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The active Sun and its implication for the heliosphere
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CME-driven shocks and early development of SEP events

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Solar energetic particle (SEP) events with elevated proton fluxes are called gradual due largely to their associations with solar flares that last long (long duration events, LDEs). It is generally believed that particles in these events are accelerated at CME-driven shocks. Because of the large angular extension of these shocks, magnetic field connection around the flare region is not as frequently discussed for gradual SEP events as for 3He-rich SEP events. However, the magnetic field connection should play at least some role in the observed dependence of SEP time profiles on the longitude of the source regions. According to Cliver et al. (1982), the first arriving particles are released as the acceleration region intersects with field lines that are connected to the observer. In a handful of small proton events that occurred in 2010, we track the CMEs and their associated coronal waves using SDO AIA, and STEREO EUVI and COR1/2 data, and estimate the 3-d propagation of the shocks assuming simple geometry. This is compared with well-connected field lines obtained using the potential field source surface (PFSS) model. We study the onsets of SEP events at Earth and STEREO A and B, and discuss how they can be explained by shock acceleration and whether there are direct contributions from the flares.