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トカマク磁気座標系における流体型輸送コードTASK/TXの進展
Recent progress of the fluid-type transport code on the flux coordinates in a tokamak

本多充 [1], 福山淳 [2]

Mitsuru HONDA[1], Atsushi FUKUYAMA[2]

量研機構 [1]，京大院工 [2]

QST[1], Kyoto Univ.[2]

The one-dimensional fluid-type transport code, TASK/TX, is developed compatible with the flux coordinates in a tokamak [1]. Unlike diffusive transport equations usually adopted in conventional transport codes, the governing equations conform to a two-fluid model consisting of Maxwell's equations and the multiple fluid moment equations for each species. Namely, Gauss's law, Faraday's law, Ampère's law, the continuity equations, the radial force balance equations, the parallel flow equations, the toroidal momentum transport equations, the heat transport equations and the parallel heat flow equations are simultaneously solved as well as the neutral transport equations and some algebraic equations that is needed to relate one variable with another. Quasi-neutrality and ambipolar flux conditions are not imposed, which are inherently satisfied as a consequence of the equation system solved. These features are the ones that obviously distinguish TASK/TX from other conventional transport codes. The neoclassical transport characteristics, such as the resistivity, the bootstrap current, poloidal rotation drive and so on, naturally come in because the parallel force balance equations are solved in a manner compatible with other equations. Hence, the neoclassical particle flux is not approximated by the flux-gradient relationship, and the total particle flux composed of the neoclassical and turbulent contributions is directly treated as the particle flux itself, i.e., the dependent variable. In other words, TASK/TX by itself has the function of a neoclassical transport solver based on the moment approach as well.

Several numerical tests clearly reveal the unique features of TASK/TX not possessed by conventional transport codes. For example, the left figure shows the profiles of the radial electric field E_r and the charge neutrality. TASK/TX can calculate the E_r compatible with this slight charge imbalance, while conventional transport codes do assume the complete charge neutrality. The right figure shows the comparison of the parallel current density profiles, indicating that the neoclassically-determined parallel current can be reproduced in TASK/TX as the sum of the parallel flows.

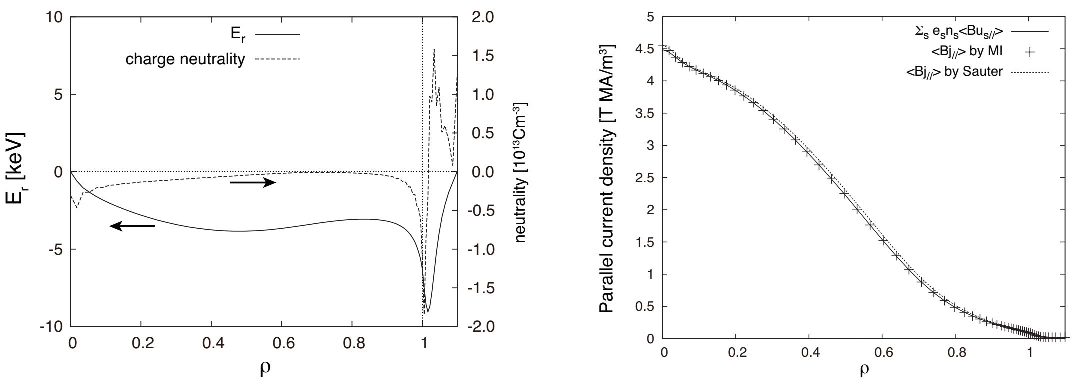

図 1: Left: Profiles of E_r (solid line) and the charge neutrality (broken). Right: Comparison of the parallel current density profiles among TASK/TX, Matrix Inversion and the Sauter model, the latter two of which are neoclassical transport modules.

[1] M. Honda and A. Fukuyama, *Comput. Phys. Commun.* **208** (2016) 117-134.