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Levitated Optomechanics for Fundamental Physics[1] MUDDASSAR RASHID, JAMES BATEMAN, JAMIE VOVROSH, DAVID HEMPSTON, HENDRIK ULBRICHT, University of Southampton — Optomechanics with levitated nano- and microparticles is believed to form a platform for testing fundamental principles of quantum physics, as well as find applications in sensing. We will report on a new scheme to trap nanoparticles, which is based on a parabolic mirror with a numerical aperture of 1. Combined with achromatic focussing, the setup is a cheap and readily straightforward solution to trapping nanoparticles for further study. Here, we report on the latest progress made in experimentation with levitated nanoparticles; these include the trapping of 100 nm nanodiamonds (with NV-centres) down to 1 mbar as well as the trapping of 50 nm Silica spheres down to $10^{?4}$ mbar without any form of feedback cooling. We will also report on the progress to implement feedback stabilisation of the centre of mass motion of the trapped particle using digital electronics. Finally, we argue that such a stabilised particle trap can be the particle source for a nanoparticle matterwave interferometer. We will present our Talbot interferometer scheme, which holds promise to test the quantum superposition principle in the new mass range of 10^6 amu.

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