

Modeling the near-earth positron fraction

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Abstract. Observations in consecutive solar magnetic polarity cycles show a clear difference in the energy dependence of the positron fraction observed by balloons and spacecraft near Earth. This difference has been ascribed to charge-sign dependent modulation of the electrons and the positrons. In this progress report we compare results for the positron fraction for solar minimum conditions for opposite solar magnetic polarities, calculated with two different numerical codes, for different diffusion tensors, and for different forms of local interstellar spectra. The latter contain excesses that might be caused by nearby pulsars. The two codes are a steady-state three-dimensional finite-difference code developed at the Unit for Space Physics in Potchefstroom, and a time-dependent three-dimensional stochastic code under development at the Bartol Research Institute of the University of Delaware. Both codes contain a flat current sheet, but drift along it is implemented in different ways. We find that for the same input parameters, the modulated spectra produced by the two codes for electrons and positrons for consecutive solar magnetic polarity cycles agree very well, with typical differences of a few percent. Our preliminary results show that the positron fraction is rather insensitive to the choice of diffusion tensor, with maximum differences between 0.2 and 10 GeV of not more than 20% for the two very different tensors that we have used. Overall our results agree qualitatively with observations during solar minimum conditions. This confirms that drift effects are a key reason for the observed difference in the energy dependence of the positron fraction in consecutive solar magnetic polarity cycles. We also infer from previous model results for protons and antiprotons how the positron fraction could change during the course of two consecutive solar activity cycles.

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