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Results on low-mass weakly interacting massive particles from a 11 kg d target exposure of DAMIC at SNOLAB

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Experimental efforts of the last decades have been unsuccessful in detecting WIMPs (Weakly Interacting Massive Particles) in the 10-to-10^4 GeV/c^2 range, thus motivating the search for lighter dark matter. The DAMIC (DArk Matter In CCDs) at SNOLAB experiment aims for direct detection of light dark matter particles ($m_\chi < 10$ GeV/c^2) by means of CCDs (Charge-Coupled Devices). Fully-depleted 675 μm-thick CCDs are used to such end. The optimized readout noise and operation at cryogenic temperatures allow for a detection threshold of 50 eV$_{ee}$ electron-equivalent energy. Focusing on nuclear and electronic scattering as potential detection processes, DAMIC has so far set competitive constraints on the detection of low mass WIMPs and hidden-sector particles.

In this work, a 11 kg·d exposure dataset is exploited to search for light WIMPs by building the first comprehensive radioactive background model for CCDs. Different background sources are discriminated making conjoint use of the spatial distribution and energy of ionization events, thereby constraining the amount of contaminants such as tritium from silicon cosmogenic activation and surface lead-210 from radon plate-out. Despite a conspicuous, statistically-significant excess of events below 200 eV$_{ee}$, this analysis places the strongest exclusion limit on the WIMP-nucleon scattering cross section with a silicon target for $m_\chi < 9$ GeV/c^2.

Keywords

Direct detection; WIMP; CCD; DAMIC;

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Experimental Results

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