

## **A prototype muon detector network covering a full range of cosmic ray pitch angles**

K. Munakata (1), J. W. Bieber (2), S. Yasue (1), C. Kato (1), Z. Fujii (3),  
K. Fujimoto (4), M. L. Duldig (5), J. E. Humble (6), N. B. Trivedi (7),  
W. D. Gonzalez (7), B. T. Tsurutani (8) and N. J. Schuch (7)

(1) Physics Department, Faculty of Science, Shinshu University, Matsumoto, Japan,

(2) Bartol Research Institute, University of Delaware, Newark, USA,

(3) Solar Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan,

(4) Nagoya Women's University, Nagoya, Japan,

(5) Australian Antarctic Division, Kingston, Tasmania,

(6) School of Mathematics and Physics, University of Tasmania, Hobart, Australia,

(7) Southern Space Observatory, National Institute for Space Research,  
OES/CRSPE/INPE, Santa Maria, Brazil,

(8) Space Plasma Physics, Jet Propulsion Laboratory, California Institute of  
Technology, Pasadena, USA.

[kmuna00@gipac.shinshu-u.ac.jp](mailto:kmuna00@gipac.shinshu-u.ac.jp) /FAX: +81 263 37 2562

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 (Munakata et al., JGR, 105, A12, 27457, 2001). The network 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 range of pitch angle 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 (Geographic Coordinates: Lat 29°26'24" and Log 53°48'38"W, Alt.: 500m) in São Martinho da Serra, near Santa Maria, southern Brazil and started a preliminary measurement. The vertical count rate with geomagnetic cut-off rigidity of about 10GV is ~400,000 counts per hour, which is comparable to the low-zenith-angle components in Mawson proportional counter telescope. In this report, we will report on the performance of this new instrument, particularly focusing on its directional coverage over the gap mentioned above. We will also analyze the new network data and examine the expected appearance of muon precursors over a full range of pitch angle.