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Directional dark matter searches using levitated optomechanics

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Levitated optomechanics provides a novel platform to test fundamental physics. One such application provides a unique directional dark matter direct detection technique to explore alternative parameter space to that being investigated by large scale experiments deployed underground. We present progress towards an experiment built at University College London, capable of resolving collisions in all three dimensions, utilising nanoparticles (10^{-18} kg) for composite dark matter searches in the 10 MeV –10 GeV mass range. We detail the theoretical calculations, experimental apparatus, data analysis framework and statistical inference that we aim to use to obtain results competitive with world-leading dark matter constraints. In addition, we present first results from impulse calibrations of the setup, directly demonstrating its directional force sensing capability.

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