

Why are there so few solar proton events in Solar Cycle 24?

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There have been significantly fewer large solar proton events (SPEs) in the current solar cycle (solar cycle 24) compared to the previous one. Solar proton events occur when the flux of solar-energetic particles with energies greater than 10 MeV exceeds 10 protons/(cm² s sr) and are reported by NOAA/GOES. Such events are usually associated with shock waves driven by fast coronal mass ejections (CMEs). Using a model combining observations of CMEs and diffusive shock acceleration of energetic protons at interplanetary shocks, we determine the total integrated flux of SPEs at Earth throughout the past two solar cycles. We compare with NOAA/GOES observations of SPEs during this period. We find that the dearth of large SPEs in the current solar cycle is caused partly by there being fewer fast CMEs, and partly because the inferred diffusion coefficients of energetic particles moving in the turbulent interplanetary magnetic field is larger in solar cycle 24. This causes the particles to be accelerated more slowly; and during the time over which shocks move from the Sun to 1 AU, the slower acceleration rate results in a lower intensity of high-energy particles. The cause of the larger diffusion coefficient is the result of a significantly weaker interplanetary magnetic field magnitude this solar cycle, compared to the previous one.

Primary author: GIACALONE, Joe (University of Arizona)

Presenter: GIACALONE, Joe (University of Arizona)

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