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Shock propagation model for Solar Energetic particles flux prediction

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Solar energetic particles (SEPs) are one of the most significant part of the space weather forecast. The most widely accepted acceleration mechanism is diffusive shock acceleration (Axford et al 1977, Bell 1978, Blandford & Ostriker 1978, Krymskii 1977) in a shock wave driven by a coronal mass ejection (CME).

Largest events associated with high energy SEPs are called as ground level enhancements (GLEs) in which high energy particles are detected in ground-based neutron monitors. In those events, protons whose energy exceed 1 GeV are accelerated very rapidly just after the associated flare/CME beginning. The fact means the GeV protons may be accelerated in a shock propagating in the corona near the Sun. Recently some studies show that particles can be rapidly accelerated by the shock with the time varying shock parameters (Tilka & Lee 2006; Sandroos & Vainio 2007; 2009; Ng & Reames 2008). The variation of the shock parameters along a field line during the propagation can be very important information for the forecast of proton fluxes.

We are developing a new model to trace the time variation of the shock parameters along a field line near the Earth. We first calculated three dimensional coronal magnetic field using a high resolution potential source surface model with SOHO/MDI synoptic maps. Next we assumed a virtual shock source near an active region, and then a spherically propagating shock wave. As the shock propagates, the cross point between the shock and the field line moves and then shock parameters change.

Keywords: solar energetic particle, solar corona, shock, coronal mass ejection, solar wind