Progress in time-dependent heat transport simulation
by the integrated transport code, TASK3D

H. Yamaguchi1, S. Murakami1, A. Sakai1, A. Fukuyama1, A. Wakasa1, H. Takahashi2,
K. Nagaoka2, H. Nakano2, M. Yokoyama2, I. Yamada2, and LHD experiment group2

1 Department of Nuclear Engineering, Kyoto Univ., Kyoto, Japan
2 National Institute for Fusion Science, Toki, Japan

Integrated modeling of toroidal plasmas is essential for the systematic understanding of confinement physics and the prediction of plasma performances in future fusion reactors. An integrated transport code for helical plasmas, TASK3D[1], has been developed based on TASK code for two-dimensional tokamaks. TASK3D has several additional modules that treat physics specific to non-axisymmetric systems in, such as, neoclassical transport, radial electric field and beam depositions. Recently, TASK3D has been applied to time-evolving NBI-heated plasmas such as the high-ion-temperature (high-$T_i$) plasma with carbon pellet injection [2] in LHD.

In this paper, we present recent progress and present status of the time-dependent predictive simulation using TASK3D code. TASK3D is applied to integrated heat transport simulations of time-evolving LHD plasmas combining GNET-TD[3], which can evaluate the NBI beam deposition profiles taking into account the effect of plasma time-evolution on beam ion birth and energy slowing-down. Flux surface-averaged one-dimensional heat transport equation is solved by TASK3D assuming the density of the experimental plasma and heat deposition profiles calculated by GNET-TD. Several turbulent heat transport models are validated comparing with the experimental results. Also the heat transport simulation of high-$T_i$ plasma of LHD is performed assuming a multi-ion-species plasma. The simulation results are compared with the experimental observations and we discuss the improvement in ion thermal transport after pellet injection.

References