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Modelling tangential discontinuities at the Magnetopause with the new Energy Conserving Moment Implicit Method ELISABETTA BOELLA, KU Leuven, ALFREDO MICERA, Politecnico di Torino, DIEGO GONZALEZ-HERRERO, MARIA ELENA INNOCENTI, GIOVANNI LAPENTA, KU Leuven — Kinetic modeling of heliospheric plasmas is computationally very challenging due to the simultaneous presence of micro and macroscopic scales, which are often interconnected. As a consequence, simulations are expensive and hard to deploy within the existing Particle-In-Cell techniques, being them explicit, implicit or semi-implicit. Very recently we have developed a new semi-implicit algorithm, which is perfectly energy-conserving and as such, stable and accurate over a wide range of temporal and spatial resolutions. In this work, we are going to describe the main steps that led to this great breakthrough and report the implementation of the method in a new massively parallel code, called ECsim. The new approach is then employed to investigate tangential discontinuities (TD) at the magnetopause. Two and three-dimensional simulations of TDs are carried out over MHD time scales, retaining a kinetic description for both electrons and ions with a realistic charge to mass ratio. The formation of a high-energy tail Maxwellian is observed in the distribution function of the electrons on the Earth side. This leads to a crescent-shaped distribution in the plane perpendicular to the magnetic field, in agreement with recent observations of the Magnetospheric Multiscale (MMS) mission.

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