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Constraints on axionlike particles and non-Newtonian gravity from measuring the difference of Casimir forces

Klimchitskaya G., Mostepanenko V.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2017 American Physical Society. We derive constraints on the coupling constants of axionlike particles to nucleons and on the Yukawa-type corrections to Newton's gravitational law from the results of recent experiment on measuring the difference of Casimir forces between a Ni-coated sphere and Au and Ni sectors of a structured disc. Over the wide range of axion masses from 2.61 meV to 0.9 eV the obtained constraints on the axion-to-nucleon coupling are up to a factor of 14.6 stronger than all previously known constraints following from experiments on measuring the Casimir interaction. The constraints on non-Newtonian gravity found here are also stronger than all that following from the Casimir- and Cavendish-type experiments over the interaction range from 30 nm to 5.4 μm. They are up to a factor of 177 stronger than the constraints derived recently from measuring the difference of lateral forces. Our constraints confirm previous somewhat stronger limits obtained from the isoelectronic experiment, where the contribution of the Casimir force was nullified.

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