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PD/P8-08: Divertor Power Deposition Control and ELM Mitigation with Supersonic Molecular Beam Injection in the EAST Tokamak

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One of the major challenges for the magnetic fusion community is how to extract energy from the core plasma of the fusion reactor without endangering the plasma facing components, in particular the divertor plates. For ITER, in order to not damage the divertor plates, the peak power load on the target plates is limited to 10MW/m2 in steady condition and 20MW/m2 in transient condition during Type-I ELMs. How to reduce the power flux density on the divertor plates is a critical issue. We report here the experimental results in EAST tokamak showing a very promising and effective technique with Supersonic Molecular Beam Injection (SMBI) and Lower Hybrid Current Drive (LHCD) for the control of heat deposition on the divertor plates, and the mitigation of large ELMs.
During LHCD a striated heat flux (SHF) clearly observed in an area higher from the outer strike points (OSP). The SMBI increases the SHE and decreases the heat flux at the OSP. The quantity of heat transferred from the OSP area to the SHF area increases with the SMBI pulse length. In addition the power deposition width (λ_qˆdiv) increases of a factor of 2 with SMBI. In the same time the amplitude of ELMs is strongly reduced by SMBI, and the ELM frequency increases of a factor of 5-10. Quasi-steady state scenario over 3s has been realized for the ELM mitigation with SMBI. After SMBI the edge density gradient decreases, and the high frequency turbulence increases in the pedestal region. The energy confinement is slightly degraded during the ELM mitigation. The edge turbulence power spectrum decreases for low frequencies, but increases for high frequencies after SMBI.
Experiments in EAST demonstrate that technically the combination of SMBI and LHCD can offer a large possibility of control for the heat flux deposition on the divertor plates by changing qa, the LHCD power, and the parameters of SMBI including the gas pressure, the pulse length, and the frequency. In the same time the large ELMs can be strongly mitigated by SMBI with slight degradation of the energy confinement.

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