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Transport simulation of EAST long pulse discharge and high betaN discharge with integrated modelling

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In the past two years, two major scenarios were developed on the EAST tokamak, the long pulse steady state scenario and the high β_N scenario. For the steady state scenario, 100 s long pulse discharge was achieved with only radio frequency heating and current drive (CD) and it has improved confinement with H98~1.1. For the high β_N scenario, the β_N ~2.0 was sustained for ~2 s, with an internal transport barrier (ITB) in all channels. Under OMFIT framework, a workflow was developed to simulate the two scenarios on EAST. The workflow integrated the equilibrium code EFIT, transport code TGYRO for energy transport, transport code ONETWO for current evolution and radiation, heating and CD code GENARY/TORAY/NUBEAM for driven current and energy sources. For long pulse discharge, the integrated modelling well reproduced the experimental electron and ion temperature profiles and current (or q) profiles. This validated our integrated modelling workflow and validated the TGLF transport model for the scenario possessing dominant electron heating and low toque. The modelling also gives the physical picture of the improved confinement induced by the on-axis ECH: the on-axis ECH increased the central electron temperature, make the LHCD power deposit to inner region and make the current profile more peaked, which suppress the high-k micro-instabilities at the core region and improve the confinement. The integrated modelling workflow also was used for the high β_N discharge of EAST. However, it could not reproduce the experimental temperature profiles. The reason is that the fishbone instability appears in the discharge, which could redistribute the fast ion and affect the energy transport. A heuristic model was developed to include the effects of fishbone instability, then the temperature profiles simulated by our integrated modelling qualitatively agreed with the experiments.

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