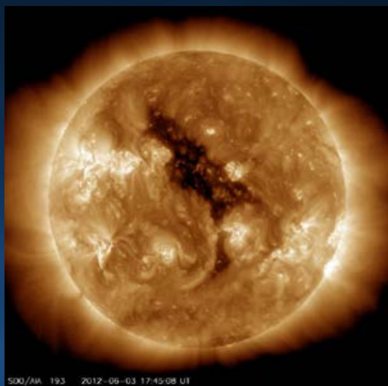
The Not-So-Calm After the Storm: Study Reports New Findings Regarding Earth's Radiation Belts

Using NASA, NOAA and Los Alamos National Laboratory data, scientists examine 43 high-speed solar-wind streams at Earth providing new insights and supporting space weather prediction efforts.

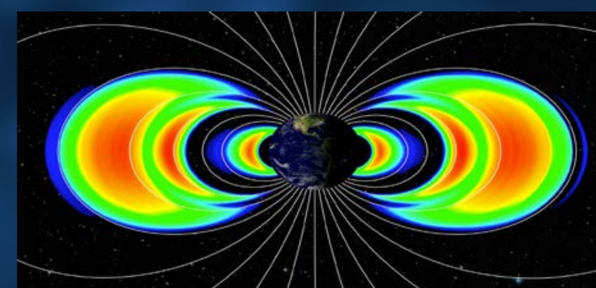


Coronal holes are regions where the sun's corona is dark. Image from NASA SDO/AIA

Scientists have spent decades trying to forecast the arrival of high-speed streams (HSSs) within the solar wind which trigger geomagnetic storms and can cause aurora, disrupt communications, and damage satellites.

HSSs originate in the sun's corona, where wisps of plasma swirl and loop back to the surface, trapped by the star's magnetic field. Sometimes the corona develops "holes" from which plasma streams out into space faster than the solar wind surrounding the hole. If the hole persists on the corona for some time, HSSs can impact Earth over multiple solar orbits, battering Earth's magnetosphere each time the coronal hole aligns with Earth; solar orbits last about 27 days.

Scientists analyzed 43 HSS events and found that typically, for the first six days or so the solar wind speed was faster than 550 kilometers per second (kps). For 2-3 days after that, the HSS had a trailing edge of 300-400 kps. As the HSS eased during this calmer period, Earth's magnetic field relaxed and went quiet. Surprisingly, the Earth's radiation belts didn't. As the solar and magnetic field activity decreased, the number of high-energy electrons in the outer radiation belts increased, peaking as the trailing edge passed over.



Van Allen Probes data used in an animation of the Van Allen Radiation Belts Credit: NASA GSFC/JHU-APL

Radiation can have detrimental impacts on our missions and instruments in space. Until now, radiation belts were almost always considered to be their most dangerous during storms, not in the calm period afterward. The team also found that the trailing edges occur in predictable, 27-day intervals – a reassuring finding that will be crucial in helping predict when these events might impact Earth.

Denton, M. H., and J. E. Borovsky (2017), The response of the inner magnetosphere to the trailing edges of high-speed solar-wind streams, JGR, doi:10.1002/2016JA023592.