

Asymptotic preserving methods for the BGK-Vlasov-Poisson system in the quasi-neutral and fluid limits

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I am interested in asymptotic preserving schemes to solve plasma models. These schemes are well known to be particularly well adapted to multiscale problems in which different regimes can be attained. I will present the particular case of the joint quasi-neutral and fluid limit of the Vlasov-BGK-Poisson system. This problem depends on two parameters: the scaled Debye length and the Knudsen number. The Debye length measures the scale of charge unbalances in the plasma. When this parameter is small, as compared as the size of the domain, the plasma is at equilibrium and the electric charge unbalances are negligible in the plasma. This is the so-called quasi-neutral regime. The Knudsen number measures the ratio between the mean free path between two collisions and the size of the domain. When this parameter is small, the number of collisions is large and the fluid regime is attained. When a standard explicit scheme is used to discretize this system, these micro-scale phenomena must be resolved to ensure the stability and the consistency of the scheme. Then, explicit discretizations suffer from severe numerical constraints. It is necessary to develop new algorithms to bypass this limitation. These schemes must be stable in all regimes: Debye length and Knudsen number large or small, without having to resolve these small scales.