Transport codes for magnetic fusion: ASTRA (overview of applications)

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Abstract

During its more than 30 years history ASTRA code [1] became one of the most popular numerical tools used for analysis and modelling of magnetically confined plasmas in a number of tokamaks (ASDEX Upgrade, COMPASS, DIII-D, FTU, Globus-M, JET, JT-60U, KSTAR, LTX, MAST, T-10, TCV, TFTR and Tore Supra), W7-X stellarator and reversed filed pinch (RFX). Being equipped with the most advanced equilibrium, transport, fuelling, heating and current drive modules this user-friendly code has been successfully applied for a number of physics studies including energy, particle and momentum transport, current diffusion, sawtooth stabilisation, L-H transition and ELM dynamics, triggering and maintenance of Internal Transport Barriers, development of feedback algorithms for control of kinetic and magnetic profiles, optimisation of plasma operational scenarios. As a mathematically well verified and well validated numerical tool [2] ASTRA has been used for benchmarking of new codes. The modules validated on existing databases have been applied in ASTRA simulations predicting the plasma performance in future tokamaks (JT-60SA, ITER, DEMO). A range of ASTRA applications has been recently increased by coupling/interfacing the ASTRA code with the edge and impurity codes. This talk covers the key applications of ASTRA code (and predictive core modelling in general) such as interpretative analysis of experimental databases, validation of empirical and theory-based transport models, modelling of strongly non-linear phenomenon (L-H transition, ELMs), plasma control and modelling of plasma operational scenarios.

[1] G. Pereverzev, P. N. Yushmanov, ASTRA Automated System for Transport Analysis in a Tokamak, IPP-Report, IPP 5/98, 2002
[2] E. Fable, this meeting