Moment models for rarefied gas dynamics at high temperatures

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May 2019

In this talk we will present some new models to better capture the physics of rarefied supersonic high-enthalpy flows (flows at high Mach number with temperatures of several thousands of degrees) without having the complexity of Boltzmann kernel of collisions. We first present recent works on BGK (P.L. Bhatnagar, E.P. Gross, M. Krook) models to increase the domain of validity of the BGK equation. We also study another simple approach: new Fokker-Planck models which are able to capture correct hydrodynamic limits for low temperatures as well as vibration phenomena. We present the results from ([$MM16$][$MM17$]) and works in progress ([$MM18$]).

[$MM16$] J. Mathiaud and L. Mieussens. "A Fokker–Planck Model of the Boltzmann Equation with Correct Prandtl Number". In: Journal of Statistical Physics 162.2 (Jan. 2016), pp. 397–414. ISSN : 1572-9613.

[$MM17$] J. Mathiaud and L. Mieussens. "A Fokker–Planck Model of the Boltzmann Equation with Correct Prandtl Number for Polyatomic Gases". In: Journal of Statistical Physics 168.5 (Sept. 2017), pp. 1031–1055. ISSN: 1572-9613.

[$MM18$] J. Mathiaud and L. Mieussens. "Vibrational models of Boltzmann equation with correct second principle: BGK and Fokker-Planck". In: Work in progress (2018).