Spacetime symmetries and geometric diffusion

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Abstract-

We examine relativistic diffusion through the frame and observer bundles associated with a Lorentzian manifold (M,g). Our focus is on spacetimes with a non-trivial isometry group, and we detail the conditions required to find symmetric solutions of the relativistic diffusion equation. Additionally, we analyze the conservation laws associated with the presence of Killing vector fields on (M,g) and their implications for the expressions of the geodesic spray and the vertical Laplacian on both the frame and the observer bundles. Finally, we present several relevant examples of symmetric spacetimes.

Index Terms- diffusion Lorentzian manifolds, covariant Fokker-Planck equation, spacetime symmetries