Contribution ID: **704** Type: **Poster**

Self-consistent optimization of neoclassical toroidal torque with anisotropic perturbed equilibrium in tokamaks

Tuesday, 18 October 2016 08:30 (4 hours)

Control of toroidal rotation is an important issue for tokamaks and ITER since the rotation and its shear can significantly modify plasma stability from microscopic to macroscopic scales. A potentially promising actuator for the rotation control is the non-axisymmetric (3D) magnetic perturbation, as it can substantially alter toroidal rotation by neoclassical toroidal viscosity (NTV). The optimization of the 3D field distribution for the NTV and rotation control is however a highly complicated task, since NTV is mostly non-linear to the magnitude of the applied field with a complex dependency on the 3D field distribution [1]. In this paper we present a new method that entirely redefines the optimizing process, using the new general perturbed equilibrium code (GPEC). GPEC solves a non-self-adjoint force operator and balance with the first-order change in pressure anisotropy by non-axisymmetry, and integrates its second-order change for NTV under the force balance. This self-consistent calculation uniquely yields the torque response matrix function, and enables the NTV profile optimization by a single code run based on the full eigenmode structure of the matrix function. The code applications to non-axisymmetric control coil (NCC) design in NSTX-U demonstrated the efficiency and accuracy of the new method, and in addition showed the importance of the backward helicity modes and self-shielding by torque [2] in local NTV control. The access to the optimized field distribution is limited in practice by available coils, but it is also straightforward to couple the coils to torque matrix and optimize the current distributions in the coils, as has been actively studied in KSTAR, NSTX-U, and ITER. A number of other GPEC applications will also be discussed, including the verification and validation of high-β 3D plasma response [3] and kinetic stabilization with the self-consistent eigenfunctions.
[1] S. Lazerson, J.-K. Park et al., Plasma Phys. Control. Fusion 57, 104001 (2015)
[2] A. H. Boozer, Phys. Rev. Lett. 86, 5059 (2001)
[3] Z. R. Wang, M. Lanctot, Y. Liu, J.-K. Park et al., Phys. Rev. Lett. 114, 145005 (2015)
*This research was supported by U.S. DOE contracts #DE-AC02-09CH11466.

Paper Number

TH/P1-6

Country or International Organization

USA

Primary author: Dr PARK, Jong-Kyu (Princeton Plasma Physics Laboratory)

Co-authors: Dr GLASSER, Alan (Fusion theory and computation Inc.); Prof. BOOZER, Allen (Columbia University); Prof. KOLEMEN, Egemen (Princeton University); Dr LOGAN, Nikolas (Princeton Plasma Physics Laboratory); Dr WANG, Zhirui (Princeton Plasma Physics Laboratory)

Presenter: Dr PARK, Jong-Kyu (Princeton Plasma Physics Laboratory)

Session Classification: Poster 1

Track Classification: THS - Magnetic Confinement Theory and Modelling: Stability