Contribution ID: **81** Type: **Oral Presentation**

Instability of twisted magnetar magnetospheres

Monday 30 March 2020 17:00 (15 minutes)

We present three-dimensional force-free electrodynamics simulations of magnetar magnetospheres with the Einstein Toolkit. Our recent work demonstrates the instability of certain degenerate, high energy equilibrium solutions of the Grad-Shafranov equation. This result indicates the existence of an unstable branch of twisted magnetospheric solutions and allows to formulate an instability criterion. The rearrangement of magnetic field lines as a consequence of this instability triggers the dissipation of up to 30% of the magnetospheric energy on a thin layer above the magnetar surface. We find that the estimated energy release and the emission properties are compatible with the observed giant flare events. The newly identified instability is a candidate for recurrent energy dissipation, which could explain part of the phenomenology observed in magnetars.

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Session Classification: Parallel 3B

Track Classification: Magnetic field formation, structure and evolution