Public Abstract

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Title:Limit of Many Molecules Dynamics with Rigorous Macroscopic Results

We obtain and study macroscopic equations as the limit of Hamiltonian equations for N molecules, with pair interaction potentials, as N becomes arbitrarily large while the total energy, mass, and moment of inertia stay constant. The construction stays in physical space and avoids Gibbs measures on phase space. The Boltzmann equation is not used.

The momentum equation, that was already obtained, is revisited and several assumptions for its validity are removed by constructing a large class of solutions of the finite Hamiltonian systems with bounds uniform in N. We then obtain the energy equation following the same methods and compare it with the corresponding equation of Irving-Kirkwood and Noll.

Our method leads naturally to a rigorous definition of averaging that includes the Maxwell-Boltzmann averaging as a special case. We argue that the Reynolds averaging is also captured first by comparing our average with abstract Reynolds averages and then by showing that a certain approximation of the quadratic velocity term in the macroscopic equations suffices to obtain the Landau-Lifschitz formula for thermal fluctuations.