Contribution ID: **61** Type: **Poster**

On the Positron Fraction in Cosmic Rays and Models of Cosmic-Ray Propagation

Tuesday, 29 June 2010 16:30 (1 hour)

The positron fraction observed by PAMELA and other experiments up to ~100 GeV is analyzed in terms of models of cosmic-ray propagation. It is shown that generically we expect the positron fraction to reach ~0.6 at energies of several TeV, and its energy dependence bears an intimate but subtle connection with that of the boron to carbon ratio in cosmic rays. The observed positron fraction can be fit in a model that assumes a significant fraction of the boron below ~10 GeV is generated through spallation of cosmic-ray nuclei in a cocoon-like region surrounding the sources, and the positrons of energy higher than a few GeV are almost exclusively generated through cosmic-ray interactions in the general interstellar medium. Such a model is consistent with the bounds on cosmic-ray anisotropies and other observations.

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Session Classification: Poster Session I

Track Classification: Balloon and satellite experiments