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Modeling for high temperature scenario on EAST

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In the 2018 EAST experiment campaign, a high electron temperature (Te ~ 10 keV), nearly non-inductive L-mode discharge has been obtained which extend the operation regime of EAST.

In this work, integrated modeling simulations are performed to investigate the novel features in physics for such scenario and extend it to H-mode. The modeling couples simulation codes including the equilibrium code EFIT, transport codes (ONETWO and TGYRO), the ray-tracing codes (GRNRAY and TORAY) and the Fokker-Planck code CQL3D using the software framework OMFIT[1, 2].

High Te profile is roughly sustained in the integrated modeling (Figure 1). Transport study shows that the location of electron cyclotron wave (EC) power deposition is one of the key factors to achieve high T_e. When both EC and lower hybrid wave (LH) turn on, the maximum of T_e can reach ~8.5 keV. As the power deposition of EC moves from the axis to ρ=0.4, T_e decreases to below 7keV. When EC turns off, T_e falls below 6.5keV and the whole temperature profile (from ρ=0 to ρ=0.8) deceases apparently (Figure 2). The frequency spectra of the most unstable modes (Figure 3) calculated by the trapped gyro-Landau-fluid model (TGLF) show that the high-k modes instability (ETG) is almost quenched in the modeled plasma with EC and the TEM modes are more unstable than those without EC, which may relieve the stiffness of the T_e profile.

The transport simulations also show the density profiles of cases with EC are lower than the one without EC (Figure 2) which may explain the density pump-out effect [3].

Work in progress are going to perform a systemic validation of the transport model in such scenario to answer why the modeled T_e near axis is lower than that from experiments. Future integrated modeling will figure out other experimental conditions to achieve a high T_e profile.

References

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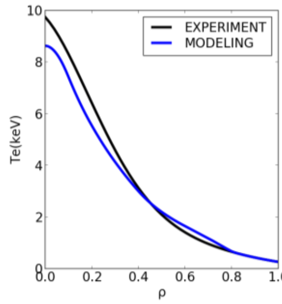

Figure 1. Electron temperature profiles from the experiment (shot 78841@4.517s) and the modeling.

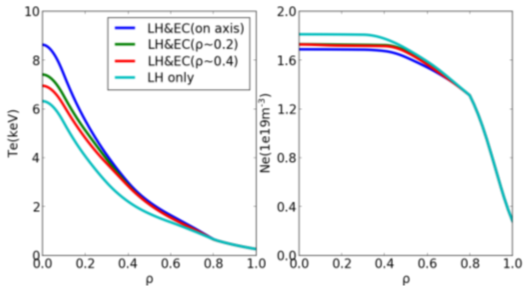

Figure 2. (Left) Electron temperature profiles from the modeling with different EC power depositions (on axis, ρ~0.2, ρ~0.4 and no EC power). (Right) Electron density profiles from the modeling with different EC power depositions (on axis, ρ~0.2, ρ~0.4 and no EC power).

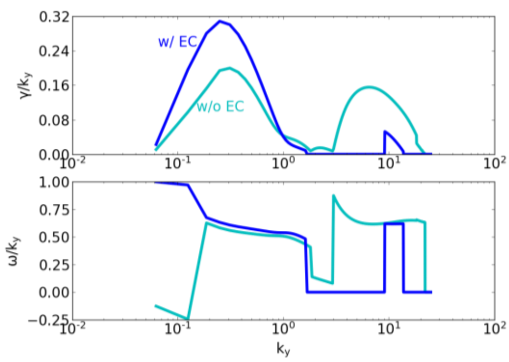

Figure 3. Linear growth rates and frequency spectra of at ρ =0.4 from TGLF simulations for the case with EC (on axis) and the case without EC, respectively.