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Maglev for Dark Matter

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Ultraprecise mechanical sensors offer an exciting avenue for testing new physics. While many of these sensors are tailored to detect inertial forces, magnetically levitated (Maglev) systems are particularly interesting, in that they are also sensitive to electromagnetic forces. In this talk, I will propose the use of Maglev systems to detect dark-photon and axion dark matter. Several existing laboratory experiments search for these dark-matter candidates at high frequencies, but few are sensitive to frequencies below 1 kHz (corresponding to dark-matter masses $m_{\rm DM}$
$lesssim 10^{-12}$ eV). As mechanical resonators, Maglev systems are sensitive to lower frequencies, and so can probe parameter space currently unexplored by laboratory experiments. I will propose the use of two systems as dark matter detectors: levitated superconductors and levitated ferromagnets. Both of these systems respond to oscillating magnetic fields. Dark-photon dark matter and axion dark matter which couples to photons can source such magnetic fields, driving the motion of these systems. Axion dark matter which couples to electrons can also drive the motion of levitated ferromagnets. These responses are resonantly enhanced when the dark matter Compton frequency matches the system's trapping frequency. I will show that in the Hz
$lesssim f_{\rm DM}$
$lesssim$kHz frequency range these techniques can achieve the leading sensitivity amongst laboratory probes of both dark-photon and axion dark matter.

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