Advances in High Energy Physics

Special Issue on Quantum Gravitational Spectroscopy

Call for Papers

Quantum gravitational spectroscopy with ultracold systems is an emerging field based on recent major experimental and theoretical advances. Gravitational spectroscopy profits from exceptional sensitivity due to extreme weakness of gravitation compared to other fundamental interactions; thus, it provides an access to the precision frontier in particle physics and other domains. Quantum gravitational spectroscopy is its ultimate limit addressing the most fragile and sensitive quantum states of ultracold particles and systems. Ultracold particles – neutrons, atoms, and antiatoms – with sufficiently high phase-space density are the condition for providing observable phenomena with gravitational quantum states. Some of such studies, like those with ultracold neutrons, have become reality; others with ultracold atoms and antiatoms are in preparation.

We invite investigators to contribute review and research articles that will provide deeper understanding of this rapidly developing field. We welcome analysis of common points and differences of its subfields. We understand the unique interdisciplinary position of "quantum gravitational spectroscopy" on a cross-road of many scientific domains and encourage the authors to reveal these interplays. We are particularly interested in articles describing research to be done with the GRANIT facility, including all aspects from the theoretical motivation and analysis of existing results to potentially new areas and methodical and instrumental developments. Potential topics include, but are not limited to:

- Measurements of gravitational quantum states of neutrons, including experimental results and theoretical developments, but also neutron interferometry in a broad sense
- Novel instruments and methods for gravitational spectroscopy and interferometry, including those capable of improving performance of the GRANIT facility
- Fundamental interactions in near-surface quantum systems, including short-range forces, chameleon-like forces, noncommutative quantum mechanics, emerging gravity, and anti-matter and gravity
- Precision fundamental measurements with ultracold systems, including gravity with atoms, molecules, neutrons and antimatter, quantum reflection and dissipation, and Aharonov-Bohm and Aharonov-Casher effects
- Surface studies with the GRANIT facility, including materials with predefined properties, levitating nanoparticles, and whispering-gallery effect

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