ICFO Colloquium Series: Levitated Nanoparticles in Macroscopic Quantum Superpositions: Pushing the Boundaries of Quantum Mechanics

ORIOL ROMERO-ISART

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12:00 to 13:00
ICFO Auditorium

BIO:

Prof Oriol Romero-Isart obtained his PhD in 2008 at the Universitat Autonoma de Barcelona, after which he carried out postdoctoral research at the theory division of the Max-Planck Institute of Quantum Optics in Munich. In 2013 he became professor at the University of Innsbruck and started his own group at the Institute for Quantum Optics and Quantum Information (IQOQI) Innsbruck, later also assuming the role of Deputy Managing Director of IQOQI. His research group, which has recently moved to ICFO, focuses on macroscopic

quantum optics and studies whether there is a limit to mass and complexity for observing unambiguous quantum phenomena. In February 2024, ICFO's Board of Trustees approve his appointment as director of the institute, beginning September 2024

ABSTRACT:

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 experimentaly 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.