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Non-perturbative closure calculation for fluids and plasmas[1] XIANZHU TANG, CHRIS MCDEVITT, ZEHUA GUO, Los Alamos National Laboratory — Closure calculation of the Chapman-Enskog type is based on a perturbative expansion in the small parameter of Knudsen number, which is defined as the ratio of the thermal particle mean-free-path and the system gradient length scale. The error in the analysis can be locally measured in phase space using the local Knudsen number, which for the energy squared dependence of the mean-free-path, is much larger for high energy particles. Such breakdown, if occurs at sufficiently high energy, has small impact on closure results, but in cases of strong spatial gradients, can have large effect and invalidate the perturbative calculation. Here we show a non-perturbative closure formulation and its application in calculating standard closure quantitities such as heat flux. This approach applies as long as the thermal bulk is close to a Maxwellian, where a perturbative analysis can be matched onto a non-perturbative treatment of the tail population.

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Xianzhu Tang
Los Alamos National Laboratory

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