

Isolated Enhancement of $>10\text{MeV}$ protons at or near interplanetary shock

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Solar Energetic Particles (SEPs) are often produced and detected at 1AU in association with solar eruptive events. While SEP events are generally classified into gradual and impulsive events depending on the observed time profiles, detailed SEP properties vary significantly from event to event. Here we report $>10\text{ MeV}$ proton events at 1AU that do not immediately fall into either category of gradual or impulsive event. The primary feature of these events is a spiky, but relatively small, enhancement of $>10\text{ MeV}$ proton flux with typical durations of a few hours. The events we have found so far were clearly associated with a passage of an interplanetary shock. Therefore, the events may be regarded as the so-called Energetic Storm Particle (ESP) events but with no (or very small) background SEP. Because all events were preceded by a passage of another shock and an enhancement of mildly energetic (0.1 - 2 MeV) particles, we conjecture that such isolated ESP events occurred due to local acceleration of particles facilitated by pre-conditioning or pre-acceleration.