Partially ionized plasma downflows and vertical threads in solar prominences

Ramon Oliver*†[1], Roberto Soler[1], Teimuraz Zaqarashvili[2], Jaume Terradas[1], and Maxim Khodachenko[2]

[1]Universitat Illes Balears (UIB) – Departament de Física. Edifici Mateu Orfila. C. Valldemossa, km 7,5. E-07122 Palma de Mallorca, Spain

[2]Space Research Institute, Austrian Academy of Sciences, Graz, Austria – Space Research Institute Austrian Academy of Sciences Schmiedlstr. 6 A-8042 Graz, Austria

Abstract

Observations of limb prominences often show material falling along vertical threads and moving with an acceleration smaller than that of free-fall. A simple partially ionized plasma model is used to investigate these vertical downflows, which are generated by a mass condensation in the corona. From our calculations, the mass injection gives rise to the formation in _˜200 s of a dense blob that falls with a roughly constant acceleration of 15–70 m s$ˆ{–2}$ and a density of 4–10 × 10$ˆ{-11}$ kg m$ˆ{–3}$.

For a fully ionized plasma it is found that the gas pressure gradient is responsible for reducing the effect of solar gravity. In the absence of charged particles, neutrals behave like a fully ionized gas. In a partially ionized gas the mass condensation gives rise to the formation of a neutral and a charged blob that, in the absence of friction between these two species, fall with different accelerations. The friction force, however, plays a prominent role since it quickly couples charged particles and neutrals and makes them fall jointly with a constant acceleration.

Keywords: Solar prominences, vertical threads, plasma downflows

*Speaker

†Corresponding author: ramon.oliver@uib.es