A POSSIBLE RED-SHIFT MECHANISM

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As is well known a number of physical mechanisms have been proposed in order to explain the observed red shifts of both local and cosmological significanse. All these models can be classified roughly into two main classes: (a) kinematical models, like Doppler effect, variable fundamental physical constants, for example (b) dynamic phenomena, as it is the model of a nonzero-mass photon colliding with a hypothetical light boson[1], or gravitational photon interaction with ordinary interstellar matter (e.g.,[2]). Besides, there have been suggested intermediate mechanisms, by which cosmological photons lose their energy via an interaction with the large scale gravitational field, emitting gravitons[3] or secondary photons[4].

Here we investigate a possible mechanism from class (b) by which the photon may lose its energy interacting with ordinary matter, emitting gravitational waves. The model is based on the close analogy in behaviour of massless particles and nonzero rest mass corpuscules, that turns out to appear in many physical circumstances. In particular we estimate the intensity of gravitational radiation of the photon during collisions with a massive particle. The aim of this work was to examine another possible correction to Doppler shift, rather than to suggest an alternative to this widely accepted explanation to the red shift observed.

According to General Relativity every acceleration of a particle results in emition of gravitational waves, or gravitons in the language of quantum theory. This prediction should be valid for both massless and nonzero mass particles.[5] Consequently, a photon reflected

by solide surface of a massive body or passing through an optically inhomogeneous medium, should lose its energy via gravitational waves.

A possibility of an experimental investigation of the presumed gravitational energy loss in laboratory conditions has been examined in particular. It is suggested that a prismatic black body box may be used for that purpose and an eventual increase of the light wavelength could be measured after multiple photon reflection from the smooth inner surface.

Preliminary calculations, based on the quadrupole approximation (e.g.,[6]), indicate that the effect is quadratic in the photon energy and the amount of the emitted energy is extremally small. This seems to be in contradiction with qualitative estimate by Fürth[3], where, gravitons are emitted during photon motion along a curvilinear ray trajectory in the cosmological curved space.

Finally, another mechanism which can be partly responsible for the cosmological red shift, based on the so called bunching effect and on Pannerella's hypothesis[7] of an "effective photon", has been suggested and briefly discussed.

1 Z.Marić, M. Moles and J.P.Vigier, Lett. Nuovo Cimento 18 (1977)269; see also B.Dragović, Z.Marić and D.Popović, this Supplement

2 R.C.Tolman, Relativity, Thermodynamics and Cosmology, Clarendon Press, Oxford, 1969.

3 R.Fürth, Phys. Lett. 13 (1964) 221.

4 D.F. Crawford, Nature 227 (1979) 633.

5 S.Weinberg, Gravitation and Cosmology, Wiley, 1972.

6 C.W.Misner, K.S.Thorne and J.A. Whileer, Gravitation, W.H.Freeman, San Francisco, 1973.