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A 3-D Theoretical Model for Calculating Plasma Effects in Germanium Detectors[1] WENZHAO WEI, JING LIU, DONGMING MEI, Univ of South Dakota, CUBED COLLABORATION — In the detection of WIMP-induced nuclear recoil with Ge detectors, the main background source is the electron recoil produced by natural radioactivity. The capability of discriminating nuclear recoil (n) from electron recoil (γ) is crucial to WIMP searches. Digital pulse shape analysis is an encouraging approach to the discrimination of nuclear recoil from electron recoil since nucleus is much heavier than electron and heavier particle generates ionization more densely along its path, which forms a plasma-like cloud of charge that shields the interior from the influence of the electric field. The time needed for total disintegration of this plasma region is called plasma time. The plasma time depends on the initial density and radius of the plasma-like cloud, diffusion constant for charge carriers, and the strength of electric field. In this work, we developed a 3-D theoretical model for calculating the plasma time in Ge detectors. Using this model, we calculated the plasma time for both nuclear recoils and electron recoils to study the possibility for Ge detectors to realize n/γ discrimination and improve detector sensitivity in detecting low-mass WIMPs.

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