

Solar Sources of Earth-affecting Energetic Particles

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Particle radiation from the Sun is one of the most important sources of hazardous space weather in the vicinity of Earth. Detailed studies of the origin of the so-called large solar energetic particle (SEP) events became possible only during the solar cycle 23, thanks to the availability of nearly continuous observation of the solar sources of these events. In particular, coronal mass ejections (CMEs), which are found to be a key requirement for the occurrence of an SEP event, have been recorded continuously only starting in the 1990s. The physical connection between CMEs and SEPs is that the CMEs drive a fast-mode MHD shock, which accelerates SEPs in the corona and interplanetary medium. The earliest indication of a shock is the occurrence of a type II radio burst at frequencies anywhere from more than a hundred MHz to a few MHz. Recent investigations using STEREO observations have revealed that the shock forms very close to the Sun – a mere 100,000 km above the surface. The shock formation depends not only on the CME properties, but also on the physical conditions in the ambient medium that supports shock propagation. This paper considers extreme cases of SEP events and the associated CMEs and type II radio bursts to illustrate the variability observed in SEP event properties. Comparison will be made between the events of solar cycles 23 and 24.