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## Recurrence in three dimensional magnetohydrodynamic plasma

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Within the framework of MagnetoHydroDynamics, a strong interplay exists between flow and magnetic fields. This interplay is known to lead to several interesting phenomena such as nonlinear non-dispersive Alfvén waves, recurrence phenomena and magnetic reconnection, to name a few.

Using a set of divergence free sinusoidal flow fields (e.g., Arnold-Beltrami-Childress, Taylor-Green, Orszag-Tang etc) as initial flow profile we numerically integrate a self-consistent set of 3D, weakly compressible MHD equations [1] to study non-dispersive nonlinear Alfvén waves over a wide range of parameters [2]. It is inferred that these nonlinear Alfvén waves generate coherent large-amplitude oscillations between kinetic and magnetic energies. Followed by this, we identify a novel phenomena called “Recurrence”, within the premise of single fluid MHD equations for initial flow fields which are chaotic [3].

Even though it appears counter-intuitive, the strong nonlinearity of the problem allows a selected initial flow fields to quasi-periodically reconstruct its structures despite the fact that its structure is completely distorted during the evolution of the plasma. Such magnetic recurrence phenomena mediated by a dynamical energy exchange between magnetic and velocity fields via a reconnection process is believed to have wide applications

in controlling the disruptions in the magnetically confined plasmas.

After demonstrating the numerical convergence, we attempt possible explanation using a simple Hamiltonian field model.

### References

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