Overview of Recent Joint ITER/EAST Experiments with Full Tungsten Limiter/Divertor in Support of ITER New-baseline

X. Gong[1], A. Loarte[2], R.A. Pitts[2], T. Wauters[2], J. Huang[1], R. Ding[1], J.P. Qian[1], B. Zhang[1], M. Jia[1], X.J. Zhang[1], Y.H. Guan[1], G.Z. Zuo[1], Y.W. Sun[1], Y.T. Song[1] and the EAST team[1]

[1] *Institute of Plasma Physics, Chinese Academy of Sciences, Hefei, Anhui 230031 China*

[2] *ITER Organization, Route de Vinon-sur-Verdon, CS 90 046, 13067, St. Paul Lez Durance Cedex, France*

In the proposed ITER new-baseline, beryllium is replaced by tungsten as plasma-facing armour on the main chamber walls. Plasma operation with a full tungsten wall may significantly impact on ITER's objectives, due to more tungsten impurities into the main plasma. Therefore, a dedicated set of joint ITER-EAST experiments have been performed on three key topics for the new baseline: optimization and characterization of Boronization, plasma start-up on tungsten limiter, and the impact of W on the H-mode operational space with or without boron coatings. Boronizations assisted by ICWC and GDC have been applied and compared to investigate the uniformity and quality of the boron coating as well as the retained hydrogen in these coatings and the efficiency of its removal. A more uniform plasma was obtained with both toroidal and vertical magnetic field with ICWC leading to more uniform coatings. A high particle flux was measured by the low-energy neutral particle analyzer in ITER relevant conditions confirming previous estimates for ITER on which fuel removal from boron coatings is based. Plasma start-up and stationary limiter plasmas were achieved on EAST outboard, full actively cooled tungsten limiter with on-axis ECH heating. A constant radiated fraction is found in the stationary phases of limiter plasmas over a significant density range. Ohmic tungsten limiter start-up or off-axis ECH lead to radiative plasma collapse in burn-through phase. Higher plasma density can significantly reduce the edge electron temperature and the influx of medium or high-Z impurities leading to similar radiative fractions than low densities with higher impurity influxes. H-mode operation have been successfully achieved under both boronized and unboronized wall conditions with type II ELMs at q_{95} ~ 6 and with low input torque/no-torque similar to ITER with total input powers from 3 MW to 5 MW by ECH+NBI/LHW. Energy confinement can be kept high (H_{98} >1.1) with and is independent of the tungsten source from the main limiter and heating mixed. Partial detachment compatible with high H-mode confinement has been achieved with nitrogen seeding in these conditions. Furthermore, long pulse H-modes with dominant electron heating have been successfully explored with the tungsten wall, where fully non-inductive conditions with small ELMs at T_{e0} > 8.5keV have been achieved by RF-only heating with zero torque injection. On the contrary type-I ELMy H-modes in similar q_{95} ~ 6 conditions is hard to be maintain for high tungsten impurity sources, even with ELM suppressed by n = 2 RMPs and decreased energy confinement illustrating the need for optimum ELM control to achieve high confinement plasmas.