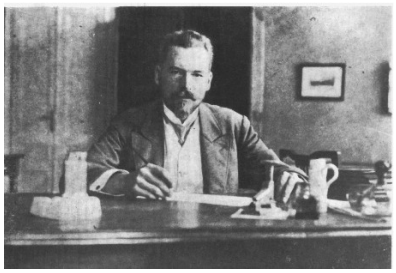

Contribution ID: **61** Type: **Regular Talk**

Global in time existence theorem for the full revised Enskog equation

Tuesday, 26 September 2023 10:05 (25 minutes)

I prove global in time existence of solutions to the full revised Enskog equation. This equation generalizes the Boltzmann theory to dense gases in two ways:

1. by taking into account the fact that the centers of two colliding spheres are at a distance a, equal to the diameter of hard spheres.
2. by increasing the collision frequency by a factor Y_0 which nowadays is identified with the radial pair correlation function g_2 for the system of hard spheres at a uniform equilibrium.

In contrast to the dilute gas mode described by the Boltzmann equation, the Enskog equation includes spatial pair correlation function for hard-spheres potential and depends in a highly non linear way on the local density of dense gas. The full revised Enskog equation refers to the case where g_2, the pair the correlation function (for non-uniform equilibrium of hard-spheres) is in general form. In terms of the virial expansion (in local density n, spatially dependent) at contact value, g_2 reads:

$g_2(n) = 1 + V_1(n) + V_2(n) + ... + V_N(n) + ...,$

where the term $V_1(n)$ depends on n linearly, $V_2(n)$ depends on n quadratically, $V_N(n)$ depends on n as n^N, and so on.

Circa 30 years ago Arkeryd-Cercignani proved the result for the truncated g_2, i.e., when $g_2 = 1$ (no density dependence). The case with $g_2 = 1$ refers to the so called Boltzmann-Enskog equation. It differs from the Boltzmann equation only by existence of the shifts in the spatial variable in the collisional integral.

Since then many researchers tried/wanted to prove the result for general form of g_2. Dependence of g_2 on n requires a different approach and new tools, as compared to Arkeryd-Cercignani proof ([1]). Additionally, this result finally completes and fulfills the existence result for the revised Enskog Equation.

The proof of existence of solutions to the revised Enskog equation is based on two constructions:

1. Construction of an H-functional (see [2]), where the full expansion of g_2 is used, but convergence of the series was not addressed.
2. Construction of a special sequence of stochastic kinetic equations (studied in [3]) and the proof that their solutions converge to weak solutions of the revised Enskog equation.

References

[1] L. Arkeryd and C. Cercignani, Global existence in L1 for the Enskog equation and convergence of solutions to solutions of the Boltzmann equation, J. Stat. Phys. 59 (1990), 845–867.

[2] M. Mareschal, J. Bławzdziewicz, and J. Piasecki, Local entropy production from the revised Enskog equation:
General formulation for inhomogeneous fluids, Phys. Rev. Lett. 52 (1984), 1169–1172.

[3] J. Polewczak and G. Stell,. Transport coefficients in some stochastic models of the revised Enskog equation, J. Stat. Phys. 109, (2002) 569–590.

Primary author: Prof. POLEWCZAK, Jacek (Department of Mathematics, California State University, Northridge, CA, 91330-8313, USA)

Presenter: Prof. POLEWCZAK, Jacek (Department of Mathematics, California State University, Northridge, CA, 91330-8313, USA)

Session Classification: Session 6