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Momentum Anisotropy from Resistive Magnetohydrodynamics

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We develop a relativistic framework for resistive magnetohydrodynamics for a two-component plasma composed of oppositely charged massless particles. Starting from the Boltzmann–Vlasov equation, the 14-moment method is used to derive coupled evolution equations for the charge–diffusion current and the shear–stress tensor. The formulation captures nonlinear feedback between electromagnetic fields and dissipative quantities and shows that even an electric field alone can generate shear stress in the fluid. In the homogeneous limit, the equations reproduce the expected Ohmic behavior at late times, while nonlinear effects modify the transient relaxation and lead to oscillatory, Hall-like responses in the presence of magnetic fields.
During Bjorken expansion, the electric field continues to act as the primary driver of shear, while the expansion rate modulates its evolution, enhancing the lifetime of the anisotropy and amplifying the coupling between diffusion and shear. The present formulation also provides a consistent basis to incorporate effects related to chirality. In particular, the inclusion of Berry-curvature terms in the kinetic description is expected to introduce parity-odd transport contributions, offering a natural way to study the connection between electromagnetic response and chiral dynamics in relativistic plasmas.

References:

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