Cosmic ray modulation

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Cosmic rays are high energetic charged particles, originating from the sun, but mainly from outside the heliosphere and they propagate at nearly the speed of light. The transport of cosmic rays in the heliosphere is governed by diffusion, convection, adiabatic energy changes, and gradient and curvature drift, and these processes are described by the so-called Parker Transport Equation. Cosmic ray intensities at earth are lower than the interstellar value outside of the heliosphere, and this decrease is referred to as modulation.

Measurements recorded by various particle detectors have shown and confirmed that the cosmic rays intensities measured at earth and space varies with time scale occurrence, position and rigidity (or energy). The modulation of cosmic rays at earth can be calculated using approximate solutions of the Parker Transport Equation with modulation parameters. These modulation parameters are described by the modulation potential ϕ and modulation function M. [2] calculated ϕ for a given interstellar spectrum (LIS), by using the force field solution and neutron monitor data since 1951.
In this project we re-evaluate these modulation parameters using the atmospheric yield function **of [1]**, as well as the most recent estimates of the LIS derived from Voyager-1 observations. An overview of recent developments of the LIS estimated intensities and the implications will be given and how they were used to describe modulation parameters in the heliosphere. Further, we will describe how these LIS estimates are incorporated with neutron monitors count rates. The central role of the SANAE neutron monitor will also be outlined briefly and why it was chosen for better understanding of solar modulation at earth.

1. Caballero-Lopez, R, and Moraal H, (2004) Limitations of the force field equation to describe cosmic ray modulation, J. Geophys. Res., 109, A01101, doi:10.1029/2003JA010098.
2. Usoskin, IG, Alanko-Huotari, K, Kovaltsov, GA and Mursula, K, (2005) Heliospheric modulation of cosmic rays: Monthly reconstruction for 1951–2004, J. Geophys. Res., 110, A12108, doi:10.1029/2005JA011250.