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Challenges with modeling thermal flows in the slip-flow regime[1]
DAVID EMERSON, XIAO-JUN GU, STFC Daresbury Laboratory — The success of the Navier-Stokes-Fourier (NSF) equations has encouraged researchers to develop various velocity-slip and temperature-jump boundary conditions that are deemed suitable for flows that are in a weakly rarefied state. The degree of rarefaction can be estimated through the Knudsen number, Kn, which relates the mean free path of the gas to some characteristic length scale. If the Knudsen number is in the range $0.001 < \mathrm{Kn} < 0.1$ the flow is in the *slip flow* regime. The assumption is that the NSF equations remain valid if the boundary conditions are modified to take account of velocity-slip and temperature-jump at the wall. If Kn is in the range $0.1 < \mathrm{Kn} < 10$, the flow is in the *transition* regime and the NSF equations are no longer considered reliable. Recent results suggest that using the modified NSF equations for thermal problems in the slip flow regime can produce erroneous answers. This presentation will discuss issues related to thermal problems in the slip flow regime and highlights where researchers need to be very cautious.

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