PROCEEDINGS OF SCIENCE

An ab initio approach to solar-cycle dependent cosmic-ray modulation

R A Burger[1]
North-West University
Potchefstroom, South Africa
E-mail: `adri.burger@nwu.ac.za`

K D Moloto
North-West University
Potchefstroom, South Africa
E-mail: `20661533@nwu.ac.za`

N E Engelbrecht
North-West University
Potchefstroom, South Africa
E-mail: `n.eugene.engelbrecht@gmail.com`

Very often cosmic-ray modulation studies entail adjusting ad hoc parameters in order to fit observed cosmic-ray intensities. Since typically not all of the parameters in such models are related to observable physical quantities like magnetic field variances and correlation scales, they cannot predict changes in cosmic-ray intensity caused by changes in turbulence quantities. In this ab initio study we use a three-dimensional steady-state cosmic-ray modulation code in which the effects of composite slab- and two-dimensional turbulence, on both diffusion and drift, are included. This is a simplified version of the model described by Engelbrecht and Burger (2013), who considered only solar minimum conditions. In the present study we use results from a recent project on the solar-cycle dependence of turbulence quantities at Earth to study long-term modulation, covering all levels of solar activity. We discuss the conditions required to explain the higher than usual cosmic-ray intensities observed during the solar minimum in 2009, compared with the 1986 minimum when the large-scale orientation of the heliospheric magnetic field was the same as in 2009. We also discuss the assumptions required to obtain an inverse relationship between reasonably realistic diffusion coefficients parallel- and perpendicular to the background field, and the magnitude of the heliospheric magnetic field. We use the present study to illustrate that such a relationship is restricted to time-dependence, and does not necessarily apply to spatial dependence.

This work is based on the research supported in part by the National Research Foundation of South Africa (Grant Numbers 81834, 93592, and 96478). NEE and KDM acknowledge support by the South African National Space Agency.

[1]Speaker

PoS(ICRC2015)210