

Dynamical response of Bose-Einstein condensates to oscillating gravitational fields

Dennis Rätzel¹, Richard Howl², Joel Lindkvist³, Ivette Fuentes²

¹dennis.raetzel@physik.hu-berlin.de, Institut für Physik, Humboldt-Universität zu Berlin, Newtonstraße 15, 12489 Berlin, Germany

²School of Mathematical Sciences, University of Nottingham, University Park, Nottingham NG7 2RD, UK

³Faculty of Physics, University of Vienna, Boltzmannngasse 5, 1090 Vienna, Austria

Bose-Einstein condensates (BECs) are very small and extremely cold systems of a large number of atoms. These properties are famously exploited for high precision measurements of forces using atom interferometry. A further way of utilizing BECs as sensors for forces is to measure the forces' effect on the collective oscillations of atoms in BECs. A specific example is the measurement of the thermal Casimir-Polder force.

In this talk, I will explain how BECs can be used to measure oscillating gravitational fields. Accelerations due to gravitational fields and their gradients give rise to effective external potentials, oscillations on resonance with elastic modes of BECs lead to the creation of phonons. For strong enough gravitational fields this effect can, in principle, be detected. For weaker gravitational fields, a squeezed probe state can be prepared and its change due to the interaction with the oscillating gravitational field may be measured. We illustrate our experimental proposal with the easily accessible example of the gravitational field of a small oscillating gold sphere.

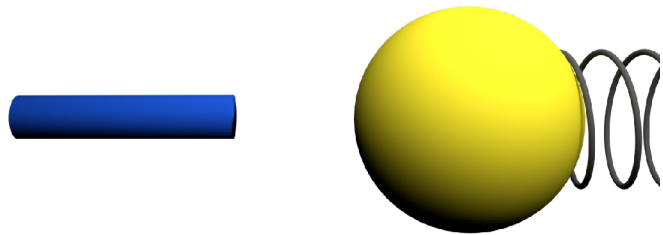


Fig. 1: The gravitational field of a gold sphere oscillating in front of a BEC creates phonons which may be used for sensing the gravitational field.

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