

Contribution ID: 410

Type: Poster

## A rigorous solution to the superluminal issue in the diffusion equation

Superluminal propagation is an intrinsic problem in the diffusion equation and has not been effectively addressed for a long time. In this work, a rigorous solution to this issue is obtained under the assumption that particles undergo a random flight process, where they move isotropically at a constant speed while experiencing random scatterings. We validate this solution by comparing it with comprehensive simulations of the random flight process and find that it significantly deviates from the solution derived from the Jüttner propagator. This solution is broadly applicable to various diffusion phenomena, such as cosmic-ray propagation. We emphasize that our rigorous solution is particularly crucial in scenarios involving burst-like particle injection, where previous phenomenological approaches to the superluminal diffusion problem may not yield accurate results.

## **Collaboration(s)**

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Session Classification: PO-1

Track Classification: Cosmic-Ray Direct & Acceleration