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Direct Detection of Dark Matter Using Optically Levitated Nanospheres

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Recent advances in levitated optomechanics have enabled the detection of tiny forces through precise control of microscopic objects in vacuum. These technologies present new experimental platforms to probe weakly coupled phenomena in particle and nuclear physics. I will describe a dark matter search based on optically trapped, femtogram-scale silica nanospheres. In ultra-high vacuum, the sensitivity of these levitated sensors is set by the quantum measurement noise, allowing the momentum transfer from a dark matter particle scattering from the sensor to be detected. For dark matter models that would primarily scatter from an entire nanoparticle (rather than a single nucleus or electron), these searches can exceed the sensitivity of even large underground detectors. I will further discuss applications of these sensors in precision measurement of nuclear decays and sterile neutrino searches.

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