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Resonance spectroscopy of antihydrogen gravitational quantum states

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Resonant transitions between gravitational quantum states of antihydrogen near material surface can be induced by weak alternating magnetic field. Such an approach opens an opportunity for precision meausrement of energy spacing between quantum gravitational states and thus determination of antihydrogen gravitational mass. Behavior of antihydrogen atom near material surface in gravitational field of the Earth and alternating inhomogeneous magnetic field is studied. Characteristic field intensities and gradients required for efficient resonant transitions between gravitational states are established. The methods of precision resonant spectroscopy are analyzed.

Summary

Long-living states of antihydrogen near material surface in gravitational field of the Earth is a quantum phenomena which is explained by over-barrier reflection of slow atoms from Casimir-van der Waals atom-surface potential. Such states could become a promising laboratory for antimatter gravitational properties study. We discuss the main properties of such states, including level spacing, spatial scale and lifetime. In the presense of alternating gradient of magnetic field antiatoms undergo resonant transitions between gravitational states. We study dynamics of such transitions and show how resonant spectroscopy methods could be used for precision measurement of antihydrogen gravitational mass.

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