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Canonical Vorticity Framework for Magnetic Reconnection YOUNG DAE YOON, PAUL M. BELLAN, Caltech — Canonical vorticity $\mathbf{Q}_\sigma = \mathbf{m}_\sigma \nabla \times \mathbf{u}_\sigma + \mathbf{q}_\sigma \mathbf{B}$, the curl of the canonical momentum $\mathbf{P}_\sigma = \mathbf{m}_\sigma \mathbf{u}_\sigma + \mathbf{q}_\sigma \mathbf{A}$, is an important ideal plasma parameter because $\mathbf{Q}_\sigma$ is perfectly frozen into the species fluid if the pressure is both isotropic and barotropic. We present a framework for reconnection where $\mathbf{Q}_\sigma$ is the main variable instead of $\mathbf{B}$. This framework shows that canonical vorticity evolution, i.e., $\partial \mathbf{Q}_\sigma / \partial \mathbf{t}$, is driven by just two terms: a convective term which describes the frozen-in property of canonical vorticity and a canonical battery term which describes effects from the pressure tensor being non-isotropic or non-barotropic. This framework is simpler than the traditional framework based on the generalized Ohm's law where a multitude of terms give $\partial \mathbf{B} / \partial \mathbf{t}$. To demonstrate the power of the canonical vorticity viewpoint, the growth, stability, morphology, and saturation of the magnetic reconnection electron-diffusion region are explained using the electron canonical vorticity framework.

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