

# ABACUS Exercise: Carrier Statistics

Dragica Vasileska and Gerhard Klimeck

(ASU/Purdue)

**Objective:** The objective of this exercise is to derive Bose-Einstein and Maxwell-Boltzmann statistics.

1. Calculate the dimensions of a rectangle for which the perimeter is constant and the area is a maximum.
2. Derive the distribution function for particles that obey the Bose-Einstein statistics (indistinguishable particles for which the Pauli exclusion principle is not valid) using:

$$Q(N_1, N_2, \dots, N_n) = \prod_{i=1}^n \frac{(N_i + g_i - 1)!}{N_i! (g_i - 1)!}$$

- (a) Subject to constant particle density and energy.
  - (b) Subject to constant energy but non-constant particle density.
3. Prove that Bose-Einstein statistics reduces to Maxwell-Boltzmann statistics when  $g_i \gg N_i$ .

Please refer for the following text for help on this exercise:

1. D. K. Ferry, Semiconductor Transport.
2. [vasileska.faculty.asu.edu](mailto:vasileska.faculty.asu.edu)