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A simulation-based background model in DAMIC search for Dark Matter

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At present, the origin of the universe matter and energy content is mostly unknown, with so-called Dark Matter (DM) amounting to roughly 27% of the total. Among important DM candidates, WIMPs (Weakly Interacting Massive Particles) would have a mass in the 10-to-10^5 GeV$/c^2$ range and would interact with ordinary matter at the weak scale. Experimental efforts of the last decades have been unsuccessful in detecting such objects. This scenario, along with new theoretical developments, has motivated the search for lighter DM ($m_\chi \lesssim 10$ GeV$/c^2$) and opened a vast bestiary of candidates: from axion-like particles to hidden-sector gauge bosons with masses as low as a fraction of eV.

DAMIC and DAMIC-M (DArk Matter in CCDs − at Modane) experiments aim for direct detection of light DM by means of CCD (Charge-Coupled Device) semiconductor targets. Scientific fully-depleted CCDs about ten times more massive than conventional ones are used to such end, employing both nuclear recoil and electronic scattering as potential detection processes. With such features, a mass range between 1 MeV and 10 GeV can be probed.

This work presents the background model used for the latest WIMP search in DAMIC (to be extended for DAMIC-M). Such model is constructed using seed-clustered Geant4 simulations, and accounts for contributions from contaminants present in the components of the DAMIC experimental setup. It is an essential ingredient of the likelihood study performed to discriminate possible DM-generated signal.

Keywords: Dark Matter, Instrumentation.