

Gravitational waves from atoms

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Abstract: *The periodic motion inside atoms is sufficiently extreme to modify gravitational properties of materials. This effect can be evaluated from experiments.*

Keywords: *gravitational waves, gravitational constant*

The finite speed of interaction causes retarded potentials that depend on a relative velocity [1]. The first order in $\beta=v/c$ vanishes in the time average for the group of bodies that it is not in a relative movement to the “observer”. Nevertheless the second order does not vanishes and we can write for the potential difference

$$\langle \delta\varphi \rangle \approx \varphi \left(\frac{\alpha E_k}{c^2} \right).$$

I.e. the correction can be approximated as a potential for some factor α of kinetic energy E_k instead of source mass. The gravitational binary mergers have relativistic speeds and large accelerations. However protons in atomic nucleus have also relativistic speeds and larger accelerations. Thus this effect per mass can be large in atoms (due to the coupling by stronger non-gravitational interaction). It can cause observable difference in gravitational potential (the gravitational constant evaluation) of source masses in the big G experiments [2] (it can be different due to a difference in charge and mass distributions). The acceleration of different test masses is the same in the same potential (the equivalence principle). However the generated potential/acceleration slightly differs by this gravitational radiation “pressure” of different source mass materials with different binding energies (internal kinetic energies). The radiated power at high frequencies (10^{23} Hz) can be in order of watt per kg of atomic nuclei according to the equation such as

$$P_g \cong \left(\frac{2G}{45c^5} \right) m^2 l_0^2 (\Delta l)^2 \omega^6$$

from e.g. [3]. I.e. the energy mc^2 in mass has time constant corresponding to the size of observable universe and the speed of light. It does not mean a finite time (Big Bang or Big Crunch) but the average retardation time constant (for equilibrium and for the fulfillment of the laws of conservation) that is different for different elements.

- [1] P. Křen: Correction due to the finite speed of gravity in absolute gravimeters, 2013, <http://gsjournal.net/Science-Journals/Research%20Papers-Relativity%20Theory/Download/5134>
- [2] P. Křen: The momentum and gravity, 2015, <http://gsjournal.net/Science-Journals/Research%20Papers-Gravity/Download/5980>
- [3] V.N.Rudenko: Optimization of parameters of a couple generator-receiver for a gravitational Hertz experiment, 2003, <http://arxiv.org/ftp/gr-qc/papers/0307/0307105.pdf>