

THE PHYSICS COLLOQUIUM

Thursday 21 September 2023, 4:00 p.m.
Nijenborgh 4, Room 5114.0043

Towards studying gravity and quantum mechanics using cold mechanical resonators

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Well isolated mechanical resonators at low temperatures are excellent probes for small scale forces. Such systems, operating at low resonance frequencies and appreciable mass may be well suited to measure both quantum mechanical effects and gravitational effects.

In this talk we present two separate experiments:

- On the one hand, we have demonstrated a sub-millimeter scale magnetic particle, levitated inside a type-I superconducting trap. At a frequency of 26.7 Hz, a mass of 0.4 mg and Q-factors in excess of 10^7 , we obtained a force noise of 0.5 fN/Hz. This force sensitivity was validated by driving the magnetic particle using a time varying gravitational field supplied by brass masses on an electric wheel positioned underneath the cryostat. This paves the way for future experiments in which small test and source masses are gravitationally coupled.

- On the other hand, we present the cooling of a ~ 1 kHz micrometer sized magnet on a mechanical resonator to a temperature below 2 mK. We explain how far we are in our effort to demonstrate interference effects to show that a relatively large object can be brought in a spatial superposition.

We hope that our work can one day provide a stepping stone towards mesoscopic probes of gravity and the quantum nature of gravity. In the meantime, our work finds application in magnetometry and magnetic resonance force microscopy.



Join us for coffee starting 3:30 p.m. Refreshments will be served after the lecture.
For more information contact the host: Steven Hoekstra (s.hoekstra@rug.nl)
Website: <http://www.rug.nl/research/vsi/colloquia/>