Interplanetary disturbances observed by the cosmic-ray muon detector network

Kazuoki Munakata[1]

[1] Physics Department, Shinshu Univ

A systematic survey of cosmic ray precursors of geomagnetic storms recorded by multi-directional muon detector network showed that 89% of large storms with maximum Kp-index greater than 8.0 were associated with precursors seen in the pitch-angle distribution of cosmic-ray intensity in space. The network consisting of three muon detectors at Nagoya, Hobart and Mawson at that time, however, had a big gap in directional coverage over the Atlantic and European regions. Owing to this gap, we were not able to analyze 43.6% of storms. This gap also made it impossible to analyze the intensity distribution over an entire pitch angle range and to precisely determine the appearance time of precursors.

To fill this gap, we recently installed a prototype multi-directional muon detector at the INPE's Southern Space Observatory in Sao Martinho da Serra, near Santa Maria, southern Brazil and started a preliminary measurement. We analyze the pitch angle distributions observed by a prototype muon detector network covering a full pitch angle range. The network includes a new muon detector installed at Sao Martinho in Brazil. It is confirmed that the pitch angle coverage by the network is greatly improved by the new detector installed in Brazil. The first order anisotropy (cosmic-ray streaming) is extensively analyzed to derive the cosmic-ray density gradients in space for periods including interplanetary disturbances recorded at the earth's orbit between March and November, 2001. We discuss temporal variation of resultant gradients relating them to the large scale structure of disturbances passing through the earth.