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Models for cosmic ray transport in the era of AMS-02

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Transport models for galactic cosmic rays depend on a large number of parameters which are poorly known and can be constrained only through derived quantities by comparison with the observed spectra of various cosmic ray species. Numerical models as implemented in the DRAGON or GALPROP code describe a multitude of observations. However, degenerate solutions limit the predictive power of these models when applied to other observables.
This might be improved with the more precise AMS-02 data.
We use Markov chain Monte Carlo methods to investigate wide ranges of transport parameters. Solutions to the transport equation are obtained numerically by using the DRAGON software. A total amount of 15 Mio. solutions was generated. The predictions are compared to measurements of cosmic ray protons and nuclei using data from PAMELA, ACE, CREAM, ISOMAXX and HEAO. More than 13,000 models were found to have a maximum deviation from the data of 1 sigma averaged over all data points.
We find that even in low dimensional models no definite solution exists. Instead, the predictions of a multitude of strongly differing parameter combinations are conform to current measurements. In a subsequent analysis, the more precise AMS-02 data have been included. We discuss the impact of the AMS-02 data on transport parameter limits and comment on the model uncertainties originating from numerics, the gas distribution and nuclei fragmentation cross sections.

Collaboration

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