

L3-M1 Internship offer

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Optical trapping of micro and nano-particles in air

Ashkin's work in the 1970s [1] showed that it was possible to manipulate and trap micro- and nanoparticles using light. Optical trapping has since been widely used, particularly in liquid environment (optical tweezers), to study physical or biological objects ranging in size from tens of nanometers to tens of microns. More recent applications in vacuum have made it possible to control the degrees of freedom of particles down to their fundamental quantum level [2].

We propose to study the intermediate regime of a particle trapped in air. We want to take advantage of the fact that the particle is isolated from the substrate to study its internal vibration modes by interferometric detection or inelastic scattering. The cooling effect of the air will stabilize the optical trap and allow us to work with different dielectric or semiconductor particles.

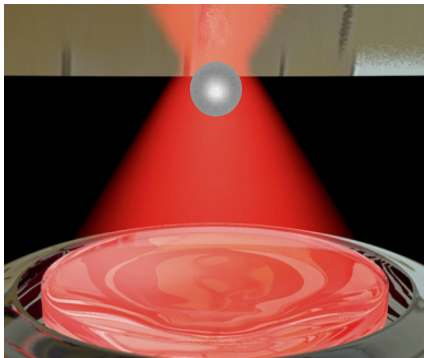


Fig. 1: The optical forces created by a focused beam enable micro and nanoparticles to be levitated and trapped. The construction of a levitation setup in air will enable the movement of the particle in the trap and its internal vibration modes to be studied.

The aim of the internship is to build an experimental setup from scratch that can levitate microparticles in the air. We also want to set up a deterministic particle loading system in the optical trap [3] and a method for detecting particle movement in the trap. The first measurements and their analysis (preferably in Python) will enable us to characterize the temperature of the particle and the Brownian motion in the trap.

¹A. Ashkin, “Acceleration and Trapping of Particles by Radiation Pressure”, en, [Physical Review Letters](#) **24**, 156–159 (1970).

²U. DeliĆ, M. Reisenbauer, K. Dare, D. Grass, V. Vuletić, N. Kiesel, and M. Aspelmeyer, “Cooling of a levitated nanoparticle to the motional quantum ground state”, en, [Science](#) **367**, 892–895 (2020).

³H. Park and T. W. LeBrun, “Optical Trap Loading of Dielectric Microparticles In Air”, en, [Journal of Visualized Experiments](#), 54862 (2017).