Contribution ID: **183** Type: **Poster**

EX/P4-08: Reactor-relevant Quiescent H-mode Operation Using Torque from Non-axisymmetric, Non-resonant Magnetic Fields

Wednesday, 10 October 2012 14:00 (4h 45m)

Recent DIII-D results demonstrate that quiescent H-mode (QH-mode) sustained by magnetic torque is a promising operating mode for future burning plasmas. We have produced steady, edge localized mode (ELM)-free, QH-mode plasmas with co-I_p neutral beam torque at reactor relevant levels. This was achieved by replacing the counter-I_p torque from neutral beam injection (NBI) with the torque due to neoclassical toroidal viscosity [1] produced by non-axisymmetric, non-resonant external magnetic fields. In addition, QH-mode plasmas have simultaneously demonstrated the reactor requirements of steady operation at the maximum stable pedestal pressure, ELM-free operation and rapid particle transport for helium exhaust in discharges which operate with constant density and radiated power [2]. Using n=3 non-resonant magnetic fields (NRMF) from two sets of non-axisymmetric coils, recent experiments have achieved long duration QH-modes with co-I_p NBI torque up to 1–1.3 Nm. Scaling from ITER, this co-I_p torque is 3 to 4 times the NBI torque that ITER will have [1]. These experiments utilized an ITER-relevant lower single-null plasma shape and were done with ITER-relevant values of nu_pedˆ*˜0.1 and beta_Tˆped˜1%. The discharges exhibited confinement quality H_98y2=1.3, in the range required for ITER. In preliminary experiments only using n=3 fields from a coil outside the toroidal coil, QH-mode plasmas with low q_95=3.4 have reached normalized fusion gain values of G= beta_N H_89/q_95ˆ2= 0.4, which is the desired value for ITER. Shots with the same coil configuration also operated with net zero NBI torque. The limits on G and co-I_p torque have not yet been established for this coil configuration. Peeling-ballooning stability calculations utilizing the EPED1 model predict that the H-mode edge pedestal in ITER will be in the stability region required for QH-mode operation [3].

[1] A.M. Garofalo, et al., Nucl. Fusion 51, 083018 (2011).
[2] K.H. Burrell, et al., Phys. Plasmas 12, 056121 (2005).
[3] K.H. Burrell, et al., Phys. Plasmas 19 (2012) to be published.

Work supported by the US Department of Energy under DE-FC02-04ER54698, DE-AC02-09ER54698 and DE-AC02-09CH11466.

Country or International Organization of Primary Author

USA

Primary author: Mr BURRELL, Keith H. (USA)

Co-authors: Dr GAROFALO, Andrea M. (General Atomics); Dr PARK, J.-K. (Princeton Plasma Physics Laboratory); Dr FENSTERMACHER, Max E. (Lawrence Livermore National Laboratory); Mr SCHAFFER, Michael J. (General Atomics); Dr SNYDER, Philip B. (General Atomics); Dr OSBORNE, Tom H. (General Atomics); Dr SOLOMON, Wayne M. (Princeton Plasma Physics Laboratory)

Presenter: Mr BURRELL, Keith H. (USA)

Session Classification: Poster: P4

Track Classification: EXC - Magnetic Confinement Experiments: Confinement