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Study of Mobility for Germanium Crystals STEVEN HARDING, DONGMING MEI, University of South Dakota, CUBED COLLABORATION — The study of mobility for n-type germanium crystals expands our capability of improving electron drift velocity and hence the time resolution of germanium detectors. With a higher mobility, we could develop a new generation of HPGe detectors for sensitive experiments like that of searching in rare event physics. Free electrons in semiconductor material move randomly with no particular average direction. Inducing a low electric field, the equation of motion for these electrons includes a resistive term, a result of the scattering processes involved with impurities and lattice vibrations of the crystal, which establishes a constant charge carrier drift velocity. The scattering mechanisms within HPGe material at 77K significantly reduce the averaged relaxation time and, thus, define the mobility. These include ionized and neutral impurity along with acoustical and optical deformation potential. Theoretical calculations were derived from first principles with reasonable assumptions and then compared with experimental data. Results show that the neutral impurity density within the acceptable range strongly affects the overall mobility. Therefore, a large reduction in neutral impurity as well ionized impurity density is necessary for high-quality mobility.

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