Exploring statistical physics and quantum mechanics at the mesoscale with levitated nanoparticles

R.A. Rica[1,2,*], F. Ricci[2], G.P. Conangla[2], I. Alda[2], J. Gieseler[2,3], J. Berthelot[2,4], R. Quidant[2,5]

(1) Departamento de Física Atómica, Molecular y Nuclear, Universidad de Granada, 18071 Granada, Spain.
(2) ICFO Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain.
(3) Physics Department, Harvard University, Cambridge, Massachusetts 02138, USA
(4) Aix-Marseille Univ, CNRS, Centrale Marseille, Institut Fresnel, Marseille, France
(5) ICREAInstitució Catalana de Recerca i Estudis Avançats, 08010 Barcelona, Spain
(* rul@ugr.es)

Levitated nanoparticles in high vacuum have emerged as a rich playground for exploring different frontiers of physics, particularly on stochastic thermodynamics and the applicability of quantum mechanics at the mesoscale [1-4]. Here, we present recent progress on the implementation of different levitation schemes, allowing for exquisite control over the dynamics of a nanoparticle. In particular, we first report on the precise control of the nonlinear and stochastic bistable dynamics of a levitated nanoparticle in high vacuum. We demonstrate how it can lead to efficient signal amplification schemes, including stochastic resonance [5]. Finally, we describe our progress towards the control of nanoparticles with internal degrees of freedom (nanodiamonds with NV centers) by means of a RF ion trap [6,7].

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