

Effect of abrupt change of the wall temperature in the kinetic theory

Hung-Wen Kuo

National Cheng Kung University
E-mail: hwkuo@mail.ncku.edu.tw

Abstract

We consider a semi-infinite expanse of a rarefied gas bounded by an infinite plane wall. The temperature of the wall is T_0 , and the gas is initially in equilibrium with density ρ_0 and temperature T_0 . The temperature of the wall is suddenly changed to T_w at time $t = 0$ and is kept at T_w afterward. We study the quantitative short time behavior of the gas in response to the abrupt change of the wall temperature on the basis of the linearized Boltzmann equation. Our approach is based on a straightforward calculation of the exact formulas derived by Duhamel's integral. Our method allows us to establish the pointwise estimates of the microscopic distribution and the macroscopic variables in short time. We show that the short-time solution consists of the free molecular flow and its perturbation, which exhibits logarithmic singularities along the characteristic line and on the boundary.