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Fluid Dynamical Consequences of Current and Stress-Energy Conservation DILLON SCOFIELD, Dept Physics, Oklahoma State University, PABLO HUQ, College of Earth, Ocean, and Environment, Univ. Delaware — The dynamical consequences of fluid current conservation combined with the conservation of fluid stress-energy are used to develop the geometrodynamical theory of fluid flow (GTF). In the derivation of the GTF, we highlight the fact the continuity equation, equivalently the conservation of current density, implies the existence of the fluid dynamical vortex field. The vortex field transports part of the stress-energy; the other part of the stress-energy is transported by the fluid inertia field. Two channels of energy dissipation are determined by the GTF. One is an analog of the Joule heating found in electrodynamics. This follows from the conservation of stress-energy. The other dissipation channel arises from mechanisms leading to complex-valued constitutive parameters described in the electrodynamical analogy as due to a lossy medium. The dynamical consequences of the continuity equation, combined with the conservation of total stress-energy, then lead to a causal, covariant, theory of fluid flow, consistent with thermodynamics for all physically possible flow rates.

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