Beta limit due to m/n=2/1 tearing mode onset in the DIII-D hybrid scenario

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Abstract. The performance, $\left(\beta_N \approx 3,\ q_{95} \approx 4.4,\ f_{BS} \approx 0.5,\ H_{89} > 2\right)$ of hybrid scenario plasmas in DIII-D [J.L. Luxon, Nucl. Fusion **42**, 614 (2002)] is limited by $m/n = 2/1$ tearing modes. Unlike conventional plasmas [T.C. Hender, *et al.*, Nucl. Fusion **44**, 798 (2004)], the linear dependence scaling of the global beta for onset of the instability with normalized local ion gyroradius ρ_i^* is modified as the $n = 1$ ideal kink beta limit is approached, suggesting that small island neoclassical tearing mode (NTM) threshold physics does not impose the dominant criterion for NTM stability. The hybrid scenario tends to go unstable just at or below the no wall $n = 1$ ideal kink beta limit of about $4\ell_i$. Experimentally $4\ell_i$ decreases with beta as $4\ell_i \approx 1.8\,\beta_N^{-1/2}$. Thus the "ceiling" in beta due to coupling of tearing to the ideal kink comes down as beta is increased. Scaling of the tearing unstable beta that combines both NTM threshold physics <u>and</u> a pole in $\Delta' r$ due to coupling to the ideal kink is presented.