

Cosmic Ray Fluctuation Spectrum and Its Long-Term Modulation

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We study the power level of rapid cosmic ray fluctuations in the frequency range of 0.1-1.67 mHz (periods from 10 min to about 3 h) using measurements by space-borne instruments for the period since 1974. We present evidence that the power level of these fluctuations varies over the solar cycle, but the phase of this variation depends on the energy of cosmic ray particles. In agreement with earlier finding, based on ground-based neutron monitor data, the power level of the rapid fluctuations in the higher energy channels (corresponding to galactic cosmic rays) changes in phase with the solar cycle. On the other hand, the fluctuation level for lower energy channels (predominantly of solar / interplanetary origin) is roughly in an opposite phase with the solar cycle. The results prove conclusively that these fluctuations originate in the near Earth space, excluding their atmospheric or magnetospheric origin. We discuss that fluctuations of galactic cosmic rays are caused by turbulence in the interplanetary magnetic field which can be affected by the lower energy solar particles through, e.g., generation of MHD-waves. In such a way the power of fluctuations of low-energy particles can be transferred to the magnetic turbulence. This provides a possible scenario to explain the observed energy-dependence of the long-term modulation of the rapid cosmic ray fluctuations.