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Department of Mathematics 數學系
The Chinese University of Hong Kong 香港中文大學

Phone: (852) 3943 7988-9 • Fax: (852) 2603 5154 • Email: dept@math.cuhk.edu.hk
Rm. 220, Lady Shaw Building, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong

Kinetic Lecture Series

Hydrodynamic Limits of the Boltzmann Equation

by

Professor Shuangqian LIU

Jinan University

ABSTRACT. In this online mini-course, I will present the hydrodynamic limits of the the Boltzmann equation in bounded domains. The topic contains three parts: The first part is concerned with the preliminary theory of the derivation of the fluid dynamic equations from the Boltmann equation. The second part is devoted to the rigorous justification of the stationary hydrodynamic limits of the Boltzmann equation with isothermal boundary in a slab. Since the kinetic boundary layer is considered, I will also sketch some mathematical analysis of the Milne problem. In the last part, I will briefly show how to deal with the stationary hydrodynamic limits of the Boltzmann equation with non-isothermal boundary case. If time permits, I also would like to report our recent study of the compressible Navier-Stokes approximation for the Boltzmann equation in 3D bounded domains. This mini-course is mainly based on the following works:

REFERENCES

[1] C. Bardos, R. Caflisch, B. Nicolaenko, The Milne and Kramers problems for the Boltzmann equation of a hard sphere gas, *Comm. Pure Appl. Math.* **39** (1986), no. 3, 323–352.
[2] C. Bardos, F. Golse, C Levermore, Fluid dynamic limits of kinetic equations. II. Convergence proofs for the Boltzmann equation, *Comm. Pure Appl. Math.* **46** (1993), no. 5, 667–753.
[3] R.-J. Duan, S.-Q. Liu, Compressible Navier-Stokes approximation for the Boltzmann equation in bounded domains, arXiv:1806.09796.
[4] R. Esposito, J.L. Lebowitz, R. Marra, Hydrodynamic limit of the stationary Boltzmann equation in a slab, *Comm. Math. Phys.* **160** (1994), no. 1, 49–80.
[5] R. Esposito, J.L. Lebowitz, R. Marra, The Navier-Stokes limit of stationary solutions of the nonlinear Boltzmann equation, *J. Statist. Phys.* **78** (1995), no. 1-2, 389–412.
[6] Y. Guo, Boltzmann diffusive limit beyond the Navier-Stokes approximation, *Comm. Pure. Appl. Math.* **55** (2006), no. 9, 0626–0687.

Lecture 1
Date & Time：November 6, 2020 (Friday); 2:00pm-4:00pm (Hong Kong SAR)
Zoom link:
https://cuhk.zoom.us/j/93583101302?pwd=VkRaNkhqRnJrYWxOWGlITUJHamJYZz09
Meeting ID: 935 8310 1302; Passcode: 541966

Lecture 2
Date & Time: November 13, 2020 (Friday); 2:00pm-4:00pm (Hong Kong SAR)
Zoom link:
https://cuhk.zoom.us/j/93425088690?pwd=RnJlOVI3NXZjdGVVUEh1NnpaM2N6UT09
Meeting ID: 934 2508 8690; Passcode: 339341

Lecture 3
Date & Time: November 20, 2020 (Friday); 2:00pm-4:00pm (Hong Kong SAR)
Zoom link:
https://cuhk.zoom.us/j/96469447324?pwd=RDVXZGJRTkpMbms1YTRINUVib09xdz09
Meeting ID: 964 6944 7324; Passcode: 387229

All are Welcome