Internal temperature of a levitated nanodiamond.

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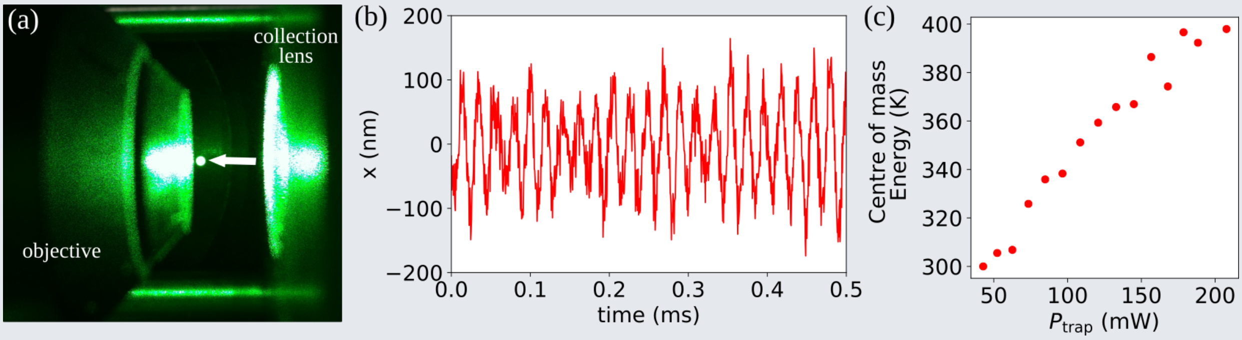
Observation of quantum phenomenon on a mesoscopic object requires a perfect control of its environment. An efficient method to gain such a control is to levitate optically a nanoparticle in vacuum. Recently this approach has known important developments, with numerous perspectives, from weak forces metrology to stochastic thermodynamics, through the study of gravity-induced quantum decoherence.



Levitation of a nanodiamond in vacuum: (a) Photography of the experimental setup showing a leviated nanodiamond (white arrow). (b) Time trace of the particle dynamics. (c) Energy of the centre of mass of the levitated diamond, at a pressure of 2 mbar, as a function of the trapping laser power.

However, the use of an intense trapping laser for the levitation could lead to an increase of the internal temperature of the levitated nanoparticle. The particle heating will then limit the stability of the system and will impact the centre of mass motion of the particle, as shown in figure 1(c). This effect could mask quantum effects and will limit force sensitivity of the apparatus.

The measure and the control of the internal temperature of the levitated nanoparticle are then crucial for the development of levitation experiments. The levitation of a nanodiamond hosting NV defects, which constitute a sensitive thermometer, is an essential step toward the understanding of the impact of internal temperature on the particle dynamics. It should also provide a solution for a better control of the particle heating.

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