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Observation of space parity gravitational violation in laser-Compton scattering

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Gravity independence on rotations or spin direction is postulated in general relativity and experimentally constrained for low energy, non-relativistic matter. An evidence for high energy CP violation in gravitational field has recently been found in the HERA Compton polarimeter's 2 spectra measured with electron and positron beams. Here I report analysis results of 838 thousand spectra, acquired during the 2004-2007 running period and tagged by laser polarization state. The tagged spectra allow to separate charge (C) and space (P) parity contributions. While the C asymmetry is contaminated by change of the accelerator parameters for the electron and positron runs, the laser helicity frequent flips eliminate most of the potential systematic errors. Measured Compton edge energy asymmetry induced by the laser helicity change is as high as $(4.62 \pm 0.06) \times 10^{-5}$ which corresponds to helicity dependent gravitational potentials' difference of $(8.1 \pm 0.1) \times 10^{-15}$. The measured sign applies a stronger gravitational coupling to left helicity particles. In case of the observed coupling universality i.e. energy independence, the gravity will induce 3.69 ± 0.05 GHz and 2.01 ± 0.02 MHz spin resonances in nuclei and atoms respectively.

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