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Force free states in magnetofluid formalism and eruptive events CHINMOY BHATTACHARJEE, New York Institute of Technology, JUSTIN FENG, CENTRA, Instituto Superior Tecnico, Universidade de Lisboa, SWADESH MAHAJAN, University of Texas at Austin — Magnetofluid formalism captures the dynamics of multi-species ideal hot plasma by treating the electromagnetic and flow field in an equal footing. For certain class of flows near black hole, the momentum evolution equation in this formalism has a structure similar to the source-free ideal MHD ohm's law. As a result, the evolution equation of vorticity, which is a now a combination of magnetic field and flow vorticity, is source-free and the topological invariant helicity is conserved for arbitrary thermodynamics. The steady state solutions of this equation have been extensively studied in classical and special relativistic systems. We present two such solutions near black hole horizon: (i) a diamagnetic solution where the vortical field is completely expelled from the interior of the plasma and (ii) a Beltrami solution which predicts the alignment of vortical field lines and plasma flow near black hole. In order to do so, we first extend the model to appropriately incorporate GR into the formalism and use 3+1 formalism to cast the momentum and vorticity equation into the familiar 3D equations. We predict that if any large scale magnetic or velocity field structure near black hole can be modeled as Beltrami field, the loss of such states can be associated with events such as outflows and jet production near black holes.

Chinmoy Bhattacharjee
New York Institute of Technology

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