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New Directions in Dark Matter Direct Detection

As the age of WIMP-scale dark matter (DM) draws to a close thanks to the ever-increasing sensitivity of direct detection experiments, the majority of DM parameter space outside of the weak scale remains to be explored. Sub-GeV DM can excite electronic transitions in a variety of molecular and nano-scale systems which have sub-eV scale thresholds. In particular, organic molecules, nanoparticles, and other mesoscopic targets can be used to detect the low momentum recoils imparted by the dark matter. We have demonstrated that aromatic molecules can be sensitive to DM as light as a few MeV. Additionally, their planar molecular structures lead to large anisotropies in the electronic wavefunctions, yielding a significant daily modulation in the event rate expected to be observed in crystals of these molecules. I will discuss the importance of molecular and mesoscopic systems as new directions in the direct detection of dark matter.

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