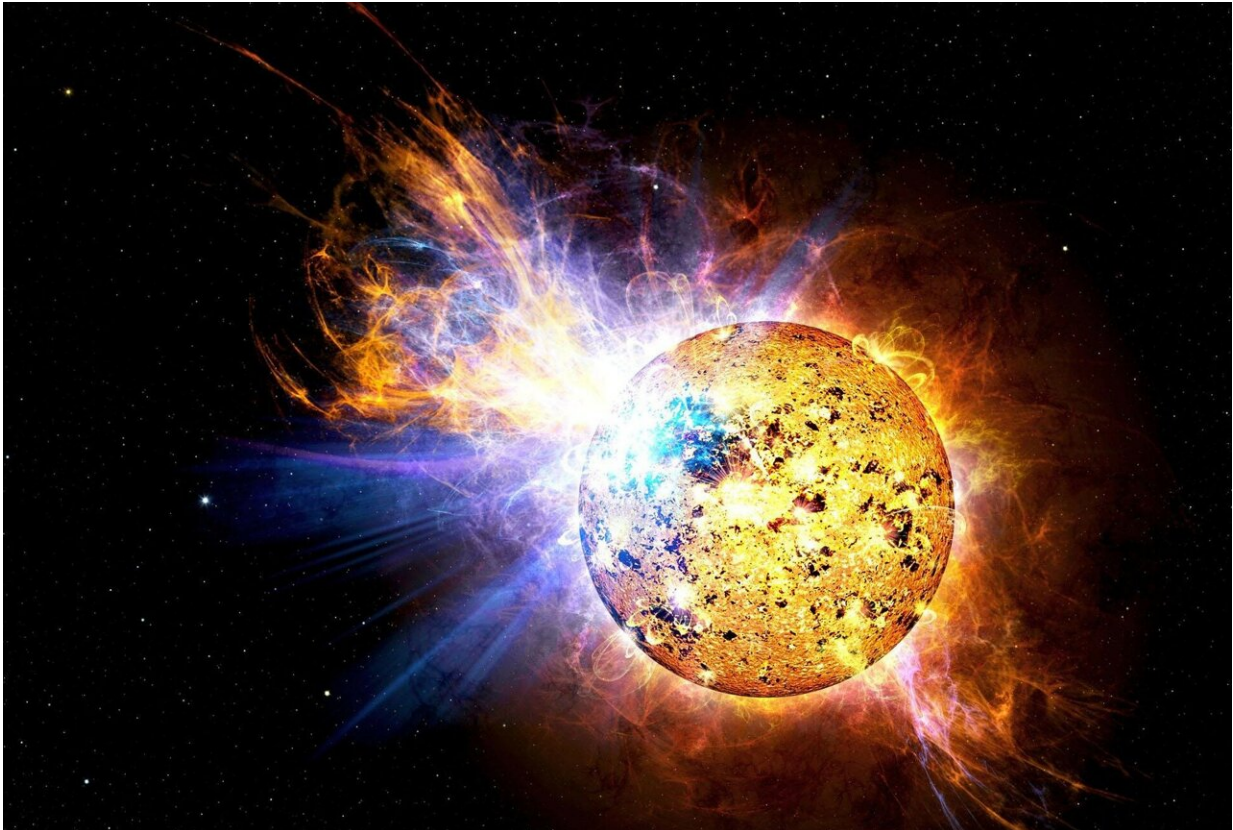


Exploring eruptions from the Sun

September 9 2021, by Li Yuan



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In our solar system, solar flares and coronal mass ejections (CME) are the most spectacular eruptive activities. Large solar flares and CMEs may bring us disastrous space weather, destroy our satellite and navigation system, and cause a large-scale blackout on the Earth.

Solar activity sometimes stays trapped close to the Sun's surface, but sometimes it breaks free in enormous ejections of hot plasma. What determines whether a solar flare stays confined or is followed by a catastrophic eruption?

A study led by Dr. Li Ting from National Astronomical Observatories of Chinese Academy of Sciences (NAOC) provides clues for the question. It was published in *The Astrophysical Journal Letters* on August 20.

The researchers explored how the fate of a flare may be influenced by the active region (AR) where it originates. They used observations from the satellite of Solar Dynamics Observatory (SDO) during 2010-2019 and established the largest flare database to date. The database includes 719 [solar flares](#) and involves the eruptive character of each large flare.

They found that the larger the total magnetic flux of the flare-host active region, the less likely the flare is associated with a CME. "For a given flare intensity, the flare is more likely to come with an eruptive CME if its active region has less magnetic flux. More magnetic flux means that there's stronger confinement of the flare by an overlying background field, preventing it from erupting," said Dr. Li.

Based on these solar observations, the researchers also speculated on the association rate R for solar-type stars by taking a representative stellar AR [magnetic flux](#) of 10^{24} Mx. For X100-class "superflares" on solar-type stars, no more than 50% flares can generate stellar CMEs. This may help to provide an explanation why the detection of stellar CMEs is rare.

The results have important implications for the prediction of CMEs occurring in association with large flares as well as for the solar-stellar connection, where the solar [flare](#)-CME association rates are used to estimate stellar CME occurrence frequencies.

More information: Ting Li et al, Magnetic Flux and Magnetic Nonpotentiality of Active Regions in Eruptive and Confined Solar Flares, *The Astrophysical Journal Letters* (2021). [DOI: 10.3847/2041-8213/ac1a15](https://doi.org/10.3847/2041-8213/ac1a15)

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