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The global modulation of cosmic rays during a quiet heliosphere: A modeling perspective

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Abstract

A perspective is given of the solar modulation of galactic cosmic rays in the heliosphere during the extraordinary quiet solar minimum period from 2006 to 2009. This is done in the context of the total modulation of cosmic rays in a global heliosphere. Such an approach has become possible since the observation of galactic cosmic rays made beyond the heliopause by Voyager 1 so that together with very precise observations at higher energies at the Earth, more reliable local interstellar spectra can be established. Combined with the results from comprehensive modeling, a global view unfolds. The requirements for such an approach to the modeling of solar modulation are discussed. Computed, modulated spectra for protons and electrons are shown, for 2006 to 2009 together with computed radial and latitudinal gradients for protons, in comparison with observations where available. Predictions are made for the energy ranges not covered by the 2006 to 2009 observations. Respectively, the modulation factor for protons, electrons and positrons are given for energies as low as 5 MeV for the mentioned period. The computed electron to positron ratio is presented as applicable to solar minimum modulation conditions. The differences in the modulation of protons, electrons and positrons are illustrated for such conditions and the main contributions to this global process, including particle drifts, are discussed.

Keywords: Cosmic rays; Solar modulation; Heliosphere; Galactic protons, electrons and positrons; Particle drifts

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