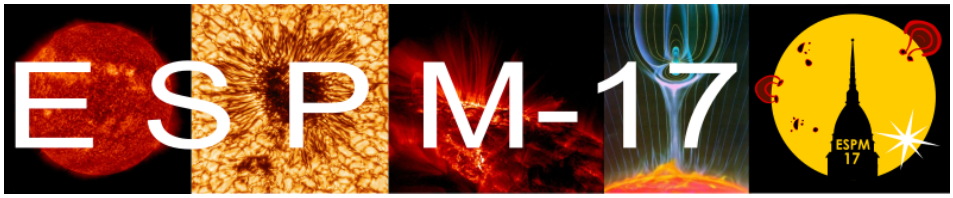

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Potential Predictions of Magnetic Flux Rope Eruptions

Magnetic flux rope eruptions are one of the primary mechanisms behind large coronal mass ejections. Flux ropes are twisted bundles of magnetic flux in the lower solar corona, which can store vast amounts of magnetic energy and remain in quasi-equilibrium for some time. If the conditions are correct, these ropes can violently erupt –but it is also equally possible for them to diffuse away into insignificance. The mechanisms behind such instabilities have been studied extensively for decades, but any definitive method of predicting the timing or magnitude of future eruptions has so far eluded us. In a slightly unusual approach, we have attempted to determine several scalar quantities measured from the magnetic field which could theoretically be used to predict an imminent eruption. With a large parameter study in 2.5D, we have used both MHD and magnetofrictional models to study thousands of flux rope eruptions, and in these simple cases we have found several such diagnostics which can predict imminent eruptions with up to around 90% certainty, providing the magnetic field is accurately reconstructed. We then consider the potential extension of this approach to full 3D models, and the possibilities of combining it with real-time photospheric magnetogram data to theoretically make useful predictions of eruptions and (by extension) potentially problematic space weather events.

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