CME geometry derived from the network observation of the galactic cosmic ray intensity

Cosmic Ray Modulation Team

The global network of high-energy cosmic-ray observations on the earth allows us to precisely measure the cosmic-ray streaming (the anisotropy of intensity), which often shows temporal variations associated with the CME arrival at the earth. As the component streaming perpendicular to the IMF can approximately be expressed by BxG, with the IMF vector B and the cosmic-ray density gradient G, we can deduce the gradient from the observed streaming and the IMF. In our previous paper, we found that the temporal variation of the derived G is consistent with the cosmic-ray depleted region formed behind the shock approaching and leaving the earth (Munakata et al., Proc. of the 34th COSPAR, 2002, submitted). The Forbush decrease is well known as the manifestation of the depleted region arriving at the earth. In the present paper, we deduce the near-earth trajectory of the center of the depleted region from the observed gradient G. The direction of negative gradient -G tells us the orientation of the density minimum viewed from the earth and the distance to the minimum can be deduced from the magnitude of G using a simple model for the density distribution. We thus deduce the location of the minimum density on an hourly basis. We then derive the trajectory by fitting a straight line to those locations. We analyze three events observed in 2001 both by the muon detector network and the high-latitude neutron monitor network (the Spaceship Earth), responding respectively to the higher (~50GeV) and lower (~10GeV) energy primary cosmic rays.