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Plasma heating and improvement of lower hybrid current drive efficiency by electron cyclotron waves on EAST

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The electron cyclotron (EC) system on EAST consists of three gyrotrons with a frequency of 140 GHz (second harmonic of the extraordinary mode), each of which is expected to deliver a maximum power of 1.0 MW and be operated at 100-1000 s pulse length. Significant progress in long-pulse operation has been achieved during the 2021 campaign, including the pulse duration of 100 s with EC power injected into plasma of 1.4 MW, and the pulse duration up to 1056 s with EC power of 0.55 MW. High electron temperature (Te > 12 keV) plasma measured by Thomson scattering was produced with the combination of EC and lower hybrid (LH) waves. It is found that the plasma heating effect depends on the EC power location greatly. As a consequence of the increasment of electron temperature by electron cyclotron resonance heating (ECRH), the lower hybrid current drive (LHCD) effieicny is improved, benefiting for the long-pulse operation. By adjusting the EC power location, the plasma current profile can be modified. The synergy effect between EC and LH current drive was demonstred in steay-state opration on EAST. During this experiment, the LH power was feedback controlled by the magnetic flux consumption with constant plasma current and constant density, which is similar to the previous expetiment on Tore Supra [1]. During the application of 0.55 MW ECCD, the LH power drops by approximately 0.3 MW, at constant loop voltage (Vp = 0 V), plasma current and density. The synergy factor defined as Fsyn = Delta_I / I_EC with Delta_I = I_LH+EC − I_LH, is estimated to be ˜ 2.1.

References

[1] G. Giruzzi, et al., Phys. Rev. Lett. 93, 255002 (2004).

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