A Quantum Phenomenon that Forces the Extra Energy Shift in Mössbauer Rotor Experiment

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Abstract: Here, within the Scale-Symmetric Theory (SST), we described a quantum phenomenon that forces a rapid additional increase in the coefficient k which defines the Mössbauer rotor experiment (k increases from 0.5 predicted within the General Theory of Relativity to 0.714). The extra energy shift follows from the interactions of photons with virtual charged pairs produced at the cost of the relativistic mass. Production of such pairs results from the atom-like structure of baryons described within SST. We as well answered following question: Why are there so many different theories of gravity?

1. Introduction

We can calculate the relative energy shift $\Delta E/E$ between the source of resonant radiation, which is placed at the centre of the rotating system in the Mössbauer experiment, and the resonant absorber, which is situated on the rotor rim [1]

$$\Delta E/E = - k\, u^2 / c^2 \,, \qquad (1)$$

where k is some coefficient, u is the tangential velocity of the resonant absorber, and c is the velocity of light in "vacuum".

Within the General Theory of Relativity (GTR), because of the special relativistic time dilation for the rotating resonant absorber, it was predicted that $k = 0.5$ [1]. On the other hand, the experimental results for k are shifted

$$k = 0.596 \pm 0.006 \text{ [2], [3] (1963).} \qquad (2a)$$

$$k = 0.66 \pm 0.03 \text{ [4] (2009).} \qquad (2b)$$

$$k = 0.69 \pm 0.02 \text{ [5] (2015).} \qquad (2c)$$

We can see that with time the central value of k increases.

Here, within the Scale-Symmetric Theory (SST) [6], [7], we described a quantum phenomenon that forces a rapid additional increase in the coefficient k, which defines the Mössbauer rotor experiment, from $k = 0.5$ to the maximum value $k = 0.714$.

According to SST, the phase transitions of the initial inflation field lead to five different energy/size scales in Nature and to the atom-like structure of baryons [6], [7]. In nucleons there is the core with a mass of $H^+ = 727.44$ MeV [7]. Outside it is relativistic pion in the $d = 1$ state [7]. The core consists of torus/electric-charge with a mass of $X^+ = 318.30$ MeV and central condensate [7].

2. Calculations

Within GTR, for $u << c$, we can write following expression

$$(\lambda_{emitted} - \lambda_{received}) / \lambda_{emitted} = (E_{received} - E_{emitted}) / E_{emitted} = \Delta E/E \approx$$

$$\approx - (3/2 - 1)\, u^2 / c^2 = - 0.5\, u^2 / c^2. \tag{3}$$

On the other hand, the very small increase in relativistic mass of the rotor forces a rapid increase in number density of the virtual X^+X^- pairs. The resonant radiation is emitted via the H^+ cores and is absorbed via the virtual X^+X^- pairs. Lengths of radiation $\lambda_{emitted}$ and $\lambda_{received}$ are inversely proportional to masses the radiation interacts with i.e.

$$\lambda_{received} / \lambda_{emitted} = H^+ / (X^+ + X^-) = f = 1.1427\ . \tag{4}$$

It additionally increases $\lambda_{received}$. It leads to conclusion that we can rewrite formula (3) as follows

$$\Delta E/E \approx - (f\, 3/2 - 1)\, u^2 / c^2 = - 0.714\, u^2 / c^2, \tag{5}$$

i.e. $k = 0.714$ which is the upper limit.

3. Summary

There are three different explanations for the elevated value of the coefficient k. The Corda suggestion (higher value than $k = 0.5$ is due to a clock synchronization) leads to $k = 0.667$ [1]. There is some description within the YARK gravitation theory which leads to $k = 2/3$ (it is due to "a natural symbiosis of YARK theory with quantum mechanics") [8]. Presented here within the Scale-Symmetric Theory the origin of the shifted k suggests that due to a quantum phenomenon, there should be a rapid increase in k from 0.5 for $u \rightarrow 0$ ($u \neq 0$) to $k = 0.714$ (it should be an asymptote).

To find out which description leads to a result consistent with experimental data, we have to reduce uncertainties and errors by one order of magnitude, that is to about ± 0.001.

Why there is great freedom in interpreting the results received for the Mössbauer experiment in a rotating system? SST shows that there is the two-component spacetime and both components are grainy [7]. The first component is the SST Higgs field – it consists of the non-gravitating tachyons with infinitesimal spin. When we neglect the infinitesimal spin then we cannot explain the matter-antimatter asymmetry. The second component is the flat Einstein spacetime (ES) composed of the spin-1 neutrino-antineutrino pairs moving with the speed c in relation to the stable boundary of ES (only then the physical constants are constant [7]). The ES components can be entangled or confined and then gravitational-mass density can be higher than the mean – such masses curve the SST Higgs field. The inertial-mass density of the flat ES is about 42 orders of magnitude higher than the SST Higgs field [7]. It means that the two-component spacetime as a whole is flat but there is the curved component which is associated with the geometry in GTR. Existence of the ES causes that there can appear the YARK-type gravitation theories as well – there instead of the geodesic motion in a curved spacetime (precisely, in the curved SST Higgs field) as it is in GTR, there is a dynamical equation of motion for a test particles in a flat spacetime (precisely, in the flat Einstein spacetime) governed by the force resulting from the spatial variation of the static gravitational binding energy [9].

Notice that the gravitational energy associated with the flat ES can be localized (i.e. in YARK theory can be localized) but the gravitational energy associated with the gradients/gravitational-fields in the SST Higgs field cannot (i.e. in GTR). It is easier to describe correctly some phenomena within GTR (because of the curved SST Higgs field) and it is easier to describe correctly some phenomena within YARK theory (because of the flat ES and localized gravitational energy – gravitational energy is localized inside the ES components and is distributed across the outer Cosmos).

We can see that both theories GTR and YARK are the incomplete theories but we can use them to solve correctly some selected problems. Both theories do not take into account that the speed c is the speed of photons or gluons in relation to objects with which they are entangled – it can be a source or a last-interaction object so it can be a detector as well (it means that GTR is the theory of observer).

Why are there so many different theories of gravity? It is because

- there is the two-component grainy spacetime,
- the invariance of c for Nature itself is incorrect, and
- we neglect internal structure of bare particles.

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