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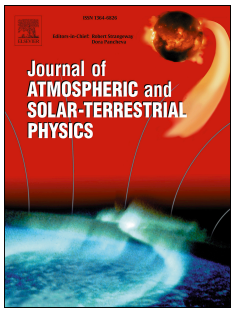

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Prominence activation by increase in electric current

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Abstract

We consider activation of a solar prominence by sharp increase in electric current in the frame of the Kuperus-Raadu model. The dynamics of the prominence is described in terms of the Ampère force, gravity, and the drag force. We suggest that the drag force is determined by the ion viscosity of ambient plasma. The upward Ampère force acting on the filament increases with the electric current in the filament, which results in the increase in the height of the filament. As a result of the dynamical process, a new equilibrium state corresponding to the new value of the electric current is reached. The maximum height and velocity of the prominence are estimated using the nonlinear equation for prominence dynamics. A sharp increase in the electric current can be due to the magnetic Rayleigh-Taylor instability in the chromospheric footpoints of the filament. Two examples of solar active filaments are analyzed in the context of the proposed model. Failed or two-stage eruption of the prominences is also discussed.

Keywords: Sun: prominences, activity, electric currents

1. Introduction

It is known that activation of prominences and filaments often leads to the eruption of their matter into the solar corona, the event that forms the core of a coronal mass ejection (CME). There are quite a lot papers devoted to the precursors and triggers of a prominence eruption. For example, Filippov and Den (2001) revealed the critical height of a prominence before eruption, 50-200 Mm. Jenkins et al. (2018) pointed into attention on the unloading of prominence mass in the pre-eruption period. Heating of an erupting prominence (≥ 6 MK) associated with CME have been observed by Lee et al. (2017). Ryutova et al. (2010) suggested the Rayleigh-Taylor and

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