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Modelling cosmic-ray transport in jets as a correlated random walk

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This work provides the description of charged particle transport in magnetic fields via a correlated random walk of particles and derives a telegraph transport equation from first principles that describe the initial, ballistic, and later diffusive phases in a consistent manner. A novel high-performance numerical method based on the theoretical considerations is presented that propagates single particles while statistically satisfying the particle distribution described by the transport equation. This novel method is superior to diffusive propagation codes for compact objects, such as AGN blobs, pulsars, and supernovas, because of its ability to correctly describe the initial transport phase relevant for compact objects. The method is applied for blobs in AGN jets and compared to ballistic and diffusive propagation codes.

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