# Levitated microdiamonds for optomechanics

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The center of mass of levitating particle have shown record high quality factors under vacuum, stemming mostly from the absence of clamping losses. This makes levitating optomechanics a promising field to observe a macroscopic oscillator close to its quantum ground state. Inspired by ideas for mechanical control of oscillating cantilevers using magnetic field sensitive probes [1], trapped macroscopic objects coupled to single spins via magnetic field gradients are envisioned [2].

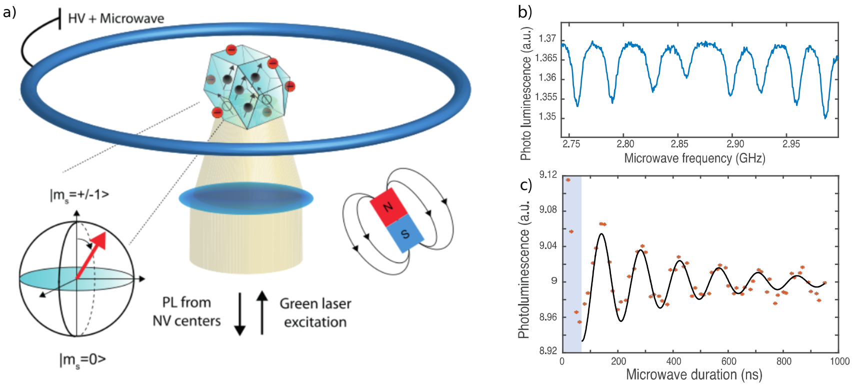

Figure 1: a) Set-up used for micro-diamond levitation. b) Electron Spin Resonance spectrum, c) Rabi oscillation from levitating micro-diamonds.

Here we levitate nano and microdiamonds in a Paul trap and study the spin of NV centers within these levitating diamonds. Contrary to the ubiquitous optical tweezers, levitation offered by Paul traps allows us to considerably reduce the large heating of the diamond when the pressure is lowered. Monitoring the NV spin enables us to demonstrate small heating under vacuum [3] and to show angular stability of the particle in the Paul trap. Moreover coherent manipulation of the spin ensembles is used to probe their coherence time and show negligible decoherence induced by the trap [4]. Finally, we theoretically show how one can use an NV spin to manipulate the angular degrees of freedom of a levitating diamond instead of its center of mass [5].

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[5] Delord, T., et al. , Phys. Rev. A 96.6 (2017): 063810.