RED SHIFT ATOMIC AND NUCLEAR LEVELS AND THE PROBLEM OF ENERGY SPECTRUM SHIFT OF PHOTONS (g -QUANTA) IN THE GRAVITATIONAL FIELD

Kh.M. Beshtoev
Joint Institute for Nuclear Research, Joliot Curie 6, 141980 Dubna,
Moscow region, Russia, beshtoev@cv.jinr.dubna.ru

The radiation spectrum (or energy levels) of atoms (or nuclei) in the gravitational field has a red shift

$$E_{nm} = hn_{nm}, \qquad \frac{\Delta n_{nm}}{n_{nm}} = \frac{j(r)}{c^2} = -\frac{\Delta l_{nm}}{l_{nm}} \quad , \tag{1}$$

since the effective mass m_{eff} of radiating electrons (or nucleons) changes in this field

$$\Delta mc^2 = |E_{\mathrm{int}}| = m|j(r)|, \qquad m_{eff} = m - \Delta m \quad . \tag{2}$$

This red shift is equal to the red shift of the radiation spectrum in the gravitational field measured in existing experiments.

The same shift must arise when the photon (or g -quantum) is passing through the gravitational field if it participates in gravitational interactions

$$\frac{\Delta m_{pho}}{m_{pho}} = \frac{\Delta n}{n} = \frac{\Delta j}{c^2} \quad , \tag{3}$$

where

$$m_{pho} = \frac{E_{pho}}{c^2} = \frac{hn}{c^2} \quad . \tag{4}$$

The absence of the double effect in the experiments means that photons (or g -quanta) are passing through the gravitational field without interactions.