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Perspectives of measuring the gravitational field of laser light and ultrarelativistic particle beams

We study possibilities of creation and detection of oscillating gravitational fields from high energy laser beams in an optical cavity and from the ultra-relativistic proton bunches circulating in the beam of the Large Hadron Collider (LHC) at CERN. These sources allow for signal frequencies much higher and far narrower in bandwidth than what most celestial sources produce. In addition, by modulating the beams, one can adjust the source frequency over a very broad range, from Hz to GHz. The gravitational field of these sources and responses of three different detectors are analyzed: a Weber-bar type mechanical rod, a detector based on superfluid helium-4 coupled parametrically to a superconducting microwave cavity, and a monolithic pendulum. We find that with the planned high-luminosity upgrade of the LHC and an improved design of a recently experimentally demonstrated monolithic pendulum, a signal to noise ratio substantially larger than 1 should be achievable. This opens new perspectives of studying general relativistic effects and possibly quantum-gravitational effects with ultra-relativistic, well-controlled terrestrial sources.

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Short summary of your poster content

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Poster printing

Yes

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