Contribution ID: **52** Type: **15 min Oral**

Feedback control of LHW-plasma coupling for long pulse operation in EAST

Tuesday 15 October 2024 16:40 (15 minutes)

Lower hybrid current drive (LHCD) has proven to be one of the most efficient methods to sustain long pulse plasma operation in tokamak. In order to sustain good LHW (lower hybrid wave) -plasma coupling required for long pulse plasma, it is the first time that the coupling feedback control is designed and realized in EAST through PID (Proportion Integration Differentiation) method by choosing RC (reflection coefficient of LHW power) as the reference for the feedback of gas puffing, including one pulse test and multi-pulse experiments.

Experiments show that the designed feedback control works correctly and keeps good LHW-plasma coupling effectively for long time, suggesting the possibility of feedback control application on LHW-plasma coupling in long pulse plasma. Furthermore, during the process of feedback control of multi-pulse SMBI (supersonic molecular beam injection), the stored energy changes from 29kJ to 58kJ, and the energy confinement factor (H89) increases from 0.98 to 1.45, implying a positive effect of coupling feedback on plasma performance. In addition, experiments between SMBI fueling and the gas-puffing fed by piezoelectric valve near the antenna are further investigated, showing that the response time on the modification of edge density with SMBI is faster than that by the piezoelectric valve and that SMBI puffing in the electric drift side of LHW antenna is a little quicker than that in the ion drift side.

Studies suggest that the feedback control through RC is effective for long pulse LHW-plasma coupling and that the gas puffing by SMBI in the electric drift side of LHW antenna offers a new and effective method to sustain good LHW coupling in steady state operation in future, encouraging the LHCD application in fusion reactor. Further optimization will be continued later.

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Session Classification: H&CD session

Track Classification: Long-Pulse Heating and Current Drive