Drift effects and the cosmic ray density gradient in a solar rotation period

Kazuoki Munakata[1]

[1] Physics Department, Shinshu Univ

We present for the first time hourly variations of the spatial density gradient of 50 GeV cosmic rays within each solar rotation period in 2006-2007. By inversely solving the transport equation, including diffusion, we deduce the gradient from the anisotropy that is derived from the observation made by the Global Muon Detector Network (GMDN). The anisotropy obtained by applying a new analysis method to the GMDN data is precise and free from atmospheric temperature effects on the muon count rate recorded by ground based detectors. We find the derived north-south gradient perpendicular to the ecliptic plane is oriented toward the Helioshperic Current Sheet (HCS) (i.e. southward in the toward sector of the Interplanetary Magnetic Field (IMF) and northward in the away sector). The orientation of the gradient component parallel to the ecliptic plane remains similar in both sectors with an enhancement of its magnitude seen after the Earth crosses the HCS. These temporal features are interpreted in terms of a local maximum of the cosmic ray density at the HCS. This is consistent with the prediction of the drift model for the A positive epoch. By comparing the observed gradient with the numerical prediction of a simple drift model, we conclude that particle drifts in the large-scale magnetic field play an important role in organizing the density gradient, at least in the present A negative epoch. We also found that corotating interaction regions did not have such a notable effect. Observations with the GMDN provide us with a new tool for investigating cosmic ray transport in the IMF.