§11. Development and Application of Integrated Transport Code for Helical Plasmas, TASK3D

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The integrated code for helical plasmas, TASK3D, has been developed, both by modifying TASK[1] modules to three-dimensional magnetic configurations, and by adding new modules for stellarator-heliotron specific physics. The Large Helical Device (LHD) experiments have steadily expanded the parameter regime of helical plasmas such as temperatures, beta value, electron density, pulse length and total input energy to plasma in a long-pulse operation[2]. The wide-range applicability and the experimental verification of each module and then its integration should be performed by utilizing the experiment database.

The radial transport aspect of TASK3D employs the diffusive transport equation **[TR]** with the local diffusivity (particle and heat) and the particle and heat source/sink term. Taking three-dimensional configuration's impact into account has been main focus of module modification/supplement in TASK3D development. A few examples are described in brief.

***[DGN/LHD, ER**: Neoclassical transport, radial electric field]* The ripple transport is specific feature in non-symmetric magnetic configurations. The ambipolarity of neoclassical (NC) particle fluxes has been demonstrated to well describe the bifurcation nature of the radial electric field (Er) in LHD and other helical plasmas[3,4]. Thus, it is of a great importance to accurately calculate the NC fluxes, and then ambipolar Er. For this purpose, NC diffusion coefficient database, DGN/LHD (DCOM-GSRAKE/NNW for LHD)[5] has been prepared by utilizing the advantages of NC transport codes, DCOM[6] and GSRAKE[7]. This accurate NC module has made it possible to compare with the power-balance analysis to elucidate the turbulent transport contribution[8] .

***[EI**: Time evolution of iota (current) profile]* The three-dimensional magnetic configuration's impact on the current evolution has been formulated[9]. The evolution of the rotational transform profile through this current evolution equation is compared to show the same trend (even quantitatively) with Motional Stark Effect (MSE) measurement in LHD.

***[FIT3D, MORH**: NBI-related modules]* As for the NBI, FIT3D[10] has been routinely utilized in LHD experimental analysis. To examine the impact of re-entering particles especially for high-beta and/or low magnetic field conditions, new module (MORH[11]) has been developed.

For illustrative purpose, TASK3D-related modules are written in bold characters in Fig. 1. The integration of these modules based on Ruby script[12] is in progress so that module/IO handling can be relatively easily performed.

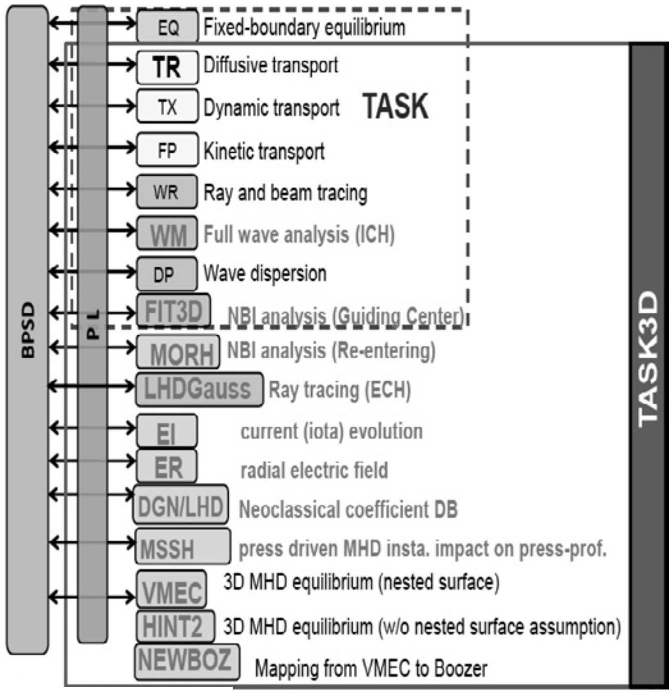

Fig. 1 Modules being developed/implemented into TASK3D.

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