Modelling of JT-60SA Operational Scenarios

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Introduction

The aim of the simulations was to assess steady-state conditions estimated with 0-dimensional codes and provide a profile database for further physics studies. Three scenarios considered standard H-mode, hybrid, advanced steady-state. Codes deployed: ASTRA, CRONOS, JINTRAC.

Core transport models: TGLF (CRONOS), CDBM (CRONOS), GLF23 (ASTRA, CRONOS), Bohm gyro-Bohm (ASTRA, JINTRAC).

Advanced time-dependent edge transport barrier models: continuous ELMs (JINTRAC), Corex scaling + EPED1 (CRONOS) in ASTRA.

Boundary conditions imposed at separatrix (CRONOS JINTRAC) or top of the pedestal (ASTRA).

- Fully predictive simulations of current density, ion density (CRONOS and JINTRAC), density not evolved in ASTRA, ion and electron temperature. No rotation. Equilibrium solver SPIDER or three moments (ASTRA), HELENA (CRONOS) and ESCO (JINTRAC).

Standard H-mode (scenario 2)

- JINTRAC: Bohm gyro-Bohm, α = 1.3. Tends to underestimate height of density pedestal.
- ASTRA: SPIDER equilibrium solver and JET-like Bohm gyro-Bohm. Boundary conditions at top of ETB. Reasonable agreement with JINTRAC results. (Density not simulated)
- CRONOS: CDBM+GLF23. Underestimates on axis electron and ion temperatures.
- Generally all codes give values for zero-dimensional quantities close to nominal scenario. Integrated core/SOL simulations with COREDIV indicate that q<0.2<10^7 m/s (instead of 10^8 m/s used in these simulations) is a boundary condition more compatible with the assumption Z<1.5. This could have an effect on stiff transport models like GLF23 (higher core density, lower edge temperature).

Hybrid scenario (scenario 4-2)

- ASTRA: with SPIDER and JET-like Bohm gyro-Bohm (solid line), less energy content than JINTRAC. JINTRAC with analytical equilibrium and GLF23 (dashed line). Lower energy content, but volume is different. Ion and electron temperature lower than in JINTRAC.

- CRONOS: CDBM+GLF23. ITB on density, electron and ion temperature. (High pressure gradient and low shear).

Conclusions and future work

- JT60-SA scenarios have been simulated with different codes and transport models. Results are close to those obtained with zero-dimensional codes.
- Analysis of time dependent scenarios (density and current ramp up and down) planned.
- Further analysis of pedestal stability is required.