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A conservative dynamical low-rank algorithm

Kinetic equations present computational challenges due to their (up to) six-dimensional phase space dependence, resulting in high memory requirements and high computational cost. Traditional particle methods alleviate this burden, but generally suffer from noise. Dynamical low-rank approximation is a novel approach that significantly reduces the computational burden, but often fails to preserve physical invariants such as mass, momentum, and energy. This destroys the inherent physical structure of the problem. In this talk, we present a modified low-rank algorithm that conserves mass and momentum while improving energy conservation. The resulting method is applied to the Vlasov-Poisson equations, though the same strategy can be applied to other equations. Numerical results for phenomena such as Landau damping and two-stream instability demonstrate the effectiveness of the new method.