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CME-geometry and cosmic-ray anisotropy observed by a prototype muon detector network

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We analyze the cosmic-ray anisotropy observed by a prototype network of muon detectors during geomagnetic storms associated with coronal mass ejections (CMEs). The network currently consists of multidirectional surface muon detectors at Nagoya (Japan) and Hobart (Australia), together with a prototype detector at São Martinho (Brazil) which has been in operation since March, 2001. In this report, we analyze the anisotropy recorded in both the muon detector and neutron monitor (the Spaceship Earth) networks and find significant enhancements of cosmic-ray anisotropy during geomagnetic storms. Following the analysis by Bieber and Evenson [Bieber, J.W., Evenson, P. CME geometry in relation to cosmic ray anisotropy. Geophys. Res. Lett. 25 (1998) 2955-2958] for the neutron monitor data at ~10 GeV, we also derive cosmic-ray density gradients from muon data at higher-energy (~50 GeV), possibly reflecting the larger-scale geometry of CMEs causing geomagnetic storms. We particularly find in some events the anisotropy enhancement clearly starting prior to the storm onset in both the muon and neutron data. This is the first result of the CME-geometry derived from simultaneous observations of the anisotropy with networks of multidirectional muon detectors and neutron monitors.

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