universität innsbruck

Department of Theoretical Physics

Theory Colloquium

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"Quantum Correlations in Atomic Clocks and Interferometers"

Abstract

Precision measurements and fundamental tests of physics on one hand, and modern quantum technologies on the other, are closely linked through mutual influence and fertilization. In my presentation, I will discuss several examples of theoretical studies conducted by my research group at this intersection: Firstly, I will present the prospects and challenges faced by the use of entangled states and measurements in frequency metrology, particularly in optical atomic clocks. I will show the results of quantum variational optimizations of Ramsey protocols, which turn out surprisingly different depending on which decoherence processes (such as laser noise or spontaneous emission) dominate.

Subsequently, I will address related issues in atom interferometry, where the use of correlated states, such as squeezed states, requires tailored light pulses for the realization of beam-splitter or mirror operations. In the context of atom interferometry, I will discuss the fundamental limitations of the efficiency of such operations based on Bragg diffraction or Bloch oscillations, and their impact on the systematics of atom interferometric measurements. All these efforts contribute to improving the quality of precision measurements for fundamental tests of physics, especially the dynamics of quantum matter in gravitational fields.

Wednesday | 05.06.2024 | 16:30

SR 1| ICT building