Cosmological observations as a hidden key to quantum gravity

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Abstract

Some important consequences of the model of low-energy quantum gravity by the author are described, which give a possibility to re-interpret such cosmological observations as redshifts of remote objects and the dimming of Suprnovae 1a without any expansion of the Universe and without dark energy, but as manifestations of quantum gravity.

Keywords: low-energy quantum gravity, redshifts, dark energy, cosmological observations.

1 Introduction

In contrast with classical electrodynamics in the XIX century or quantum electrodynamics in the XX century, at present we have a complete lack of experimental evidence to construct a theory of quantum gravity. From dimensional reasons only, if one assumes that the Newton constant is universal for any scales, the effects of quantum gravity are expected to be measurable over extremely small distances or very high energies. There are proposals how to detect some effects in a laboratory - for example, [1, 2], - or to observe a

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possible small violation of the Lorentz invariance for remote sources, but we have not any results in a frame of current paradigms which may pave us to the goal. Another constrain is, as I think, the common expectation that the future theory should be some symbiosis of the geometrical theory of general relativity and quantum mechanics. Geometry is useful for a description of the average motion of big bodies due to the universality of gravitation, but it is not the fact that quantum effects may be described geometrically. It is also necessary to keep in mind that the nature of gravity as well as the nature of quantum behavior of microparticles are unknown - we have remarkable descriptions in different languages but not understanding in both cases.

I describe here briefly some consequences of my approach to quantum gravity [3, 4], in which the phenomenon is a very-low-energy one and is caused by the background of super-strong interacting gravitons. The main quantum effect of this approach is the Newtonian attraction; its small effects enforce us to look at the known results of astrophysical observations from another point of view and give us the reasons to doubt in the validity of the current standard cosmological model.

2 Consequences of the model of low-energy quantum gravity

There are the two circumstances introduced in the model to rich the needed strength of gravitational attraction: 1) gravitons should be super-strong interacting, and 2) a part of gravitons should be paired and the pairs must be destructed by interaction with bodies. It leads to the very unexpected consequence: in the model, a black hole should have different gravitational and inertial masses, i. e. its possible existence contradicts to general relativity. Another unexpected feature of this approach is a necessity of "an atomic structure" of matter, because the considered mechanism doesn't work without it.

The property of asymptotic freedom of this model at very short distances leads to the important consequences, too. First, a black hole mass threshold should exist. A full mass of black hole should be restricted from the bottom with m_0; the rough estimate for it is: $m_0 \sim 10^7 M_\odot$. The range of transition to gravitational asymptotic freedom for a pair of protons is between $10^{-11} - 10^{-13}$ meter, and for a pair of electrons it is between $10^{-13} - 10^{-15}$ meter. This

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transition is non-universal; it means, second, that a geometrical description of gravity on this or smaller scales, for example on the Planck one, is not valid.

The standard cosmological model is based on the assumption that redshifts of remote objects arise due to an expansion of the Universe. The model was re-builded a few times to save this base, the last innovation of it is an introduction of dark energy. Many people are searching for dark energy now or plan to do it, for example, with the help of big colliders. This basic cosmological assumption is considered by the community as a dogma, an invioalable sanctuary of present cosmology. For example, all observations of remote objects in the time domain are corrected for time dilation - but this effect is an attribute only of the standard model. In my model this assumption does not seem to be absolutely necessary. There exists a possibility in the model to interpret observations in another manner, without any expansion of the Universe. In this model, the luminosity distance is

$$D_L = c/H \ln(1+z) \cdot (1+z)^{(1+b)/2},$$

where H is the Hubble constant and c is the light velocity. The luminosity distance is caused here by redshifts due to forehead collisions of photons with gravitons and by the additional relaxation of any photonic flux due to non-forehead collisions of them. The theoretical value of relaxation factor b for a soft radiation is $b = 2.137$. The theoretical Hubble diagram of this model is compared with Supernovae 1a observational data by Riess et al [5] (corrected for no time dilation) on Fig.1. As you can see, the theoretical diagram fits observations very well without any dark energy. In the model, space-time is flat, and the geometrical distance $r(z) = c/H \ln(1+z)$ as a function of a redshift z coincides with the angular diameter distance. Given these expressions for the luminosity distance and the geometrical distance, calculations of expected galaxy number counts has been done.

Any massive body moving relative to the graviton background should suffer in the model the constant deceleration of the order of $\sim Hc$, i. e. of the same order as an anomalous acceleration of the NASA's deep space probes (the Pioneer anomaly) [6]. Recently, it was shown by S. Turyshev et al [7], that the thermal origin of the Pioneer anomaly is very possible. From another side, the mass discrepancy in spiral galaxies appears at very low accelerations less than some a_0 and not much above a_0 [8], where the boundary acceleration a_0 has the same order. The need for dark matter in

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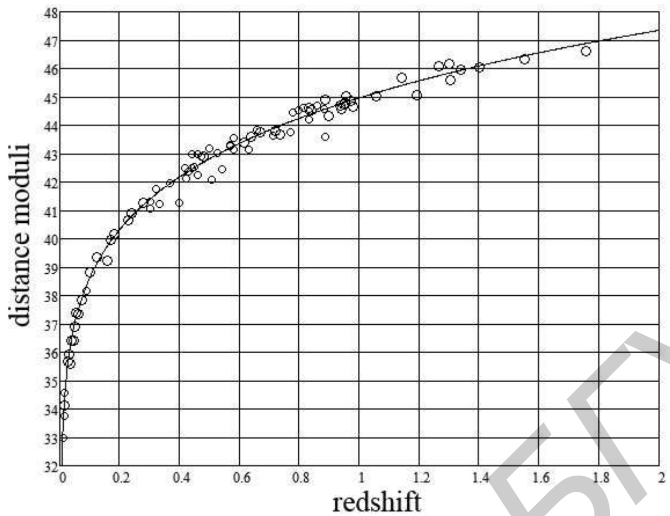

Figure 1: The theoretical Hubble diagram $\mu_0(z)$ of this model(solid); Supernovae 1a observational data (circles, 82 points) are taken from Table 5 of [5] and corrected for no time dilation.

spiral galaxies appears at very low accelerations. A simple alternative to dark matter is MOND by M. Milgrom [9], in which such the boundary acceleration is introduced by hand. The main feature of MOND is the strengthening of gravitational attraction in a case of low accelerations; I do not think that an exact form of this strengthening has been guessed in MOND. But MOND gives us a clear hint that general relativity may be not valid on galactic or bigger scales of distances, and its application in cosmology is in doubt. In my model, the universal deceleration of bodies should lead in any bound system to an additional acceleration of them relative to the system's center of inertia. Some additional strengthening of gravitation on a periphery of galaxies may be caused in the model by the destruction of graviton pairs flying through their central parts whereas pairs flying to the center are destructed in a less degree. The problem is open in this model.

3 Conclusion

A lot of allusions of black holes, the expanding Universe, the Bing Bang and inflation, dark energy and dark matter, the Planck scales of quantum gravity

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compel us to forget that we deal with hypothetical things and we have not direct proofs of their reality. From another side, our attempts to understand quantum gravity have not obvious successes despite huge continuous efforts of many physicists. Perhaps, something is wrong in our interpretations of astrophysical observations and in our expectations about quantum gravity. I gave here another possible interpretation of some observations in my approach, that may be useful to understand such an unknown phenomenon as quantum gravity.

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