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Cosmic Rays Propagation with HelMod: Difference between forward-in-time and backward-in-time approaches

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The cosmic rays modulation inside the heliosphere, is well described by a transport equation introduced by Parker in 1965.
To solve this equation several approaches were followed in the past.
Recently the Monte Carlo approach become widely used in force of his advantages with respect to other numerical methods. In the Monte Carlo approach the transport equation is associated to a fully equivalent set of Stochastic Differential Equations. This set is used to describe the stochastic path of quasi-particle from a source, e.g. the interstellar medium, to a specific target, e.g. a detector at Earth. In this work we present both the Forward-in-Time and Backward-in-Time Monte Carlo solutions. We study performances of the numerical solutions as well the precision of both methods. We discuss advantages and disadvantages of the two approaches and the differences with respect to other numerical solutions. Finally we present how both methods were implemented in the HelMod Code for the study of cosmic rays modulation in the heliosphere.

Collaboration

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