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GPU simulations in Multiphasic Nanosolids and Superconducting Nanostructures
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Physics DissertationPh.D.Doctor of Philosophy October2016 Department of Physics Andreas Glatz

abstract With the ever-increasing availability of computing power, namely from Graphics Processing Units (GPUs), comes the responsibility to simulate more complicated systems. Complex functions such as the Ginzburg-Landau function can not be studied analytically for mesoscopic phenomena. Similarly, a thorough understanding of variable range hopping in electrons requires a Markov-Chain Monte-Carlo algorithm. With this in mind we computationally study two cases of condensed matter physics, thermoelectrics and superconductor-bound vortices. Here, We develop and implement a novel algorithm for simulation of variable-range-hopping of electrons in a nanosolid. We exploit the similarities between granule hopping and electrons in a coulomb glass. We also created an ad-hoc cluster in order to run these and other simulations. We benchmark this code using well studied Coulomb Glass theories, then make predictions on what Seebeck coefficients will be in various conductor-semiconductor combinations. Vortex-vortex interactions and vortex-inclusion interactions are not very well understood analytically. The mathematics becomes near-impossible when taken to mesoscopic scales. Applied temperature, magnetic field, or currents only serve to complicate the system. Yet these are all factors that need to be well understood before serious applications can take place. Here we report two basic systems, The effect of vortex-inclusion matching on the effective resistance, and a novel funnel system for slowing the vortices. We describe how matching the number of inclusions to the number of vortices can help reduce the amount of vortex-induced resistance. We also describe how an aperture-type system can help to slow down vortices as they are travelling through the system draining energy.