25th IAEA Fusion Energy Conference - IAEA CN-221

IAEA FEC 2014

Contribution ID: **483** Type: **Poster**

Identification of Intrinsic Torques in ASDEX Upgrade H-Mode Plasmas

Tuesday 14 October 2014 08:30 (4 hours)

Previous work performed has amassed a substantial database of intrinsic rotation measurements in various tokamak devices. However, as our understanding of momentum transport has evolved, it has become clear that a reliable prediction of the rotation in future devices requires a more complete momentum transport model and a more fundamental understanding of the mechanisms driving the intrinsic rotation. Initial estimates from this database project a large intrinsic velocity (~300 km/s) for ITER. The next step in intrinsic rotation studies is to characterize the "intrinsic torque"associated with its generation. The primary goal of this paper is to clarify whether or not the edge localized intrinsic torque scales with the pedestal strength on the ASDEX-Upgrade tokamak. In the q-profile scan resulting effectively in a pedestal strength scan (factor of 2-3 variation in pedestal top values of Ti, Te and ne), the integrated intrinsic torque profiles show clearly that the intrinsic torque increases with increasing plasma current on the outer half of the plasma radius. All the cases at different currents have in common that the intrinsic torque has a rather broad profile with the main contribution coming from outside r/a=0.4 which is somewhat different from what has been observed previously on DIII-D where the intrinsic torque is more pronouncedly peaked at the edge. In the ECRH power scan, the intrinsic torque during the low ECRH power phase is in the co-current direction and increases toward the plasma edge. In the high power ECRH phase, however, a negative (counter-current) torque source is present from the centre of the plasma up to mid radius consistent with previous work on AUG. The ECRH power deposition is centrally located. In addition to the counter intrinsic torque, the rotation modulation data cannot be explained by any other mechanism than outward convection at r/a < 0.4. The first intrinsic torque experiments on AUG show that co-torque is driven in the outer part of the plasma radius and that counter-torques can develop in the inner half radius when sufficient ECRH is applied to alter the heat transport and the local plasma turbulence.

Country or International Organisation

Finland

Paper Number

EX/P1-21

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Session Classification: Poster 1