Contribution ID: **543** Type: **Poster**

Investigation of merging/reconnection heating during solenoid-free startup of plasmas in the MAST spherical tokamak

Wednesday, 19 October 2016 14:00 (4h 45m)

We present results of recent studies of merging/reconnection heating during central solenoid (CS)-free plasma startup in the Mega Amp Spherical Tokamak (MAST) which achieved major progress in the last three years through the use of new 32 chord ion Doppler tomography, 130 channel YAG- and 300 channel Ruby-Thomson scattering diagnostics. In addition to the previously achieved ˜1keV heating without solenoid, detailed full temperature profile measurements including the diffusion region of magnetic reconnection have been achieved for the first time. 2D imaging measurements of ion and electron temperature profiles have revealed that magnetic reconnection mostly heats ions globally in the downstream region of outflow jet and electrons locally at the X-point. The electron temperature profile forms a characteristic peaked structure at the X-point on a scale length of typically 0.02-0.05m < c/omega_pi. The higher toroidal field in MAST strongly inhibits cross-field thermal transport scaling as 1/B_tˆ2 and the established profile is sustained on a millisecond time scale. In contrast, ions are mostly heated in the downstream region of outflow acceleration inside the current sheet width (c/omega_pi ˜ 0.1m) and around the stagnation point formed by reconnected flux mostly by viscosity dissipation and shock-like compressional damping of the outflow jet. Toroidal confinement also contributes to the characteristic profile, with a high temperature region arising from outflow heating, forming a ring structure aligned with the closed flux surface. There is an effective confinement of the downstream thermal energy due to a thick layer of reconnected flux. The characteristic structure is sustained for longer than an ion-electron energy relaxation time (tauˆE_ei ˜ 4-11ms) and the energy exchange between ions and electrons contributes to the bulk electron heating in the downstream region. The toroidal guide field mostly contributes to the formation of a localized electron heating structure at the X-point but not to bulk ion heating downstream; the latter determines the overall performance of the bulk startup heating. We have thus demonstrated that merging/reconnection heating can be achieved in plasmas with higher toroidal fields (B_t > 0.3T) than those used in other experiments.

Paper Number

EX/P4-32

Country or International Organization

Japan

Primary author: Dr TANABE, Hiroshi (University of Tokyo)

Co-authors: Dr MEAKINS, Alex (CCFE); Dr CROWLEY, Brendan (CCFE); Prof. CHENG, Chio-Zong (University of Tokyo); MICHAEL, Clive (CCFE); Dr FITZGERALD, Ian (CCFE); Dr HARRISON, James (CCFE); Mr KADOWAKI, Kazutake (University of Tokyo); Dr GI, Keii (University of Tokyo); Dr MCCLEMENTS, Ken (CCFE); Dr

GRYAZNEVICH, Mikhail (CCFE); Dr CONWAY, Neil (CCFE); Dr HAWKES, Nick (CCFE); Dr SCANNELL, Rory (Association CCFE/Euratom); Mr WATANABE, Takenori (Univerisity of Tokyo); Prof. YAMADA, Takuma (Kyushu University); Dr O'GORMAN, Thomas (CCFE)

Presenter: Dr TANABE, Hiroshi (University of Tokyo)

Session Classification: Poster 4

Track Classification: EXW - Magnetic Confinement Experiments: Wave–plasma interactions; current drive; heating; energetic particles