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Is There a Nonlinear Subcritical MHD Beta Limit?*

R.E. Waltz, *General Atomics* — Since the 2005 beta scan on Cyclone case [1], the GYRO code has not been able to operate past about half the ideal MHD critical beta limit with finite stationary transport levels. There appears to be a *nonlinear subcritical MHD beta limit* [2] which maybe induced by the increased effective pressure gradients from the nonlinearly driven zonal flows. The high-n ideal beta limit is defined as the point where the growth rate extrapolated to the lowest possible wave number is greater than zero. The subcritical point for Cyclone case is about 0.5 the ideal limit ($\beta_{\text{crit}} = 3.0\%$). Some GA-std cases with $\beta_{\text{crit}} = 1.4\%$ have the subcritical beta at 0.42-0.35 the ideal. However, some very high beta DIII-D shot manage to get past the usually lower external kink beta limit and close to the ideal high-n limit with good confinement. The remedy appears to be the addition of ExB shear sufficient to reduce the transport at near zero beta by about half. GYRO simulations of the shots reasonably match the low transport when the high experimental level of ExB shear is applied.

[1] J. Candy, Phys. Plasmas **12**, 072307 (2005).

[2] R.E. Waltz, Phys. Rev. Lett. **55**, 1098 (1985).

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