An Investigation and Computer Simulation on the Temperature Dependence for Hall Mobility and Quality Factor in GaAs

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To improve how researchers study materials for high-performance electronics, mathematical models and simulations can be created to predict the performance and properties of these materials. Currently, researchers studying carrier properties in semiconductors can either test the results in a lab expending time or use long algorithms that take time and use significant amounts of computational power. To solve these problems, a new simulation program was created that implemented a pseudo-binary search algorithm to solve the Fermi-Dirac Distribution equation to determine how carriers are affected by temperature and the mobility of these carriers. Once the simulation program was completed, three GaAs samples were lab tested for physical properties and compared with the simulation program. The results showed that both the simulation program and the tested results created the same trend of mobility vs temperature with the only exception being that the simulation program predicted slightly higher mobility than what was measured. The results point to a more efficient way for researchers to predict properties of samples. The program is able to calculate the results almost 5000 times faster than current methods. Ultimately, the creation of this program will give researchers a useful tool to help them in their pursuit to develop high-performance electronics, especially for microwave resonators used in Josephson Junction pairings for quantum computing.

Awards Won:
University of Arizona: Tuition Scholarship Award