Abstract Submitted
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Simple Flows Using a Second Order Theory of Fluids SAMUEL PAOLUCCI, University of Notre Dame — The Navier-Stokes-Fourier (NSF) equations have proved very valuable in modeling fluid flows over the last two centuries. However, there are cases in which large gradients in velocity and/or thermal fields occur where it has been shown that they do not provide accurate results. Second order equations were derived and shown to reproduce experimental results of the shock structure of gases over a large range of Mach numbers (Paolucci & Paolucci JFM, **486**, 686-710 (2018)). Computer experiments using the direct simulation Monte Carlo (DSMC) method have shown that at small Knudsen number the pressure and temperature profiles in the thermal stress problem as well as in the Couette and force-driven compressible plane Poiseuille flows exhibit different qualitative behavior from the profiles obtained by NSF equations. We compare the DSMC measurements with the numerical solutions of equations resulting from the second order theory. We find that the second order equations recover many of the anomalous features (e.g., non-constant pressure and non-zero parallel heat flux). Comparisons of the predictions coming from the second order theory are provided in order to critically assess its validity and usefulness.

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