Rayleigh–Taylor instability in prominences from numerical simulations including partial ionization effects

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Abstract

Solar prominences consist in cool, dense, and partially ionized chromospheric plasma remaining stable for days in the solar corona. They should be a subject to Rayleigh–Taylor instability (RTI), when a cooler material forms turbulent drops, mixing with a hotter underlying material. High-resolution observations indeed reveal turbulent up- and down-flows from the visible base of prominences. We study the physics of Rayleigh–Taylor instability by means of 2.5D numerical simulations in a single-fluid MHD approach including a generalized Ohm's law. Our aim is to understand the influence of a large fraction of neutral atoms into the the stability of prominences and the development of RTI. The initial configuration includes a homogeneous magnetic field forming an angle with the direction in which the plasma is perturbed. We study the instability onset time, the growth rate, and the velocity of the downflowing turbulent drop as a function of the orientation of the magnetic field and the fraction of neutrals in the prominence material. We compare the numerical results with the analytical linear calculations in the initial stage of the instability.

Keywords: Prominence, simulations, partial ionization

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