

Measurements of radioactive backgrounds in high-resistivity silicon CCDs of the DAMIC-100 experiment

The DAMIC (Dark Matter in CCDs) experiment employs the bulk silicon of scientific-grade charge coupled devices (CCDs) to detect Dark Matter particles. DAMIC-100, a 41 g detector, is operating in the SNOLAB laboratory, located 2 km below the surface within the Vale Creighton Mine near Sudbury, Ontario, Canada. We present a powerful technique to distinguish and reject background events. Utilizing the exquisite spatial resolution of CCDs, discriminating between α and β particles, we identify spatially-correlated decay sequences over long periods. We report measurements of the radioactive contamination of ^{210}Pb and ^{32}Si in DAMIC-100 CCDs, and place limits on ^{238}U and ^{232}Th contamination. DAMIC's capability to measure contamination has significant implications for the next generation of silicon-based dark matter experiments. For example, ^{32}Si could become a dominant and irreducible background for future programs. We show that ^{32}Si levels may vary significantly in high-purity silicon, and indicate feasible methods to screen materials for fabrication of future detectors in order to push experimental sensitivity to unprecedented levels.

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