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Type: Talk

The Archimedes experiment: can quantum vacuum feel gravity?

Monday 2 September 2024 11:00 (20 minutes)

Among the most surprising predictions coming from General Relativity, one in particular is about the weight of material bodies. According to Einstein theory, such classical quantity should not be only due to the amount of substance in bodies, but it should also depend from the amount of stress and internal energy stored inside them. Being General Relativity a classical theory, such prediction is generally considered valid for classical energy terms (although no experiment was ever set up to test it). Nothing certain can be said for energy terms coming from Quantum Field Theory, because of its mathematical and physical incompatibility with Einstein theory.

Within this background, the Archimedes experiment aims to investigate the relationship between zero-point quantum fluctuations of the electromagnetic field and gravity.

Although Archimedes is a human-scale experiment in fundamental physics, it involves several other research fields: high T_c superconductivity, cryogenics, precision mechanics and optical interferometry are the main field on which the experiment is based.

Without going into the details of the measurement strategy (which will be described during the talk), the general idea is to measure weight variation in special samples where vacuum energy is modulated in time by exploiting superconductive transition. The expected weight variation is so small that a highly sensitive beam-balance has been realized for the scope and placed in one of the most seismically quiet sites of all Europe: the SarGrav Laboratory at the Sos-Enattos, in Sardinia (candidate site for hosting the third-generation Gravitational Waves detector Einstein Telescope).

The tilt sensitivity of Archimedes prototype, installed in the same laboratory, is currently thermal-noise limited, and has been measured to be below $10^{-12} Nm/\sqrt{Hz}$ in the frequency band 20 mHz - 70mHz, which makes it one of the most sensitive beam-balance in the world in this frequency range. The final setup of the Archimedes experiment is now fully installed, the first sensitivity measurement in vacuum is expected by the end of 2024, while the final measurement of the vacuum fluctuations' weight is forecast to be performed within 2026.

Internet talk

Maybe

Is this an abstract from experimental collaboration?

Yes

Name of experiment and experimental site

Archimedes experiment, SAR-Grav Laboratories in Sos-Enattos, Sardinia.

Is the speaker for that presentation defined?

Yes

Details

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