

Solar cycle variation of the galactic cosmic-ray density gradient observed with the Global Muon Detector Network (GMDN)

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We deduce the spatial gradient of galactic cosmic rays in three dimensions from the first order anisotropy observed with the Global Muon Detector Network. The anisotropy vector is first corrected for the solar wind convection and the Compton-Getting effect arising from the solar wind and the Earth's orbital motion around the Sun. We then convert the component anisotropy perpendicular to the interplanetary magnetic field to the spatial density gradient by assuming that the perpendicular anisotropy is mainly due to the diamagnetic streaming. In this paper, we analyze the solar cycle variation of the gradient observed with the GMDN during ten years between 2001 and 2010 and show that the derived density gradient is clearly decreasing with the decreasing solar activity toward the solar activity minimum in 2008-2009. We also find a clear seasonal variation in each of the radial and longitudinal component of the gradient vector in a close correlation with the heliographic latitude of the Earth. The amplitude of this seasonal variation also decreases with the decreasing solar activity. We discuss the origin of this seasonal variation in terms of the global distribution of cosmic-ray density in the heliosphere.