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Two-fluid simulations of Rayleigh-Taylor instability in a magnetized solar prominence thread. Effects of prominence magnetization, mass loading and collisionality

Thursday, 9 September 2021 09:00 (13 minutes)

We explore the dynamical impacts and observable signatures of
two-fluid effects in the parameter regimes when ion-neutral collisions do not fully couple the neutral and charged fluids.
Popescu Braileanu et al., A&A (2021a,b): doi.org/10.1051/0004-6361/202039053 ; doi.org/10.1051/0004-6361/202140425

We performed 2.5D two-fluid simulations of the Rayleigh-Taylor instability (RTI) at a smoothly
changing interface between a solar prominence thread and the corona.
Our two-fluid model takes into account viscosity, thermal conductivity, and collisional interaction
between neutrals and charges: ionization or recombination, energy and momentum transfer, and frictional heating.
We explore the sensitivity of the RTI dynamics to the prominence equilibrium configuration, including the impact of the magnetic field strength and shear supporting the prominence thread, the amount of prominence mass-loading and to collisional effects for different magnetic field configurations supporting the
prominence thread.
At small scales, a realistically smooth prominence-corona interface leads to qualitatively
different linear RTI evolution than that which is expected for a discontinuous interface, while magnetic field shear has
the stabilizing effect of reducing the growth rate or eliminating the instability.
Ionization and recombination reactions
between ionized and neutral fluids do not substantially impact the development of the primary RTI, but they can impact the development of secondary structures during the mixing of the cold prominence
and hotter surrounding coronal material. We find that collisionality within and between ionized and neutral particle populations plays an important role in both linear and nonlinear development of RTI; ion-neutral collision frequency is the primary determining factor in development or damping of small-scale structures.

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