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**Finite Time Lyapunov Exponents for magnetically confined plasmas**[1] LINDA SUGIYAMA, MIT, HARINARAYAN KRISHNAN, LBNL — Finite Time Lyapunov Exponents (FTLEs) are applied for the first time to magnetically confined plasmas. The FTLE measures the local divergence or convergence of $n$-dimensional vector fields. Time-dependent FTLEs are directly related to Lagrangian Coherent Structures, which form the underlying structure of turbulent flows. Modern FTLE methods, developed over the past decade, are evolving rapidly and leading to new practical and theoretical insights into turbulent fluid dynamics. In contrast to fluids, an MHD plasma has two vector fields, the magnetic field and the plasma flow. Accurate methods for computing and visualizing FTLEs for the MHD fields have been developed, based on the VisIt visualization package. They are applied to time slices of a large sawtooth crash in a toroidal plasma, computed by the M3D extended MHD code. The plasma structures for both $\mathbf{B}$ and $\mathbf{v}$ have unexpected properties that are not brought out by conventional analyses. The sawtooth crash is also found to have well-organized "flow" structures in $\mathbf{v} \pm \mathbf{B}$. The FTLE appears to be a sensitive diagnostic for the structure of stochastic magnetic fields. The methods are not restricted to MHD, since they apply to almost any vector field.

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