The graviton background vs. dark energy

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Abstract

In the model of low-energy quantum gravity by the author, cosmological redshifts are caused by interactions of photons with gravitons. Non-forehead collisions with gravitons will lead to an additional relaxation of any photonic flux. It gives a possibility of another interpretation of supernovae 1a data. Every massive body would be decelerated due to collisions with gravitons that may be connected with the Pioneer 10 anomaly. This mechanism needs graviton pairing and "an atomic structure" of matter for working it. Also an existence of black holes contradicts to the equivalence principle: any black hole should have a gravitational mass to be much bigger - about three orders - than an inertial one.

1 Introduction

A very interesting situation exists today: the standard cosmological model explains observations only under the circumstance that almost all matter and energy of the Universe are hidden in some unknown *dark* forms. It may mean that this model is based on some false conjectures. An alternative

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interpretation of flat rotation curves of galaxies was proposed by Mordehai Milgrom (for example, see [1]). His idea gives us a possibility to introduce a dependence of gravity on an environment. The characteristic acceleration for a transition to another gravity strength has the order of Hc, where H is the Hubble constant, and it is of the same order as the anomalous additional acceleration of the Pioneer 10/11 [2]. I do not think that this finding may be laid in a basis of a future theory of gravity but it is a good heuristic prompt - what one would expect to get. It seems to me that an attempt by Jacob Bekenstein to build up a relativistic theory of such the kind [3] is not deeper in a logical sense: it contains an arbitrary function which must be chosen by hand, too.

I would like to present here[1] my model of low-energy quantum gravity based on the idea of an existence of the background of super-strong interacting gravitons (for more details, see [4]). In the model, a cosmological redshift is caused by interactions of photons with gravitons. Non-forehead collisions with gravitons lead to a very specific additional relaxation of any photonic flux that gives a possibility of another interpretation of supernovae 1a data - without any kinematics or dark energy.

2 The graviton background and the Universe without any expansion and dark energy

Average energy losses of a photon with an energy E on a way dr through the graviton background will be equal to: $dE = -aEdr$, where $a = H/c$. Let us introduce a new dimensional constant D, so that: $\sigma(E, \epsilon) = D \cdot E \cdot \epsilon$, $\sigma(E, \epsilon)$ is a cross-section of interaction by forehead collisions of a photon with an energy E and a graviton with an energy ϵ. Then we can compute the Hubble's constant in this approach: $H = (1/2\pi)D \cdot \bar{\epsilon} \cdot (\sigma T^4)$, where $\bar{\epsilon}$ is an average graviton energy, and T is a temperature of the background. The constant D should have the value: $D = 0.795 \cdot 10^{-27} m^2/eV^2$; the one may be found from the Newtonian limit of gravity. If r is a geometrical distance from a source, then we have for $r(z)$, z is a redshift: $r(z) = ln(1 + z)/a$. None-forehead collisions of photons with gravitons of the background will lead to a scatter of photons and to an additional relaxation of a photon

[1]This paper was also poster presented at the Alternative Gravities and Dark Matter Workshop, Edinburgh, UK, 20-22 April 2006

flux, so that the luminosity distance D_L is equal in this approach to: $D_L = a^{-1}\ln(1+z)\cdot(1+z)^{(1+b)/2} \equiv a^{-1}f_1(z)$, where $f_1(z) \equiv \ln(1+z)\cdot(1+z)^{(1+b)/2}$, and the factor b can be calculated: $b \simeq 2.137$. To compare this predicted dependence $D_L(z)$ with the observational supernova data by Riess et al. [5], let us introduce distance moduli $\mu_0 = 5\log D_L + 25 = 5\log f_1 + c_1$, where c_1 is an unknown constant (it is a single free parameter to fit the data); f_1 is the luminosity distance in units of c/H. In Figure 1, the Hubble diagram

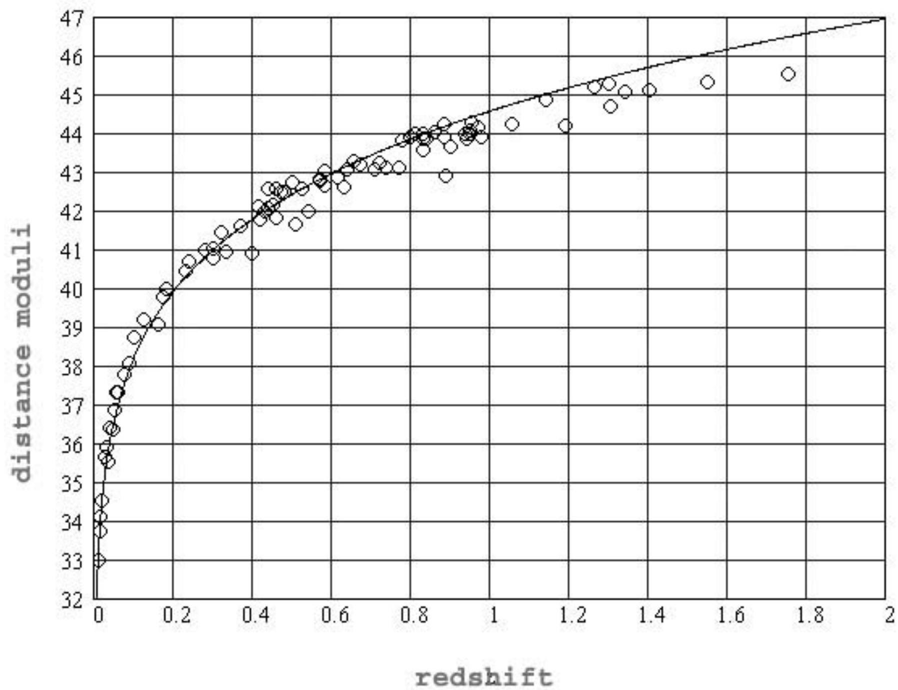

Figure 1: Comparison of the theoretical values of distance moduli $\mu_0(z)$ in this model (solid line) with observations (points) from [5] by Riess et al.

$\mu_0(z)$ is shown with $c_1 = 43$; observational data (82 points) are taken from Table 5 of [5]. The predictions fit observations very well for roughly $z < 0.5$. It excludes a need of any dark energy to explain supernovae dimming; there is not any expansion of the Universe in this model, too. It is difficult to suppose that many observational points would lay on the theoretical curve due to a chance coincidence. Discrepancies between predicted and observed values of $\mu_0(z)$ for bigger redshifts would be explained in the model as a result of specific deformation of SN spectra due to a discrete character of photon energy losses. Also the ones may arise due to gravitational lensing of some supernovae (it is favored with a big scatter of observations in this range of a redshift) or a selection effect.

A result of interaction of any massive body with the graviton background is a body deceleration w which will be directed against a body velocity v *relative to the background:* $w = -Hc(1 - v^2/c^2)$ (this deceleration is an analog of the redshift in the model). It has the same order of magnitude as a value of the observed additional acceleration $(8.74 \pm 1.33) \cdot 10^{-10} m/s^2$ for NASA probes Pioneer 10, 11 [2]. To verify this conjecture about the nature of NASA probes' additional acceleration, one could re-analyze radio Doppler data for the probes. If such the re-analysis will be done by Toth and Turyshev [6], I hope that it may shed a new light on a possibility of the considered here explanation of probes' deceleration. The observed value of anomalous acceleration of Pioneer 10/11 relative to the Earth should represent the vector difference of two accelerations: an acceleration of the probe and an acceleration of the Earth relative to the background. The latter one may manifest itself as an annual periodic term in the residuals of Pioneer 10 [7], and it may represent an essential part of the anomaly.

3 Newtonian gravity in the sea of gravitons

In the sea of gravitons, a pressure force of single gravitons and a repulsive force due to scattered gravitons are approximately equal for any pair of usual bodies. But they are three order greater than the Newtonian force between bodies. It leads immediately to the very surprising conclusion: Einstein's equivalence principle would be roughly violated for black holes, because this repulsive force is equal to zero for them. The ratio of gravitational to inertial masses of a black hole is equal to 1215.4. For a binary system of a black hole and a usual body, the third Newtonian law will be broken, too.

If single gravitons of running flux associate in pairs which are destructed in collisions, then we have for the Newton constant, G :

$$G \equiv \frac{4}{3} \cdot \frac{D^2 c (kT)^6}{\pi^3 \hbar^3} \cdot I_2,$$

where $I_2 = 2.3184 \cdot 10^{-6}$. It follows from this expression that by $T = 2.7K$ the constant D should have the above mentioned value: $D = 0.795 \cdot 10^{-27} m^2/eV^2$. A connection between the two fundamental constants, G and H, can be found in this approach:

$$H = (G \frac{45}{64\pi^5} \frac{\sigma T^4 I_4^2}{c^3 I_2})^{1/2},$$

where $I_4 = 24.866$, and then we have for $H : H = 2.14 \cdot 10^{-18}\ s^{-1}$, or in the more familiar units: $H = 66.875\ km \cdot s^{-1} \cdot Mpc^{-1}$. To have the condition of big distances: $\sigma(E_2, < \epsilon >) \ll 4\pi r^2$ be fulfilled, it is necessary to accept an "atomic structure" of matter, i.e. gravitons cannot interact with big bodies in the aggregate, they may interact only with "small particles" of matter - for example, with atoms.

4 Conclusion

There are many open problems in this approach but there is an impression that we hear something like to a quiet whisper of the nature here. We see a good agreement of the predicted luminosity distance with observations for small z - without any need of dark energy and with the additional factor b which can be calculated in a simple manner. The found here value of the Hubble constant is in a good enough accordance with the majority of present astrophysical estimations. If the mentioned observational facts may be interpreted as manifestations of an existence of the graviton background, it would have a big impact on such fields of physics as cosmology, quantum gravity and particle physics.

References

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