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Collective excitations from boosted dark matter

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Plasmon, a collective mode of electronic excitation in solid-state detectors, provides a novel way to detect light dark matter (DM). In this work, we present the conditions of DM to produce plasmon resonance, requiring relativistic velocities for light DM, and generalize the collective excitation framework to account for relativistic DM. As a demonstration, we consider the cosmic ray boosted DM (CRDM) and find that the plasmon resonance can be significantly enhanced in the scenario with a light mediator. Utilizing the first data from SENSEI experiment with the skipper-CCDs at SNOLAB, we obtain a new strong limit on the sub-MeV DM-electron scattering cross section.

Primary author: 祝, 斌

Presenter: 祝, 斌