Asymptotic-preserving finite volume scheme for the multi-fluid equations towards electric propulsion applications[1] ALEJANDRO AL-VAREZ LAGUNA, LPP/CMAP, Ecole Polytechnique, THIERRY MAGIN, VKI, PASCAL CHABERT, LPP, MARC MASSOT, CMAP, ANNE BOURDON, LPP — In this work, we introduce a numerical method for electric propulsion applications that solves for a fluid model that considers non-equilibrium, collisional, and anomalous transport processes. Previous fluid descriptions disregard some of these effects, whereas Particle-in-Cell (PIC) simulations are computationally very expensive and remain unaffordable to study full-domain geometries. The numerical method that is proposed here features a second-order finite volume discretization with an asymptotic-preserving scheme that is able to tackle the quasi-neutral behavior of the plasma without resolving the Debye length. Similarly, the scheme preserves the behavior of the fluids at different regimes of Mach number, similar to the one proposed by Alvarez Laguna et al. (2016, 2018). These properties are found to be important to resolve the stiff system of equations that results from the large mass disparity between ions and electrons. Additionally, we analyze the numerical implications of discretizing the fluid set of equations for electric propulsion applications. The novel numerical model is benchmarked against PIC simulations obtained by LPPiC (Croes et al. 2017) and other fluid models that are available in the literature.

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