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Asymptotic preserving boundary conditions for kinetic models

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In this work we propose asymptotic preserving boundary conditions for kinetic problems. We concentrate on the BGK model, and illustrate with several examples why and how the asymptotic limit must be preserved also when imposing boundary conditions. Next, we illustrate the robustness of the method with examples involving rarefied flow at several regimes on non trivial geometries.

Recently there has been great attention to the study of Asymptotic Preserving (AP) schemes (see the recent review [2]), but the same care has not been bestowed on the enforcement of boundary conditions. However, numerical experiments show clearly that, if proper boundary conditions are not imposed, spurious effects are to be expected, which prevent convergence to the correct asymptotic limit, [3].

We start from illustrating the problem, and proposing a solution. Next we discuss how to implement kinetic BGK and ES-BGK models preserving the correct asymptotic limits.

The talk will also illustrate applications. In particular, we will consider the passive transport of a set of particles on a rarefied flow in a nozzle. These simulations provide useful data for the study of the behaviour of pollutants, composed of unburnt particles, ejected from satellite thrusters.

References

[1] G. Dimarco L. Pareschi, Numerical methods for kinetic equations. *Acta Numerica* :1-137, 2014.

[2] F. Bernard, A. Iollo, G. Puppo, Accurate asymptotic preserving boundary conditions for kinetic equations on Cartesian grids. *Acta Numerica* to appear on JOMP, 2015.