Understanding coronal mass ejections

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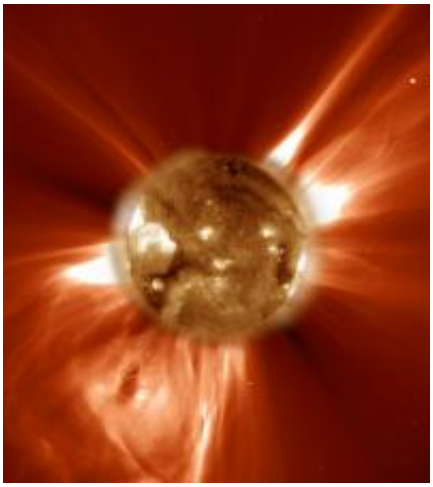

Filaments erupting from the solar surface and blasting enormous bubbles of magnetic plasma into space in a coronal mass ejection (CME). Astronomers have found that traditional ways of monitoring solar flares will miss significant numbers of CMEs. The coronal activity in this image extends over two million kilometers from the solar surface. Credit: NASA SOHO

(PhysOrg.com) -- The corona of the sun is the hot (over a million kelvin), gaseous outer region of its atmosphere. The corona is threaded by intense magnetic fields that extend upwards from the surface in loops that are twisted and sheared by the convective stirrings of the underlying dense atmosphere.

When these loops snap, they eject energetic charged particles in events called coronal mass ejections (CMEs). When the expelled particles reach the earth, they can disrupt communications satellites and electrical

systems, and pose a hazard to astronauts in space. Understanding these physical processes is essential to the development of a long-range space weather prediction capability. We are currently in a minimum of solar activity, but the active sun has been seen with as many as three CMEs in one day.

Since CME's were first identified from spacecraft in the 1970's, scientist have suspected that they were intimately associated with other kinds of events that originate low in the corona and that had been previously studied from the ground, like solar flares. There was no convincing theory behind such an assumption, however. CfA astronomers Suli Ma, G. Attrill, and Leon Golub, with a colleague, used the Solar Terrestrial Relations Observatory (STEREO) satellites to investigate the relationships between CMEs and other coronal activities. The STEREO mission provides two simultaneous views of the corona from different directions, enabling scientists to identify more precisely the location of coronal activity.

The astronomers studied the solar corona over eight months in 2009, and recorded thirty-four CMEs whose ejecta were directed towards earth. By tracing the evolution of each event, and by following the development of other activity low in the corona, they found that about one-third of the CMEs were not associated with the traditional markers. The results, while still needing a clearer theoretical explanation, indicate that space weather detection systems that rely only on flares or other traditional events will fail to detect a significant fraction of the coronal mass ejections.

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