"BADHWAR-O'NEILL 2011 GALACTIC COSMIC RAY MODEL UPDATE AND FUTURE IMPROVEMENTS"

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ABSTRACT

The Badhwar-O'Neill Galactic Cosmic Ray (GCR) Model based on actual GCR measurements is used by deep space mission planners for the certification of micro-electronic systems and the analysis of radiation health risks to astronauts in space missions. The BO GCR Model provides GCR flux in deep space (outside the earth's magnetosphere) for any given time from 1645 to present. The energy spectrum from 50 MeV/n – 20 GeV/n is provided for ions from hydrogen to uranium.

This work describes the most recent version of the BO GCR model (BO'11). BO'11 determines the GCR flux at a given time applying an empirical time delay function to past sunspot activity. We describe the GCR measurement data used in the BO'11 update – modern data from BESS, PAMELA, CAPRICE, and ACE emphasized more than the older balloon data used for the previous BO model (BO'10). We look at the GCR flux for the last 24 solar minima and show how much greater the flux was for the cycle 24 minimum in 2010.

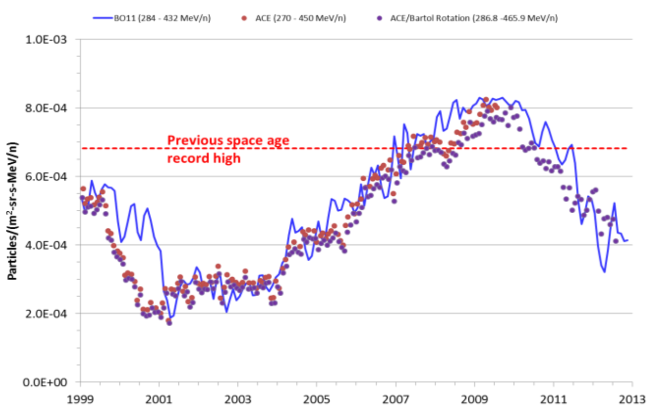

Fig. 1 GCR Ion Flux Comparison to BO11 model from 1999 to present (including the deepest Minimum of 2010). BO11 model calculation (solid line) shows very good agreement with Fe nuclei measurement.

The BO'11 Model uses the traditional, steady-state Fokker-Planck differential equation to account for particle transport in the heliosphere due to diffusion, convection, and adiabatic deceleration. It assumes a radially symmetrical diffusion coefficient derived from magnetic disturbances caused by sunspots carried outward by a constant solar wind.

A more complex differential equation is now being tested to account for particle transport in the heliosphere in the next generation BO model. This new model is time dependent - not steady-state. The new model accounts for the dynamics and anti-symmetrical features of the actual heliosphere so empirical time delay functions are not required. The new model will be capable of simulating the more subtle features of modulation – such as the Sun's polarity and modulation dependence on gradient and curvature drift. This improvement is expected to significantly improve the fidelity of the BO GCR model. Preliminary results of its performance will be presented.