Abstract Submitted
for the DPP10 Meeting of
The American Physical Society

A nonlinear theory of the parallel firehose and gyrothermal instabilities[1] MARK ROSIN, University of Cambridge, ALEX SCHEKOCHIHIN, University of Oxford, FRANCOIS RINCON, University of Toulouse, STEVEN COWLEY, Imperial College — Weakly collisional magnetized plasmas tend to develop pressure anisotropies which trigger fast ($\sim$ ion cyclotron period) plasma instabilities at scales between the ion Larmor radius ρ_i and the mean free path λ_{mfp}. These can dramatically affect the global ($\gg \lambda_{mfp}$) dynamics and their nonlinear evolution should drive pressure anisotropies towards marginal stability values, controlled by the plasma beta β_i. This nonlinear evolution is worked out in an *ab initio* kinetic calculation for the parallel ($k_\perp = 0$) firehose instability in a high-beta plasma. We use a particular physical asymptotic ordering to derive a closed nonlinear equation for the firehose turbulence, which we solve. We find secular ($\propto t$) growth of magnetic fluctuations and a $k_\parallel^{-3}$ spectrum, starting at scales $\gtrsim \rho_i$. When a parallel ion heat flux is present, the parallel firehose instability mutates into the new *gyrothermal instability.* Its nonlinear evolution also involves secular magnetic energy growth, but its spectrum is eventually dominated by modes with a maximal scale $\sim \rho_i l_T/\lambda_{mfp}$, ($l_T$ is the parallel temperature gradient scale).

[1]Funding from STFC and the Leverhulme Trust

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Date submitted: 21 Jul 2010 Electronic form version 1.4