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Monte Carlo Simulations of Electron and Phonon Thermalization in Graphene at the Diffusive-Ballistic Crossover Point[1] SOPHIE LI, Caltech — The ability to detect single photons has applications in a wide range of disparate fields. One approach for pushing the limits of single-photon detector (SPD) energy resolution is to exploit the temperature rise in a low-heat capacity material upon absorption of a photon. A collaboration between the research groups of Prof. Michael Roukes and Prof. Stevan Nadj-Perge has developed a novel thermal detector based on graphene, due to its attractive electrical, thermal and material properties. In contrast to most existing graphene thermal detectors, this SPD accesses the novel regime in which the mean free path of charge carriers exceeds the dimensions of the flake. In this regime, boundary scattering dominates the behavior of phonons and electrons and determines the temperature distribution across the graphene flake. By way of Monte Carlo simulations, we have quantified the effect of diffuse scattering and specular reflections for circular and rectangular flake boundaries. The results strongly support existing literature regarding phonon heat transfer and surface scattering.

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