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A weighted particle scheme for solving the Enskog-Vlasov equation in spherical geometry

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The Enskog-Vlasov equation has proven successful in investigating fluids undergoing a phase change [1,2,3,4]. However, the numerical solution of this kinetic model is computationally demanding and, therefore, existing studies are restricted to one-dimensional planar flows or flows with cylindrical symmetry. In this work, a weighted particle scheme is developed for solving the Enskog–Vlasov equation in spherically symmetric geometry. It is shown how to cope with the non-local structure of the Enskog collision integral and a closed-form expression of the mean force field is determined using the shell theorem.

As an application, the growth rates of nano-droplets/bubbles in the bulk of a homogeneous metastable vapour/liquid are evaluated in a wide range of supersaturation ratios that was not possible until now due to the high computational cost required by alternate approaches.

The proposed scheme significantly broadens the range of problems that can be investigated via the Enskog-Vlasov equation, and it is thus a valuable tool for studying fluid flows with phase change.

References

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