

## Invited talks

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### Levitated Nanoparticles in Macroscopic Quantum Superpositions: Pushing the Boundaries of Quantum Mechanics

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In recent years, advancements in optically levitated nanoparticles have enabled the cooling of their center-of-mass motion to the quantum ground state. As a result, a nanoparticle, which comprises billions of atoms, becomes delocalized over picometer scales. This talk aims to explore the challenges and requirements of achieving a macroscopic quantum superposition of a nanoparticle, in which the center-of-mass position is delocalized over orders of magnitude larger scales. We will discuss an experimentally feasible approach that employs fast quantum dynamics in nonharmonic potentials to meet the stringent requirements imposed by environmentally-induced decoherence. The generation of such macroscopic quantum states would test quantum mechanics at unprecedented scales, develop highly sensitive detectors of external signals, and address fundamental questions, such as the nature of the gravitational field generated by a delocalized mass source.