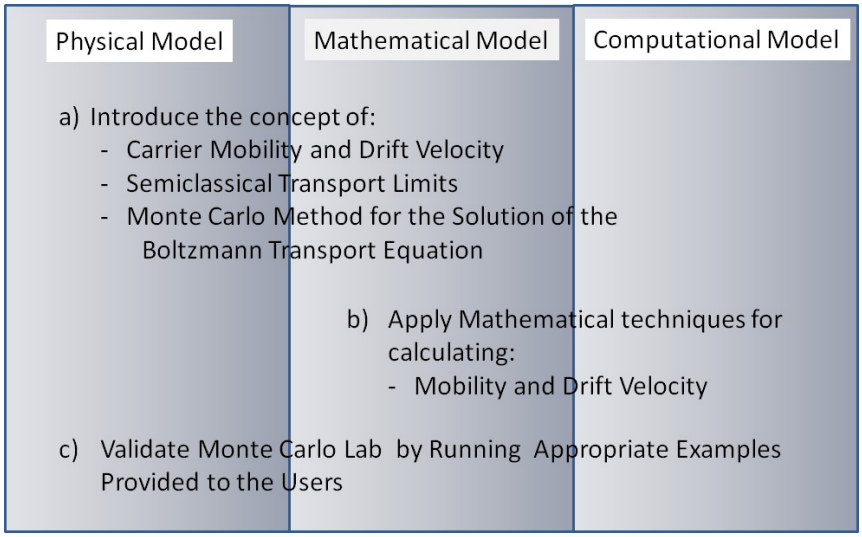
Bulk Monte Carlo Learning Materials

By completing the Bulk Monte Carlo Lab exercises and tests, users will be able to: a) understand the way the Boltzmann Transport Equation (BTE) is solved using the Monte Carlo method, b) the concept of drift velocity and average carrier energy, c) the reason why drift velocity saturates in, for example Si, and d) why do we observe the Gunn effect in, for example, GaAs material system.

The specific objectives of the Bulk Monte Carlo Lab are:



Recommended Reading

Users who are new to the concept of solution of the BTE with the Monte Carlo Method should consult the following resources:

1. Mark Lundstrom, Fundamentals of Carrier Transport, Cambridge University Press.

2. David K. Ferry, Semiconductor Transport, Taylor & Francis.

3. D. Vasileska, S. M. Goodnick and G. Klimeck, Computational Electronics: Semiclassical and Quantum Transport Modeling, Morgan & Claypool, June 2010.

Theoretical descriptions

* Manual for the Generalized Bulk Monte Carlo Tool

* Single Particle and Ensemble Monte Carlo Method

* Bulk Monte Carlo: Implementation Details and Source Codes Download

* Bulk Monte Carlo Code Described

* Consistent Parameter Set for an Ensemble Monte Carlo Simulation of 4H-SiC

* Monte Carlo and Path Integral Formulation

* Ensemble Monte Carlo Method Described

* Monte Carlo Method and Its Applications

* Generalized Monte Carlo Presentation

* High Field Transport and the Monte Carlo Method for the Solution of the Boltzmann Transport Equation

Exercises and Homework Assignments

1. Bulk Monte Carlo Lab:Scattering Rates for Parabolic vs. Non-Parabolic Bands: an Exercise

2. Homework Assignment for Bulk Monte Carlo Lab: Velocity vs. Field for Arbitrary Crystallographic Orientations

3. Homework Assignment for Bulk Monte Carlo Lab: Temperature Dependence of the Low Field Mobility for [100] Orientation

Solutions to Exercises

Solutions are provided only to instructors!

Evaluation

This test will assess the users conceptual understanding of the physical, mathematical and computational knowledge related to understanding the solution of the BTE using the Monte

Carlo method.

Test for Monte Carlo Learning Module

Challenge

Users are challenged to integrate what they have learned about modeling semiconductor materials with Bulk Monte Carlo Lab.

Homework Assignment for Bulk Monte Carlo Lab: Arbitrary Crystallographic Direction