2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Recent advances in the HL-2A experiments

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Recent experiments on the HL-2A tokamak have been aimed at physics issues involved in advanced tokamaks and ITER. Significant progress has been achieved in the areas of ELM mitigation, disruption mitigation, energetic particle physics, and development of advanced tokamak scenario. All these experiments benefited from several newly installed or improved diagnostics, such as Beam Emission Spectroscopy, Helium gas-puffing imaging diagnostic, Charge Exchange Recombination Spectroscopy (CXRS) and multi-channel Dopper reflectometry, and the upgrade of Low Hybrid Wave (LHW) and Neutral Beam Injection (NBI) systems. ELM control is a key issue in the magnetic fusion reactor. Intensive experiments for controlling ELMs have been performed in the HL-2A tokamak with several tools, including LHCD, LBO-seeded impurities (Al, Fe, W) and impurity SMBI (Ar, Ne). In order to understand the mechanism of the turbulence enhancement during ELM mitigation, a theoretical turbulent heat transport model, based on the regulation of the turbulence amplitude by its radial wave-number spectral shift caused by external velocity shear, has been developed. Toroidal Alfvén eigenmodes (TAE) driven by energetic-ion and energetic-electrons had been observed on HL-2A. The stabilization of m/n=1/1 ion fishbone activities by ECRH were found on HL-2A. In HL-2A, advanced tokamak scenario with central q close to 1 has been achieved. Auxiliary heating (mainly NBI) during the current rise phase is used, creating ITBs with a weak magnetic shear in the plasma centre. Confinement enhancement factors over ITER89P L-mode scaling, $H^{ITER89\text{-}P}$=1.8, has been obtained. With weak negative central magnetic shear $s = (r/q)(dr/dq)$, the analysis of ITB triggering reveals a correlation between the formation of the ITB and q_{min} reaching an integer value ($q = 1$) or fishbone activity. Its confinement performance and steady state (up to 20 confinement times) properties make it quite attractive for advanced tokamak regimes.

References

[1] Y.P. Zhang *et al Nucl. Fusion* **58** (2018) 046018

[2] G.L. Xiao *et al Phys. Plasmas* **24** (2017) 122507

[3] W.Chen *et al Nucl. Fusion* **58** (2018) 014001

[4] Y. Shen, *et al Nucl. Fusion* **58 (**2018**)** 014004

[5] M. Jiang *et al Nucl. Fusion* **58** (2018) 026002

[6] D. Guo *et al Nucl. Fusion* **58** (2018) 026015