Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Disruption Event Characterization and Forecasting in Tokamaks and Expansion to Real-Time Application* S.A. SABBAGH, J.W. BERKERY, Y.S. PARK, J.H. AHN, J. BIALEK, Y. JIANG, J.D. RIQUEZES, Columbia U., J.G. BAK, S.H. HAHN, J. KIM, J. KO, J. LEE, S.W. YOON, NFRI, C. HAM, A. KIRK, L. KOGAN, D. RYAN, A. THORNTON, CCFE, M. BOYER, K. ERICKSON, Z. WANG, PPPL, V. KLEVAROVA, G. PAUTASSO, IPP-Garching — Disruption prediction and avoidance is critical for ITER and reactor-scale tokamaks. Disruption event characterization and forecasting (DECAF) results are shown for multiple tokamaks including KSTAR, MAST, NSTX, and AUG. Automated analysis of rotating MHD modes allows identification of disruption event chains including coupling, bifurcation, locking, and triggering by other MHD activity. DECAF analysis of a ~10^4 plasma database predicts disruptions with over 91% true positives and 8.7% false negatives. DECAF provides an early disruption forecast (on transport timescales) for disruption avoidance through profile control. Significant new hardware and software for real-time data acquisition and analysis are being designed/written and installed on KSTAR including magnetics, plasma velocity and T_e profiles, pitch angle and magnetic fluctuation profiles, and 2D internal T_e fluctuations. Real-time magnetics data processed off-line shows excellent agreement with offline data/analysis. TRANSP predictive analyses computes plasmas at β_N >3.5 with 100% non-inductive current drive: a novel operating regime for disruption prediction studies. Resistive stability including calculation of Δ' by DCON is evaluated with comparison to experiment. *US DOE grants DE-SC0016614, DE-SC0018623.

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Date submitted: 08 Jul 2020 Electronic form version 1.4