

PEM023-04

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Precursors of the Forbush Decrease on December 14, 2006 observed with the Global Muon Detector Network (GMDN)

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We analyze the precursor of a Forbush Decrease (FD) observed with the Global Muon Detector Network in December 14, 2006. An intense geomagnetic storm is also recorded during this FD with the peak Kp index of 8+. By using the "two-dimensional map" of the cosmic ray intensity produced after removing the contribution from the diurnal anisotropy, we succeed in extracting clear signatures of the precursor. A striking feature of this event is that a weak loss-cone signature is first recorded even more than one day prior to the SSC onset. This suggests that the loss-cone precursor appeared only 7 hours after the CME eruption from the Sun, when the IP shock driven by the ICME located at 0.4 AU from the Sun. We find the precursor being successively observed with multiple detectors in the network according to the Earth's spin and confirmed that the precursor continuously exists in space. The long lead time (15.6 hours) of this precursor which is almost twice the typical value indicates that the IMF was more quiet in this event than a typical power spectrum assumed for the IMF turbulence. The amplitude (-6.45 %) of the loss-cone anisotropy at the SSC onset is more than twice the FD size, indicating the maximum intensity depression behind the IP shock is much larger than the FD size recorded at the Earth in this event. We also find the excess intensity from the sunward IMF direction clearly observed during about 10 hours preceding the SSC onset. It is shown that this excess intensity is consistent with the measurement of the particles accelerated by the head-on collisions with the approaching shock. This is the first detail observation of the precursor due to the shock reflected particles with muon detectors.

Keywords: Forbush decrease, loss-cone precursor, muon detector network, interplanetary shock