Stabilization and prevention of the 2/1 neoclassical tearing mode for improved performance in DIII-D

R. Prater 1), R.J. La Haye 1), T.C. Luce 1), C.C. Petty 1), E.J. Strait 1), J.R. Ferron 1), D.A. Humphreys 1), A. Isayama 2), J. Lohr 1), K. Nagasaki 3), P.A. Politzer 1), M.R. Wade 1), and A.S. Welander 1)

1) General Atomics, San Diego, California, USA

2) Japan Atomic Energy Agency, Naka, Japan

3) Institute of Advanced Energy, Kyoto University, Kyoto, Japan

e-mail contact of main author: prater@fusion.gat.com

Abstract. The $m = 2/n = 1$ neoclassical tearing mode (NTM) has been observed to strongly degrade confinement and frequently lead to a disruption in high β discharges in DIII-D if allowed to grow to large size. Stabilization of grown NTMs by application of highly localized electron cyclotron current drive (ECCD) at the island location has led to operation at increased plasma pressure, up to the no-wall kink limit. After the NTM is stabilized by the ECCD, the correct location for the current drive is maintained using information from real-time equilibrium reconstructions which include measurements from the motional Stark effect diagnostic. This same process is used alternatively to prevent the mode from ever growing, leading to performance at the pressure limit in high performance hybrid discharges with β above 4%. Modeling using the modified Rutherford equation shows that the required power is in close agreement with the experimental threshold for prevention of the 2/1 NTM.