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Cavity Control and Cooling of Nanoparticles in High Vacuum
JAMES MILLEN, Univ of Vienna — Levitated systems are a fascinating addition to the world of optically-controlled mechanical resonators. It is predicted that nanoparticles can be cooled to their c.o.m. ground state via the interaction with an optical cavity[1]. By freeing the oscillator from clamping forces dissipation and decoherence is greatly reduced, leading to the potential to produce long-lived, macroscopically spread, mechanical quantum states, allowing tests of collapse models and any mass limit of quantum physics. Reaching the low pressures required to cavity-cool to the ground state has proved challenging[2]. Our approach is to cavity cool a beam of nanoparticles in high vacuum. We can cool the c.o.m. motion of nanospheres[3], and control the rotation of nanorods[4], with the potential to produce cold, aligned nanostructures. Looking forward, we will utilize novel microcavities to enhance optomechanical cooling, preparing particles in a coherent beam ideally suited to ultra-high mass interferometry at 10^7 a.m.u.

[1]T S Monteiro et al., **New J. Phys. 15** (2013)
[2]**JM** et al., **Nature Nanotechnology 9**, 425 (2014)
[3]P Asenbaum, et al., **Nature Communications 4**, (2013)
[4]S Kuhn et al., **Nano Letters 15**, (2015)

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