

Title:High Order Asymptotic Preserving Semi-implicit RK Schemes For The Two-Fluid Euler-Poisson System In The Quasineutral Limit

Author: Saurav Samantaray,
Department of Mathematics, IIT Madras, Chennai, India

Abstract: We consider the two-fluid (TF) Euler-Poisson(EP) system which models plasma in the quasineutral limit. As the quasineutral limit is singular for the governing equations, the time discretisation is tantamount to achieving an accurate numerical method. We view the TF-EP system as a differential algebraic system (DAEs). The direct approach which is employed to develop implicit RK schemes for DAEs is amalgamated with SI-IMEX-RK or multiplicatively partitioned IMEX-RK schemes to obtain a framework suitable to obtain high-order time semi-discrete scheme for the TF-EP system. In the time discretisation Euler fluxes are split into stiff and non-stiff components, in order to account for rapid plasma oscillations in the quasineutral regimes. The high order scheme possesses the asymptotic preserving (AP) property. In order to discretise in space a Rusanov-type central flux is used for the non-stiff part, and simple central differencing for the stiff part. AP property is established also for the space-time fully-discrete scheme. Results of numerical experiments are presented to validate the theoretical claims.