Sophisticated semiconductor simulation for exotic physics searches

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INTRODUCTION

A careful understanding of the quasiparticle dynamics inside a semiconductor becomes a crucial element of the discovery potential of many experiments searching for exotic new physics. This happens both at the level of timing reconstruction as well as variations in the number of quasiparticles created, among other changes. While many of these features are well-known at room temperature, cryogenic detection systems require careful simulation.

A treatment of quasiparticle dynamics is inherently a multi-scale problem, with results approaching classical physics on a macroscopic level while individual interactions require a careful understanding of the quantum mechanical processes and solid state physics. The discovery potential of many dark matter searches and electroweak tests of the Standard Model hinge critically on a more detailed understanding.

DESCRIPTION OF THE WORK

The project consists of an expansion of an under-development code to improve many-body dynamics of quasiparticles and optimize charge transport. Additionally, detailed simulation of phonon dynamics at low temperature will be used to establish bounds of the discovery potential of dark matter searches. Further study using density functional theory and ab initio condensed matter methods are envisaged.

REQUIREMENTS

Strong python skills, a good understanding of nuclear and solid state physics.