Satellites more at risk from fast solar wind than a major space storm

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Satellites are more likely to be at risk from high-speed solar wind than a major geomagnetic storm according to a new UK-US study published this week in the Journal Space Weather.

Researchers investigating the space weather risks to orbiting satellites calculated electron radiation levels within the Van Allen radiation belts. This ring-doughnut-shaped zone wraps around the Earth, trapping

charged particles. Geostationary orbit lies inside the Van Allen radiation belts

The study, which analysed years of satellite data, found that electron radiation levels at geostationary orbit could remain exceptionally high for 5 days or more, even after the solar wind speed had died down. As a result, electronic components on satellites could charge up to dangerously high levels and become damaged.

Professor Richard Horne, lead author of the study, said: "Until now we thought that the biggest risk to orbiting satellites was geomagnetic storms. Our study constructed a realistic worst-case event by looking at space weather events caused by high-speed solar wind flowing away from the Sun and striking the Earth. We were surprised to discover just how high electron radiation levels can go."

This new research is particularly interesting to the satellite industry. Professor Horne continues, "Fast solar wind is more dangerous to satellites because the geomagnetic field extends beyond geostationary orbit and electron radiation levels are increased all the way round the orbit – in a major geomagnetic storm the field is distorted and radiation levels peak closer to the Earth.

"Electronic components on satellites are usually protected from electrostatic charges by encasing them in metal shielding. You would have to use about 2.5 mm of aluminium to reduce charging to safe levels – much more than is used at present. There are well over 450 satellites in geostationary orbit and so in a realistic worst case we would expect many satellites to report malfunctions and a strong likelihood of service outage and total satellite loss".

Dr. Nigel Meredith, a co-author on the study said: "A few years ago, we calculated electron radiation levels for a 1 in 150 year space weather

event using statistical methods. This study uses a totally different approach but gets a very similar result and confirms that the risk of damage is real."

The solar wind is a stream of particles and magnetic field flowing away from the Sun. It flows around the Earth's magnetic field and excites so-called 'chorus' plasma waves near geostationary orbit. Chorus waves accelerate electrons and form the Van Allen radiation belts. The chorus waves also travel along the geomagnetic field to the Polar Regions where they are detected on the ground at Halley Research Station, Antarctica.

More information: Richard B. Horne et al. Realistic worst case for a severe space weather event driven by a fast solar wind stream, *Space Weather* (2018). DOI: 10.1029/2018SW001948

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