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Jingwei Hu*, Purdue University, West Lafayette, IN 47907. *A fast spectral method for the Boltzmann collision operator with general collision kernels.*

We propose a simple fast spectral method for the Boltzmann collision operator with general collision kernels. In contrast to the direct spectral method (Pareschi and Russo, 2000; Gamba and Tharkabhushanam 2009) which requires $O(N^6)$ memory to store precomputed weights and has $O(N^6)$ numerical complexity, the new method has complexity $O(MN^4 \log N)$, where N is the number of discretization points in each of the three velocity dimensions and M is the total number of discretization points on the sphere and $M \ll N^2$. Furthermore, it requires no precomputation for the variable hard sphere (VHS) model and only $O(MN^4)$ memory to store precomputed functions for more general collision kernels. Although a faster spectral method is available (Mouhot and Pareschi 2006) (with complexity $O(MN^3 \log N)$), it works only for hard sphere molecules, thus limiting its use for practical problems. Our new method, on the other hand, can apply to arbitrary collision kernels. A series of numerical tests is performed to illustrate the efficiency and accuracy of the proposed method.

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