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Neutrons in the Low-Curvature Limit: post-Newtonian effects and more

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Ultracold neutrons are a great tool to explore the quantum nature of the gravitational interaction. From a theoretical perspective, starting from a Dirac equation in curved spacetime, one can derive the non-relativistic Schrodinger equation that governs the evolution of the neutron's wave function in the Earth's gravitational field. At the lowest order, this procedure simply reproduce a Schrodinger system affected by a Newtonian potential. However, in this talk, we argue that one should be very careful when calculating next-to-leading order corrections, since terms that at first glance seems negligible end up playing an important role at this level. Furthermore, also the differences in the nature of physical and coordinate distances show up in the corrections to the neutron energy spectrum and they must be taken into account. Finally, we observe that, even if the current Ultracold neutrons experiments' precision does not allow to probe for these perturbations yet, they could still be relevant in the future or in other ad-hoc circumstances.

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