

# **Gravity resonance spectroscopy, and a search for Lorentz violation, beyond-Riemann and entropic gravity**

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The qBounce collaboration has been developing gravity resonance spectroscopy (GRS) for ultra-cold neutrons in the gravity potential of the earth. This quantum interference technique allows to test gravity and basic symmetries on different levels. We present recent results on the following topics: First, we analyze the dynamics of ultracold neutrons caused by interactions violating Lorentz invariance within the Standard Model Extension (SME). We use the effective non-relativistic potential for interactions violating Lorentz invariance derived by Kostelecký and Lane (1999) and probe contributions of these interactions to the transition frequencies of transitions between quantum gravitational states of UCNs bouncing in the gravitational field of the Earth. Second, we analyze a possibility to probe beyond-Riemann gravity by GRS. We improve by order of magnitude some constraints obtained by Kostelecký and Li (2021). Third, Erik Verlinde's theory of entropic gravity, postulating that gravity is not a fundamental force but rather emerges thermodynamically, has gathered much attention as a possible resolution to the quantum gravity problem. We address some criticism by modelling linear gravity acting on small objects as an open quantum system and show full compatibility with the qBOUNCE experiment.