Magnetohydrodynamic study on the effect of the gravity stratification on flux rope ejections

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Abstract

Coronal Mass Ejections (CMEs) are one of the most violent phenomena found on the Sun. One model to explain their occurrence is the flux rope ejection model. In this model, magnetic flux ropes form slowly over time periods of days to weeks. They then loose equilibrium and are subsequently ejected from the solar corona over a few hours. The contrasting time-scales of formation and ejection pose a serious problem for a consistent modelling of the whole life-span of a flux rope.

In order to investigate if magnetic flux ropes formed during a quasi-static evolution can erupt to produce a CME, we run simulations of the full life-span of magnetic flux ropes coupling two models. The Global Non-Linear Force-Free Field (GNLFFF) evolution model of Mackay and van Ballegooijen (2006) is used to follow the quasi-static formation of a flux rope; the MHD code ARMVAC is used to simulate the production of a CME through the loss of equilibrium and ejection of this flux rope in presence of solar gravity and density stratification.

Our realistic multi-beta simulations describe the CME following the flux rope ejection and highlight the decisive role played by the gravity stratification on the CME propagation speed.

Keywords: MHD, CME, Flux rope, Gravity

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