Abstract Submitted
for the APR12 Meeting of
The American Physical Society

The Zero Turbulence Region in a Toroidal Plasma EDMUND HIGHCOCK, ALEXANDER SCHEKOCHIHIN, University of Oxford, STEVEN COWLEY, Culham Centre for Fusion Energy, MICHAEL BARNES, FELIX PARRA, MIT, COLIN ROACH, Culham Centre for Fusion Energy — Turbulence in the presence of a strongly sheared equilibrium flow can be thought of as the result of a three-way competition between underlying drives such as a background temperature gradient, the suppression of turbulence due to the gradient of the component of the velocity perpendicular to the magnetic field, and the additional driving of turbulence by the gradient of the parallel velocity component. We present a thorough nonlinear investigation of these three effects, in the limit of zero magnetic shear, to show that there is a large region in parameter space where turbulence is completely suppressed, and that, at sufficiently low ratios of the magnetic safety factor to the inverse aspect ratio (which determines the ratio of the parallel and perpendicular components of the velocity) this zero turbulence region extends to extremely high temperature gradients. Indeed, the critical temperature gradient, R/LTc, can exceed 20, where LTc is the critical temperature gradient scale length and R the major radius. Thus, we show that the limit of zero magnetic shear, low magnetic safety factor, low aspect ratio and high toroidal flow is a promising regime for tokamak operation.

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Date submitted: 09 Jan 2012 Electronic form version 1.4