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CRPropa 3.1 – Stochastic differential equations for anisotropic cosmic ray transport

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The propagation of charged cosmic rays through the Galactic environment influences all aspects of the observation at Earth. Energy spectrum, composition and anisotropy are changed due to deflections in magnetic fields and interactions with the interstellar medium. Today the transport is simulated with different simulation methods either based on the solution of a transport equation (multi-particle picture) or a solution of the equation of motion (single-particle picture).

The publicly available propagation software CRPropa 3.1 can solve both approaches in two distinct modules. This duality allows the user to pick the right ansatz that suits best for the existing problem. The implemented code for the diffusion approach used stochastic differential equations (SDEs) to solve the transport equation. In doing so, it is possible to apply complicated anisotropic diffusion tensors in (nearly) arbitrary background fields which are necessary to describe the observed arrival direction of cosmic rays.

In this talk, the two propagation concepts are discussed and compared. It will focus mainly on the new diffusion ansatz and emphasize the advantages of SDEs over conventional grid based solvers. Furthermore, first use-cases of this software are presented.

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