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Twist induced Eruptions in Magnetars

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We address the primary question regarding the physical mechanism that triggers the energy release and initiates the onset of eruptions in the magnetar magnetosphere. Self-consistent axisymmetric models of the magneto -sphere are constructed based on force-free magnetic field configurations that contain a helically twisted force-free flux rope. Depending on the surface magnetic field polarity, there exist two kinds of magnetic field configurations, inverse and normal. For these two kinds of configurations, variations of the flux rope equilibrium height in response to gradual surface physical processes, such as flux injections and crust motions, are carefully examined. We find that equilibrium curves contain two branches: one represents a stable equilibrium branch, and the other an unstable equilibrium branch. As a result, the evolution of the system shows a catastrophic behavior: when the magnetar surface magnetic field evolves slowly, the height of the flux rope would gradually reach a critical value beyond which stable equilibriums can no longer be maintained. Subsequently, the flux rope would lose equilibrium and the gradual quasi-static evolution of the magnetosphere will be replaced by a fast dynamical evolution. In addition to flux injections, the relative motion of active regions would give rise to the catastrophic behavior and lead to magnetic eruptions as well. We propose that a gradual process could lead to a sudden release of magnetosphere energy on a very short dynamical timescale, without being initiated by a sudden fracture in the crust of the magnetar. Some implications of our model for gravitational event GW170817 are also briefly touched on.

References

The references related to your talks will be used to write summary paper in RMPP(Rev. Mod. Plasma Phys.). So do not miss important papers related to your talk.

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Note: Abstract should be in 1 page.