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Thermally enhanced tearing in solar current sheets: Explosive reconnection with plasmoid-trapped condensations

Thermal instability plays a major role in condensation phenomena in the solar corona, e.g. for coronal rain and prominence formation. In flare-relevant current sheets, tearing instability may trigger explosive reconnection and plasmoid formation. However, how both instabilities influence the disruption of current concentrations in the solar corona has received less attention to date. We incorporate the non-adiabatic effects of optically thin radiative energy loss and background heating, and use a resistive magnetohydrodynamic simulation of a 2D current layer to explore how the thermal and tearing modes reinforce each other. We find that the current sheet fragments through an explosive reconnection process, characterized by the formation of plasmoids which interact and trap condensing plasma. Our parametric survey explores different resistivities and plasma-beta to quantify the instability growth rate in the linear and nonlinear regimes. We notice that for dimensionless resistivity values within $10^{-4} - 5 \times 10^{-3}$, we get explosive behavior. We calculate the mean growth rates for the linear and different non-linear phases of the evolution. We note that the formation of plasmoids is noticed for the Lundquist number range between $4.6 \times 10^3 - 2.34 \times 10^5$. We quantify the temporal variation of the plasmoid numbers and the density filling factor of the plasmoids for different physical conditions. I will also discuss about the ongoing work of our more realistic 3D model of the thermally influenced tearing mode instability, where the localized cool condensations gather, realizing density and temperature contrasts similar to coronal rain or prominences.

Primary author: SEN, Samrat (KU Leuven)

Co-author: KEPPENS, Rony (CmPA, KU Leuven)

Presenter: SEN, Samrat (KU Leuven)

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