined counterparts with factors of appropriate powers of G that may remain truly constant to cosmologically long time.

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