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Abstract for an Invited Paper
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Non-ideal stability and control of ITER baseline demonstration discharges[1]

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DIII-D experiments and simulations provide new insights into the origins of disruption inducing mode locking events, showing how they correlate with increased plasma response to magnetic probing. Simulations show that changes in ideal and resistive stability impact the response in the ITER baseline regime, well below the pressure limit of the external kink mode. The dependencies of the response measurements on the plasma normalized internal inductance ℓ_i and beta β_N are qualitatively consistent with ideal MHD, although in most cases the amplitude of the measurements exceeds predictions, indicating that the experimental discharges are less stable than expected. This result is surprising in light of similar comparisons made previously in strongly rotating discharges, wherein ideal MHD predicted poorer stability than implied by measurements, and better agreement was obtained with simulations including drift-kinetic modifications to the stability [1]. New resistive MHD simulations show improved compatibility with the measurements, and the closest agreement is obtained by including the experimental plasma rotation in the simulations. Although the input neutral beam (NB) torque is near zero, the simulations show that this level of rotation leads to significant screening of the pitch-resonant field component at the $q = 2$ surface. Furthermore, we have demonstrated an elegant response control scheme, based on direct measurements and NB power feedback in the ITER-like discharges, without relying on computationally intensive real-time stability simulations or machine learning. These results provide a foundation and control technique to anticipate and optimize stability in low rotation reactor regimes like the ITER baseline. [1] F. Turco et al., Phys. Plasmas 22, 022503 (2015).

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