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OV/3-3: Overview of HL-2A Recent Experiments

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Since the last FEC, the experiments on HL-2A tokamak have been focused on the investigations on H-mode related physics including ELM mitigation, energetic particle physics, transport including nonlocality and edge impurities, MHD instabilities, turbulence and zonal flow physics, etc. In particular, it's demonstrated for the first time that the supersonic molecular beam injection (SMBI) and cluster jet injection (CJI) can convert large ELMs into a series of small ELMs in HL-2A. After SMBI or CJI, the ELM frequency rises by a factor of 2 to 3 on average and its amplitude decreases by about 50%. With high power ECRH, the energetic particle induced modes have been observed in different frequency ranges. The high frequency (200–350 kHz) modes with relatively small amplitude are close to the gap frequency of toroidacity induced Alfvén eigenmode (TAE). The coexistent multi-mode magnetic structures in the high temperature and low collision plasma will affect the plasma transport greatly. The L-I-H transition has been studied in pure NBI-heating deuterium plasmas. For the first time, the absolute rate of nonlinear energy transfer between turbulence and zonal flows was measured and the secondary mode competition between low frequency zonal flows (LFZFs) and geodesic acoustic modes (GAMs) was identified in experiments, which demonstrated that the energy transfer is large enough to affect the turbulence saturation level and its dynamics and that zonal flows play an important role in the low to high (L-H) plasma confinement transition. The increasing turbulent energy at 30 - 60 kHz, the spontaneous E⊠B flow shear are identified to be responsible for the generation of LSCSs, which is in agreement with the theoretical prediction and provides unambiguous experimental evidences for LSCS generation mechanism in tokamak edge plasmas. New meso-scale electric potential fluctuations (MSEFs) at frequency f~10.5 kHz with two components of n = 0 and m/n = 6/2 are identified in the edge plasmas for the first time. The MSEFs coexist and interact with the magnetic islands of m/n = 6/2, turbulence and LFZFs. These results benefitted from the substantial improvement of the hardware such as 3 MW ECRH and 1.5 MW NBI as well as diagnostics, and have significantly contributed to the understanding of the underlying physics.

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