Measurements of the toroidal torque balance of error field penetration locked modes

D. Shiraki[1]‡, C. Paz-Soldan[2], J.M. Hanson[1], R.J. La Haye[3], N.C. Logan[4], K.E.J. Olofsson[1], E.J. Strait[3], R.M. Sweeney[1], and F.A. Volpe[1]

[1]Department of Applied Physics and Applied Mathematics, Columbia University, New York, NY 10027, USA
[2]Oak Ridge Institute for Science and Education, Oak Ridge, TN 37831, USA
[3]General Atomics, PO Box 85608, San Diego, CA 92186-5608, USA
[4]Princeton Plasma Physics Laboratory, Princeton, NJ 08543, USA

E-mail: shirakid@fusion.gat.com

Abstract. Detailed measurements from the DIII-D tokamak of the toroidal dynamics of error field penetration locked modes under the influence of slowly evolving external fields, enables study of the toroidal torques on the mode, including interaction with the intrinsic error field. The error field in these low density Ohmic discharges is well known based on the mode penetration threshold, allowing resonant and non-resonant torque effects to be distinguished. These $m/n = 2/1$ locked modes are found to be well described by a toroidal torque balance between the resonant interaction with $n = 1$ error fields, and a viscous torque in the electron diamagnetic drift direction which is observed to scale as the square of the perturbed field due to the island. Fitting to this empirical torque balance allows a time-resolved measurement of the intrinsic error field of the device, providing evidence for a time-dependent error field in DIII-D due to ramping of the Ohmic coil current.

‡ Current address: Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA