11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
20-25 July 2014, Barcelona SPAIN

A TWO-FLUID COMPUTATIONAL MODEL TO STUDY MAGNETIC RECONNECTION IN REACTIVE PLASMAS UNDER CHROMOSPHERIC CONDITIONS

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Key words: Plasma, Solar Physics, Finite Volume Method, Magnetohydrodynamics (MHD), Multi-fluid, Magnetic reconnection

Abstract.

We use a two-fluid (plasma + neutrals) model to simulate the magnetic reconnection in chromospheric conditions. Improved models for characterizing collisional and reactive magnetized partially ionized plasma in the presence of electromagnetic fields are essential to understand the phenomena taking place in astrophysical and laboratory plasmas. Particularly, scenarios where dissipative processes and thermo-chemical non-equilibrium play an important role are beyond the classical single-fluid MHD representation. The governing equations of the multi-fluid model used include two loosely-coupled systems: the reactive two-fluid equations and the full Maxwell equations complemented with two additional divergence cleaning equations for enforcing numerically the two Gauss's laws. A second-order cell-centered Finite Volume method for unstructured grids is used to discretize both systems. In particular, a variant of the AUSM$^+$-up scheme is used to tackle the two-fluid equations, while Steger-Warming scheme is chosen for treating Maxwell equations. The unsteady simulation is advanced in time with an implicit three-point Backward Euler scheme. Results of the reconnection process are presented showing clear differences in the velocities and path of the neutrals compared to the ions that respond to the effect of the electromagnetic fields. Also shown are the different evolutions of the density of neutrals and ions that interact through chemical reactions.