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SOLAR ENERGETIC PARTICLE SPECTRA DURING THE LARGE EVENTS OF SOLAR CYCLE 23

Abstract

Solar flares and coronal mass ejections (CMEs) are the most powerful events in the solar system. In tens of minutes they can convert in excess of 1032 ergs of magnetic energy into accelerated particles, heated plasma, and ejected solar material. The most intense Solar Energetic Particles (SEPs) event measured by NOAA's GOES satellites during solar cycle 23 were analyzed in this study. Those large events had a rise time (from threshold to maximum intensity) within tens of minutes. This rapid rise time, coupled with the high intensity, means that if astronauts had been on EVA on the Moon, there would have very little warning before the maximum intensities were reached. Events of this nature need to be taken into account in planning astronaut operations and shelters on the Moon and in interplanetary space. In addition, the rapid rise places extreme requirements on models that accelerate SEPs by CME-driven shocks, because protons with energies ¿1 GeV must have been accelerated within minutes very low in the corona. We parameterized (1) CME speeds, accelerations, angular widths, locations, and earthward direction parameter, based on SOHO/LASCO catalog, (2) SPE rise time, duration time, decrease time and peak intensity, (3) Solar Flare Strength (X-ray Flare intensity) and radio type II burst, (4) propagation time delay from Solar Flare and SEP and from CME to SEP. We found that SPE rise time and duration time depend on CME speed and direction parameter, and the peak SPE intensity depends on CME speed and X-ray Flare intensity.