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An evaluation of collision models in the Method of Moments for rarefied gas problems[1] DAVID EMERSON, XIAO-JUN GU, STFC Daresbury Laboratory — The Method of Moments offers an attractive approach for solving gaseous transport problems that are beyond the limit of validity of the Navier-Stokes-Fourier equations. Recent work has demonstrated the capability of the regularized 13 and 26 moment equations for solving problems when the Knudsen number, Kn (where Kn is the ratio of the mean free path of a gas to a typical length scale of interest), is in the range 0.1 and 1.0–the so-called transition regime. In comparison to numerical solutions of the Boltzmann equation, the Method of Moments has captured both qualitatively, and quantitatively, results of classical test problems in kinetic theory, e.g. velocity slip in Kramers' problem, temperature jump in Knudsen layers, the Knudsen minimum etc. However, most of these results have been obtained for Maxwell molecules, where molecules repel each other according to an inverse fifth-power rule. Recent work has incorporated more traditional collision models such as BGK, S-model, and ES-BGK, the latter being important for thermal problems where the Prandtl number can vary. We are currently investigating the impact of these collision models on fundamental low-speed problems of particular interest to micro-scale flows that will be discussed and evaluated in the presentation.

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