Microstability properties of the local minimum |B| regime in the Pegasus spherical torus

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A local minimum |B| region, or "magnetic well," was recently observed in the low-aspect-ratio Pegasus device in high-β scenarios with strong edge current peaking [1]. ∇B reversal in the low-field-side diamagnetic well is stabilizing for drift waves, and additional favorable features include reduced trapped particle fraction and expanded parameter space for fast ion trapping [2]. Despite the diamagnetic well induced at high-β, the configuration remains net-paramagnetic with near omnigeneity, that is $|B| \approx |B|(\psi)$, in the bad curvature region. Favorable characteristics of omnigeneity also include reduced banana orbit widths and neoclassical transport [3]. Here, we report on the microstability properties of the Pegasus minimum |B| regime with calculations from the GENE gyrokinetic code [4]. Linear electromagnetic flux-tube simulations in the magnetic well region show tearing parity instabilities across $k_y\rho_s \sim 0.1$-1 (k_y is the binormal wavenumber). Instability growth rates for the magnetic well regime are about a factor of two less than corresponding growth rates in a similar conventional equilibrium (no magnetic well). Preliminary nonlinear simulations indicate electromagnetic electron thermal transport is the dominant transport mechanism and exceeds ion gyroBohm levels. Overall transport is lower in the magnetic well regime relative to the conventional equilibrium by about a factor of two due to strongly reduced transport at higher k_y values. However, transport at lower k_y values in the magnetic well regime is modestly enhanced relative to the conventional regime. The enhanced transport at lower k_y values is due to both larger fluctuation amplitudes and greater transport-relevant phase alignment.

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