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Extended Capability of the Integrated Transport Analysis Suite, TASK3D-a, for LHD Experiment, and its Impacts on Facilitating Stellarator-Heliotron Research

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The integrated transport analysis suite, TASK3D-a (Analysis), has been developed to be capable for routine whole-discharge analyses of plasmas confined in three-dimensional (3D) magnetic configuration such as the LHD.

The routine dynamic energy balance analysis for NBI-heated plasmas was made possible in the first version released in September 2012, which consisted of four parts: LHD data interface, 3D equilibrium, heating, and energy balance analysis. The LHD data interface part automatically transfers experiment data registered on the LHD Analysed Data Server.

Recently, further extension has been conducted such as including ECH ray-tracing code, neoclassical transport code, and the module for creating data files to register in the International Stellarator-Heliotron Confinement and Profile Database. Inclusion of ECH ray-tracing code has significantly enhanced systematic energy transport analysis of ECH- (and NBI-) heated LHD plasmas. Neoclassical energy diffusion flux can also be routinely calculated by the implemented GSRAKE code, and thus, systematic comparison with experimental energy balance has been available. These kinds of data have been accumulated for elucidating turbulent transport contribution in a wide parameter space of LHD plasmas.

Utilizing the TASK3D-a development, the ISH-DB takes also an advantage from the LHD unified data that can be used verification and validation (V&V) studies of large simulation codes for Stellarator-Heliotrons. The TASK3D-a has already provided profiles and equilibrium data to several large-scale simulation codes such as gyrokinetic instability, energetic particles/Alfvén eigenmodes, and neoclassical plasma flows. The TASK3D-a data interface to ISH-DB has much simplified and enhanced V&V studies of large simulations.

Much further extensions should be pursued towards full-integration by incorporating modules for other physics process such as re-distribution of energetic particles, particle transport issues. The architecture of TASK3D-a is modularized, and thus transferable to any other Stellarator-Heliotron (even tokamaks) experiments. In this way, TASK3D-a will continue to give impacts on facilitating Stellarator-Heliotron research.

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