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Solar Energetic Particle Events

Solar energetic particle events are flux enhancements of energetic particles (electrons, protons and α-particles, mainly) that are ejected out of the Sun, get injected into the interplanetary medium and are accelerated by shock waves so that they propagate through the Solar System following the interplanetary magnetic field lines. These events can last a few hours, if they are impulsive, to up to a few days if they are gradual or mixed.

Their origin is related to flares and coronal mass ejections, which are violent manifestations of solar activity. A solar flare consists of an outburst of electromagnetic radiation, while coronal mass ejections are huge bubbles of plasma that get ejected out of the Sun's corona. Even though a single solar energetic particle event can be associated to both a flare and a coronal mass ejection, there is no cause-effect relation between these two phenomena: a flare can occur without a coronal mass ejection and vice versa.

The analysis of solar energetic particle events is done in order to understand the physical processes that take place during the development of flares and coronal mass ejections, and also in order to understand how the shocks accelerate the particles and affect their trajectories. By understanding the processes involved in the origin and propagation of the particles, these kind of events can be modeled and simulated with the aim of trying to predict them.

If solar energetic particle events propagate towards the Earth, the radiation of the highly energetic and charged particles represents a hazard to spacecraft components and astronauts orbiting around the planet. Therefore, the prediction and forecast of these events is an essential tool in order ensure the safety and viability of current and future space missions.