Contribution ID: **310** Type: **Talk in a parallel session**

Perspectives of measuring the gravitational attraction of ultra-relativistic particle beams: A potential new testbed for gravitational theory

Monday, 8 July 2024 16:00 (30 minutes)

The Newtonian law of non-relativistic gravity has been tested in many laboratory experiments with very high precision. In contrast, the gravitational field of ultra-relativistic matter, dominated by kinetic energy and stresses, has not been measured directly. I will examine the gravitational field of moving source masses in general relativity and scalar-tensor theory. The latter serves as an example to show that ultra-relativistic source velocities can enhance the difference of the gravitational effect on gravity sensors predicted by theories of modified gravity and general relativity significantly. This makes new regimes of gravitational theory accessible for tests, in principle. I will then report on perspectives to detect the gravitational attraction due to proton bunches at the Large Hadron Collider (LHC). Bounds on the necessary sensitivity will be given and compared with abilities of state-of-the-art optomechanical sensors. Due to the length of the LHC's proton beam of 27 kilometers, correlated measurements with many detectors could facilitate the measurement. I will shortly dicuss the possibility to coherently couple sensors to achieve the optimal scaling with their number.

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Session Classification: Experimental graviation

Track Classification: Experimental Gravitation (EG): Experimental graviation