Dynamical study of chaotic magnetic fields in magnetohydrodynamic plasmas

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We consider nonlinear evolution of chaotic magnetic fields in flowing magnetohydrodynamic (MHD) plasmas. The evolution is described by a set of coupled nonlinear equations with the assumption that all quantities vary only in one direction. Chaotic oscillations of the magnetic fields have been analysed numerically in a general sense considering all the parameters and oscillations of lower hybrid and cyclotron types are also seen for some specific cases. The fixed points accompanied with their stability analysis corresponding to the nonlinear evolution equations are performed. The behaviours of Lyapunov exponent and correlation dimension in the parameter space are explored; in addition, the long range correlations and anticorrelations of the oscillations using the Hurst exponent estimated by the method of the rescaled range (R/S) statistics have been analysed. Our results can have implications in laboratory as well as space and astrophysical plasmas.

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