SOLAR ENERGETIC PARTICLES

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Solar energetic particles (SEPs) are an important sporadic constituent in the heliospace. As yet, the solar science has not advanced to the level that the occurrence of even the major SEP events could be reliably predicted. In spite of the direct observations of SEPs since the beginning of space age, the exact processes involved and conditions required for efficient particle acceleration are not yet fully understood. Traditionally, SEP events have been divided in gradual and impulsive events. Particles in large gradual events are believed to be accelerated in fast coronal mass ejection (CME) driven shocks, while acceleration in impulsive events is related to solar flare processes. Precise measurements with modern sensitive instruments have, however, revealed signatures of impulsive SEP events also in large SEP events associated with fast CMEs. Consequently, alternatives for the traditional SEP event classification have been presented. Important questions related to the exact origins of solar energetic particles are: what is the role of solar flares in large SEP events; where and when are shocks most efficient in accelerating particles; and how is the acceleration related to the changing magnetic geometry? As evidenced by the highly variable intensities of SEP events and by variations in shapes and occurrence of breaks in the solar energetic particle spectra, the acceleration efficiency of shocks is variable and coronal and interplanetary conditions can significantly influence the particle acceleration itself as well as what is observed at 1 AU, where most of the observations are carried out. In this review, I will briefly present observational characteristics of SEPs and summarize what the observations can tell about the origins of solar energetic particles and their associations with other energetic solar events.

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