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Archimedes experiment: weighing the vacuum

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One of the oldest questions concerning quantum mechanics and gravitation is whether vacuum fluctuations do gravitate. The question of the weight of vacuum was raised soon after the birth of quantum mechanics and many theoretical attempts were performed to explore the motivations and consequences of assuming or discarding such hypothesis, and yet today there is no complete theoretical agreement.

From an experimental point of view it is remarkable that no direct measurement has been carried out to date.

Considering that nowadays the scientific community interprets the

Casimir effect as a macroscopic manifestation of vacuum fluctuations, we recently proposed an the ARCHIMEDES experiment

to test the interaction of vacuum fluctuations with gravity by weighing in a suitable rigid Casimir cavity.

Our goal is to weight the zero point energy by weighing the condensation energy of a layered type II superconductor, where Casimir Energy is expected to sensibly contribute to the condensation energy.

In this talk, the experimental scheme and the sensitivity needed for the final measurement will be illustrated.

Moreover the present preliminary results reached with the first prototype (realized in the Gravitation Physics Laboratory in Naples)

will be presented, showing a torque sensitivity of about $10^{-11} Nm\sqrt{Hz}$ in the frequency range from 50 mHz up to 150 mHz;

the major upgrades needed and the derived hints to realize the next

ARCHIMEDES prototype, aimed at the desired final sensitivity, will be discussed. This will be the first experiment hosted in the under-construction Sos-Enattos SAV-GRAV laboratory in the North-East

of Sardinia - Italy. This site, which has been studied over long-term seismic investigations in

the framework of the site selection for the Einstein Telescope (ET), is particularly suited for the ARCHIMEDES experiment, being one of the lowest seismic noise location in Europe.

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