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Solution of the Boltzmann kinetic equation for arbitrary collisionality[1] MARK L. ADAMS, HOWARD A. SCOTT, LLNL — Solving the nonlinear Boltzmann kinetic equation by traditional explicit numerical methods becomes increasingly difficult and costly as collisionality increases. However, many problems of scientific interest span the range from nearly collisionless to highly collisional regimes and remain beyond the reach of such methods. Thus, we develop an implicit solution technique to efficiently solve the Boltzmann equation for arbitrary collisionality. The technique builds upon methods developed for radiation transport and can be applied to a variety of numerical discretizations. As an example, we apply the method to a one-dimensional characteristic solution of the integral Boltzmann kinetic equation with Krook collision operator and a rigid elastic spherical atomic interaction potential. The technique can be extended to higher dimensions, applied to multiple atomic species, and is valid for more general interaction potentials. We present results for steady-state problems of Fourier flow and Couette flow over a large range of Knudsen numbers, and compare these with analytic results obtained using Chapman-Enskog theory.

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