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Study Galactic Cosmic Ray Modulation with AMS-02 observation

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The accurate measurements of the galactic cosmic ray (GCR) fluxes as function of time and energy by the Alpha Magnetic Spectrometer (AMS) give us unique information to search dark matter, to study the dynamics of solar modulation, to constraint the parameters in modulation model, to improve the precision of radiation dose prediction in the ongoing deep space exploration.
The transport of low rigidity GCRs (<30GV) in the heliosphere is described by the Parker equation. This equation is solved by stochastic differential equation approach in numerical model. The input parameters in the model (solar wind speed, tilt angle, magnetic intensity and polarity) are obtained by the observation near the Earth. The time varying parameters (diffusion coefficient, drift coefficient) is usually tuned manually. This method only gives result what looks good, but cannot gives the uncertainty of parameters.
In this study, the Markov chain Monte Carlo (MCMC) technique is used to determine the time varying posterior probability distribution of parameters related to the GCR transport equation. In Bayesian statistics, MCMC is a class of samplers in which we can simulate draws that are slightly dependent and are approximately from a posterior distribution. The Metropolis-Hastings algorithm is used to implement the MCMC sampler. Compared to the traditional method where the likelihood function is evaluated on the grid of points in parameter space, the MCMC sampler is low resource consumption as it is insensitive to the dimensionality of the parameter space.

Keywords

galactic cosmic rays, solar modulation

Collaboration

other Collaboration

Subcategory

Theoretical Results

Primary authors: SONG, xiaojian (Shandong Institute of advanced technology); LUO, xi (Shandong Institute of advanced technology); XU, weiwei (Shandong Institute of advanced technology)

Presenter: SONG, xiaojian (Shandong Institute of advanced technology)

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