

Search for Millicharged Particles using an Optical Trap

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Standard searches for dark matter attempt to identify interactions with dark matter particles; a complementary search would involve looking for “dark forces”. As an example, if a dark force mediated by a “dark photon” exists, dark matter particles could pick up a tiny electric charge due to kinetic mixing with normal photons. Stable millicharged dark matter particles could become bound in matter, and potentially be detected by using an optical trap to measure the response to an applied electric field on a charge-neutral object that may contain such particles. This is a very well-isolated system, with an acceleration sensitivity on the order of $500 \text{ ng}/\sqrt{\text{Hz}}$ for a 20 μm diameter SiO_2 levitated sphere. Within this experiment, the acceleration sensitivity can be translated to a fractional electron number sensitivity of 10^{-7} electrons/ $\sqrt{\text{Hz}}$ regardless of the mass of the millicharged particle, allowing exploration of uncharted regions of parameter space for such dark matter candidates.

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