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Integrated Modeling of Toroidal Rotation with the 3D Non-Local Drift-Kinetic Code and Boundary Models for JT-60U Analyses and Predictive Simulations

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The integrated framework for toroidal momentum transport is developed, which self-consistently calculates the neoclassical toroidal viscosity (NTV), the radial electric field Er and the resultant toroidal rotation together with the scrape-off-layer (SOL) physics-based boundary model. The coupling of TOPICS, VMEC and FORTEC-3D makes it possible to calculate the NTV due to the non-axisymmetric perturbed magnetic field in the actual geometry. It is found that the NTV significantly influences toroidal rotation in JT-60U and Er holds the key to determine the NTV profile. The sensitivity of the toroidal rotation profile to the boundary rotation necessitates the boundary condition modeling. Owing to the high-resolution measurement in the JT-60U edge region, Er is found to be rather insensitive at the separatrix. Focusing on Er, the boundary model of toroidal momentum can be developed in conjunction with the SOL/divertor plasma code. This modeling realizes self-consistent predictive simulations for operation scenario development in JT-60SA and ITER.

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