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Gravity tests at short distances using ultracold neutrons: A review of the qBounce experiment

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Neutrons are excellent probes to test gravity at short distances –electrically neutral and only hardly polarizable. Furthermore, very slow, so-called ultracold neutrons form bound quantum states in the gravity potential of the Earth. This allows combining gravity experiments at short distances with powerful resonance spectroscopy techniques, as well as tests of the interplay between gravity and quantum mechanics. In the last decade, the qBounce collaboration has been performing several measurement campaigns at the ultracold and very cold neutron facility PF2 at the Institut Laue-Langevin in Grenoble/France. A new spectroscopy technique, Gravity Resonance Spectroscopy, was developed and snapshots of falling wavepackets of these gravitationally bound quantum states were recorded. The results were applied to test gravity at micron distances as well as various Dark Energy and Dark Matter scenarios in the lab, like Axions, Chameleons and Symmetrons.
In my talk, I will review the experiments, explain key technologies and summarize the results obtained.

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