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# Nonlinear Dynamics of the Firehose Instability in Magnetic Dipoles*

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## Abstract

There is renewed interest in the nonlinear dynamics of the firehose instability in magnetic dipoles because these modes remain as one possible explanation for the onset of plasma flow events called bursty bulk flows. The events are widely observed in the geotail plasma where the plasma pressure exceeds the magnetic pressure. We have developed a nonlinear model and computer simulations of the firehose instability. The nonlinear model gives saturation due to nonlinear weakening of the magnetic curvature force from the pressure anisotropy for large field line distortions. In addition, kinetic theory effects related to the Hall MHD fluid description are required to limit the $k_z$ for the fastest growth rate. A $\delta f$ code is used to investigate the bounce averaging effects on the growth rate. The quasilinear isotropization of the pressure anisotropy is thought to be of secondary importance because there is a strong mechanism to support this anisotropy. As flux-tubes convect toward the center of the dipole their field lines will shorten. To conserve $J$ as an adiabatic invariant requires an increase in the parallel pressure. A new nonlinear initial value fluid code is used to invetigate the instability and the nonlinear states for dipole geometries.

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