

# Model of graviton-dusty universe

By Michael A. Ivanov

Chair of Physics,

Belarus State University of Informatics and Radioelectronics,  
6 P. Brovka Street, BY 220027, Minsk, Republic of Belarus.

E-mail: ivanovma@gw.bsuir.unibel.by.

June 10, 2002

## Abstract

Primary features of a new cosmological model, which is based on conjectures about an existence of the graviton background and superstrong gravitational quantum interaction, are considered. An expansion of the universe is impossible in such the model because of deceleration of massive objects by the graviton background, which is similar to the one for the NASA deep space probes Pioneer 10, 11. Redshifts of remote objects are caused in the model by interaction of photons with the graviton background, and the Hubble constant depends on an intensity of interaction and an equivalent temperature of the graviton background. Virtual massive gravitons would be dark matter particles. They transfer energy, lost by luminous matter radiation, which in a final stage may be collected with black holes and other massive objects.

PACS 04.60.-m, 98.80.-k

## 1 Introduction

In present cosmological models, based on the big bang conjecture, redshifts of remote objects are explained as the Doppler effect. Observation of small additional acceleration of NASA deep space probes [1, 2, 3] may be interpreted

in such a manner, that redshifts of galaxies turn out a quantum gravity effect. As well as probes' acceleration, it would be caused by a hypothetical superstrong gravitational quantum interaction with the graviton background [4]. This new hypothesis about the redshift nature finds further confirmation in confrontation [4] with Supernova Search Team data [6].

In this paper, some features of the cosmological model, which may be constructed on a base of such a new approach, are discussed. They are: the redshift nature; a transfer of energy, which is lost by luminous matter radiation, with virtual massive gravitons; an increment of lifetime of such gravitons due to sequent decreasing their energy by collisions with gravitons of the background; final utilization of virtual massive gravitons in black holes and other massive objects.

## 2 Hypothetical superstrong gravitational quantum interaction and its consequences

If the graviton background exists with the equivalent temperature upwards  $3K$ , then collisions of photons with gravitons of this background will lead to photon redshifts if the interaction is strong enough. A photon energy  $E(r)$  will change with increasing of a distance  $r$  from a source as

$$E(r) = E_0 \exp(-ar), \quad (1)$$

where  $E_0$  is an initial value of energy,  $a = H/c$ ,  $H$  is the Hubble constant.

It is shown in author's paper [4], that a cross-section  $\sigma(E, \omega)$  of interaction of a photon with an energy  $E$  with a graviton, having an energy  $\omega$ , as well as the Hubble constant  $H$  may be expressed with the help of a new dimensional constant  $D$ :

$$\sigma(E, \omega) = D \cdot E \cdot \omega, \quad (2)$$

$$H = \frac{1}{2\pi} D \cdot \bar{\omega} \cdot (\sigma T^4), \quad (3)$$

where  $\bar{\omega}$  is an average graviton energy,  $\sigma$  is the Stephan-Boltzmann constant, with  $D \sim 10^{-27} m^2 / eV^2$  if whole redshift is caused by such the interaction.

An universality of gravitational interaction means that any massive body, moving relatively to the background with a velocity  $v$ , must feel a deceleration

$w$ , which is equal to:

$$w = -Hc(1 - v^2/c^2). \quad (4)$$

For  $Hc = (4.8 - 7.2) \cdot 10^{-10} m/s^2$  by  $H = (1.6 - 2.4) \cdot 10^{-18} s^{-1}$  (i.e. by  $H = (50 - 75) km \cdot s^{-1} \cdot Mpc^{-1}$ ), a magnitude of this deceleration corresponds to the one of observed additional acceleration for Pioneer 10 [1, 2, 3]. The acceleration  $w$  should be directed against a body velocity relatively to the graviton background. The refined data [2] show annual periodic variations of the apparent acceleration. Perhaps, such the variations are connected with Earth's additional acceleration under its orbital motion due to the same interaction with the graviton background [5].

If redshifts of galaxies are really caused by such the effect, then an expected picture of visible Universe changes. A region of the Universe, which is visible by an observer, will not be bounded with a sphere of the Hubble radius  $R_0 = c/H$ , but any source with a temperature  $T_s$  may be picked out by an observer above the microwave background on the distance

$$R < R_0 \ln \frac{T_s}{T}, \quad (5)$$

i.e. for a source with  $T_s \simeq 6000K$  we have  $R < 7.6R_0$ . It is  $R < (100 - 150)$  Gyr for  $R_0 \simeq (13.5 - 20)$  Gyr. An estimate of distances to objects with given  $z$  is changed too; for example, the quasar with  $z = 5.8$  [7] should be in a distance approximately twice bigger than the one expected in the model based on the Doppler effect.

### 3 Utilization of energy, which is lost by visible matter radiation

Unlike models of expanding universe, in any tired light model one has a problem of utilization of energy, lost by radiation of remote objects. In the model, a virtual graviton forms under collision of a photon with a graviton of the graviton background. It should be massive if an initial graviton transfers its total momentum to a photon; it follows from the energy conservation law that its energy  $\omega'$  must be equal to  $2\omega$  if  $\omega$  is an initial graviton energy. In force of the uncertainty relation, one has for a virtual graviton lifetime  $\tau : \tau \leq \frac{\hbar}{\omega}$ , i.e. for  $\omega' \sim 10^{-4} eV$  it is  $\tau \leq 10^{-11} s$ . In force of conservation

laws for energy, momentum and angular momentum, a virtual graviton may decay into no less than three real gravitons. In a case of decay into three gravitons, its energies should be equal to  $\omega, \omega'', \omega'''$ , with  $\omega'' + \omega''' = \omega$ . So, after this decay, two new gravitons with  $\omega'', \omega''' < \omega$  inflow into the graviton background. It is a source of adjunction of the graviton background.

From another side, an interaction of gravitons of the background between themselves should lead to the formation of virtual massive gravitons too, with energies less than  $\omega_{min}$  where  $\omega_{min}$  is a minimal energy of one graviton of an initial interacting pair. If gravitons with energies  $\omega'', \omega'''$  wear out a file of collisions with gravitons of the background, its lifetime has increased. In every such a cycle collision-decay, an average energy of "redundant" gravitons will double decrease, and its lifetime will double increase. Only for  $\sim 93$  cycles, a lifetime will have increased from  $10^{-11}s$  to 10 Gyr. Such virtual massive gravitons, with a lifetime increasing from one collision to another, would duly serve dark matter particles. Having a zero (or near to zero) initial velocity relatively to the graviton background, the ones will not interact with matter in any manner except usual gravitation. An ultracold gas of such gravitons will condense under influence of gravitational attraction into black holes or other massive objects. Additionally to it, even in absence of initial heterogeneity, the one will easy arise in such the gas that would lead to arising of super compact massive objects, which will be able to turn out "germs" of black holes. It is a method "to cold" the graviton background.

So, the graviton background may turn up "a perpetual engine" of the Universe, pumping energy from radiation to massive objects. An equilibrium state of the background will be ensured by such the temperature  $T$ , for which an energy profit of the background due to an influx of energy from radiation will be equal to a loss of its energy due to a catch of virtual massive gravitons with black holes or other massive objects. In such the picture, the chances are that black holes should turn out "germs" of galaxies. After accumulation of big enough energy by a black hole (to be more exact, by a super compact massive object) by means of a catch of virtual massive gravitons, the one must be absolved from an energy excess in via ejection of matter, from which stars of galaxy should form. It awaits to understand else in such the model how usual matter particles form from virtual massive gravitons. It is optimistic that the model of two-component fundamental fermions by the author [19] owns all symmetries of the standard model of elementary particles (on global level). Perhaps, virtual gravitons with very small masses

are fully acceptable to the role of components of such the system. Observation of non-zero neutrino mass [9] increases chances of this model of the fundamental fermions since there is an additional right singlet in the model, which is able to provide a non-zero neutrino mass. Chances of the model will rise still more, if any particle of the forth generation or some indirect indication of its existence will be detected. In author's paper [8], the model of gravity in flat 12-space was described with global  $U(1)$ -symmetry, in which a possibility exists to introduce  $SU(2)$ -symmetry. I hope that unification of these models may give us a clue to hidden still unity of gravity and other known interactions.

## 4 Conclusion

Observations of last years give us strong evidences for supermassive black holes in active and normal galactic nuclei [10, 11, 12, 13, 14] (of course, a central dark mass in galactic nucleus may not be a black hole, but it is most likely to the one by its properties from all known objects; one must remember that we know only that these objects are supermassive and compact). The available evidence is consistent with a suggestion that a majority of galaxies has black holes [10, 15]. The discovery by Gebhardt et al. [16] and Ferrarese and Merritt [17] of a correlation between nuclear black hole mass and stellar velocity dispersion in elliptical galaxies and spiral bulges shows that black holes are "native" for host galaxies. Massive nuclear black holes of  $10^6 - 10^9$  solar masses may be responsible for the energy production in quasars and active galaxies [10]. Doppler-shifted emission lines in the spectrum of active galactic nuclei are likely to originate from relativistic outflows (or jets) in the vicinity of the central black hole [18]. Black hole candidates are also known in binaries, supernovae, and clusters.

In a frame of the model [20] it was suggested that central black holes of early-type galaxies grew adiabatically in homogeneous isothermal cores due to matter accretion. In the present model, a role of black holes in evolution of the Universe is changed; the ones may be collectors of virtual massive gravitons and "germs" of galaxies. Additionally, the growth of black hole mass inside of future supernova stars would lead to their instability and formation of supernovae.

In author's papers [21, 22, 4], the methods were considered how to verify

the conjecture about the described non-dopplerian nature of redshifts. One of them is a ground-based experiment with a superstable laser radiation: if the conjecture is true, then a laser radiation frequency after a delay line should be red shifted too. I believe, that creation of necessary superstable lasers with instability  $\sim 10^{-17}$  would be speeded up after perception by the scientific community of importance of such the verification.

## References

- [1] Anderson, J.D. et al. Phys. Rev. Lett., 1998, v.81, p. 2858.
- [2] S.G.Turyshev et al. XXXIV-th Rencontres de Moriond Meeting on Gravitational Waves and Experimental Gravity. Les Arcs, Savoie, France (January 23-30, 1999). [gr-qc/9903024 v2]
- [3] Anderson, J.D. et al. Phys. Rev. **D65** (2002) 082004. [gr-qc/0104064 v4]
- [4] M.A.Ivanov, General Relativity and Gravitation, **33**, 479 (2001). [Correction of ERRATA: astro-ph/0005084 v2].
- [5] M.A.Ivanov, [gr-qc/0009043]; Proc. of the Int. Symp. "Frontiers of Fundamental Physics 4" (9-13 Dec 2000, Hyderabad, India), Eds B.G. Sidharth and M.V. Altaisky, Kluwer Academic/Plenum Publishers, August 2001; Proc. of the 4th Edoardo Amaldi Conference on Gravitational Waves (Perth, Western Australia, 8-13 July 2001) Class. Quantum Grav. **19**, 1351 (2002).
- [6] A.G. Riess et al. AJ **116**, 1009 (1998).
- [7] X. Fan et al. AJ **120**, 1167 (2000).
- [8] M.A.Ivanov, General Relativity and Gravitation, **31**, 1431 (1999).
- [9] Y.Fukuda et al. Phys. Rev. Lett, **81**, 1562 (1998).

- [10] R. P. van der Marel, 'New Light on Galaxy Evolution', Proc. IAU Symp. 171, Heidelberg, June 1995, R. Bender and R.L. Davies, eds., Kluwer Academic Publishers.
- [11] G. A. V. Kleijn et al. AJ, **120**, 1221 (2000).
- [12] B. M. Peterson and A. Wandel, ApJ, **540**, L13, (2000).
- [13] T. Di Matteo, C. L. Carilli and A. C. Fabian, ApJ, **547**, 731 (2001).
- [14] Kenji Bekki, ApJ, **540**, L79 (2000).
- [15] R. P. van der Marel, 'Galaxy Interactions at Low and High Redshift', Proc. IAU Symposium 186, Kyoto, August 1997, D. B. Sanders and J. Barnes, eds., Kluwer Academic Publ.
- [16] Karl Gebhardt et al. ApJ, **539**, L13 (2000).
- [17] L. Ferrarese and D. Merritt, ApJ, **539**, L9 (2000).
- [18] Jian-Min Wang et al, ApJ, **544**, 381 (2000).
- [19] M.A. Ivanov, Nuovo Cimento, **105A**, 77 (1992).
- [20] R. P. van der Marel, AJ, **117**, 744 (1998).
- [21] M.A. Ivanov, Quantum Electronics and Laser Science Conference (QELS'95), May 21-26, 1995, Baltimore, USA; paper number: QThG1.
- [22] M.A. Ivanov, European Quantum Electronics Conference (EQEC'96), Sept. 8 - 13, 1996, Hamburg, Germany; paper number: QWD1.