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Coherent Splitting and Recombination of Atoms Using Optical Tweezers

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Abstract

Atom interferometers (AIF) are devices that coherently split atomic wavefunctions so that each wavepacket travels through a different path and acquires phase under a local potential. The packets are then coherently recombined, and through observations of the interference fringes properties of the potential can be measured. The last two decades saw great success in precision measurements using atomic clouds in free-fall manipulated by laser pulses. Despite their many achievements, such light-pulse interferometers have several disadvantages, including large and complex experimental setups, and the inability to flexibly set the atomic trajectory.
In this talk, I propose and analyze theoretically methods for coherently splitting and recombining atomic wavefunctions for an AIF scheme based on optical tweezers. Optical tweezers, or optical microtraps, are a means to trap neutral atoms using a focused Gaussian beam through dipole interactions. In this scheme, the atomic spatial degrees of freedom are completely controlled during all stages of the interferometric sequence. Due to the favorable properties of optical tweezers, using them as confining potentials for a guided AIF holds potential for a scheme with arbitrary trajectories, high-resolution in the spatial confining of the atoms, and long probing time - leading to increased sensitivity. In addition, a possible application for using the tweezer AIF in gravitational measurements is discussed. By combining optical atomic clock with the guided AIF, proper time difference can be sensed, potentially paving the way towards measuring effects of quantum gravity.

ההרצאה תתקיים ביום רביעי, ה-20.3.24 בשעה 13:30
באודיטוריום המכון למצב מוצק, קומת כניסה
The lecture will take place on Wednesday, 20.3.24 at 13:30
at the Solid State Institute auditorium, entrance floor

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