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Recent Experimental Results on EAST in Support of ITER and CFETR SSO

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Significant progress has been achieved on EAST in the development of long-pulse steady-state advanced plasmas in support of future fusion reactors (e.g ITER and CFETR) since last IAEA technical meeting (TM) on long-pulse operation (LPO). A new record of reproducible 403s H-mode plasmas has been achieved with full metal wall with EAST improved flexibilities and capabilities. EAST scientific objectives focus on physics understanding for three scenario regimes attractive for ITER baseline, hybrid and steady-state operations. EAST experimental results have demonstrated enhanced heating and current driven efficiency by using high launched frequency 4.6GHz LHW system and ICRF antennas with lower parallel wave number k|| combined with on-axis/off-axis ECRH, MHD and transport behaviour at zero loop voltage, long-pulse fuelling and recycling control by pellet injection/SMBI and real-time wall-conditioning, improved heat exhaust with new type W/Cu divertor to avoid local hot-spots, good energy confinement exhibited in high poloidal beta scenario at high density, robust plasma shape control by upgrading magnetic measurements and optimizing plasma ramp-up/down phase, etc.

Recently, to support ITER's proposed new research plan, a dedicated set of joint ITER-EAST experiments have been performed, and the related key technical and scientific challenges have been addressed. For wall conditions with boron coating, to improve the uniformity and quality of the boron film, optimization and characterization of boronisation using ICWC and GDC has been investigated. For plasma initiation, ECW assisted start-up has been carried out and robust breakdown and plasma initiation at low toroidal electric fields has been demonstrated with optimized magnetic field configurations in a large range of prefill gas pressure. In boron wall, we demonstrated a stationary 100s H-mode plasma, and also achieved high ion-temperature plasma up to 100 million °C accompanied with fishbones using impurity (Ar) seeding. A set of dedicated experiments has been carried out to assess the impact of W as the first wall material in H-modes. A long-pulse (>50s) no-ELM H-mode discharges was achieved with feedback-controlled divertor detachment via nitrogen seeding. ELM control by various methods (RMP, impurity powder, etc) has been further studied in different scenarios. The impact of different wall conditions (lithium-coating, boron-coating, non-coating) on confinement, H&CD efficiency, particle control, etc. will be illustrated in detail, which can offer unique contributions in support of the ITER new research plan.

Primary author: HUANG, Juan (CnIPPCAS)

Co-authors: GONG, X Z (Institute of Plasma Physics, Hefei Institutes of Physical Science, Chinese Academy of Sciences); GAROFALO, A. M. (General Atomics); LOARTE, Alberto (ITER Organization); PITTS, Richard (ITER Organization); WAUTERS, Tom (ITER Organization); Dr DING, Rui (Institute of Plasma Physics, Chinese Academy of Sciences); QIAN, Jinping (Institute of plasma physics, Chinese academy of sciences); ZHANG, Bin (ASIPP); JIA, Manni; ZHANG, Xinjun (Institute of Plasma Physics Chinese Academy of Sciences (ASIPP)); GUAN, Yanhong; ZUO, Guizhong (Institute of plasma physics, HIPS, Chinese academy of Sciences); LIU, Wenbin (ASIPP); SUN, Youwen (Institute of Plasma Physics, Chinese Academy of Scienses); LIU, Lunan (ASIPP); DING, Bojiang (Institute of Plasma Physics, Chinese Academy of Sciences); XU, Guosheng (Institute of Plasma Physics, Chinese Academy of Sciences); Dr HU, Jiansheng (Institute of Plasma Physics, Chinese Academy of Sciences); LU, Kun (ASIPP); SONG, YUNTAO (Institute of Plasma Physics, Chinese Academy of Sciences)

Presenter: HUANG, Juan (CnIPPCAS)

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