Integrated core-pedestal-SOL modelling for H-mode ITER scenario including impurity (Be, C, W, …)

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COREDIV code

- **COREDIV (ni, Ti, Te, impurity simulations):**
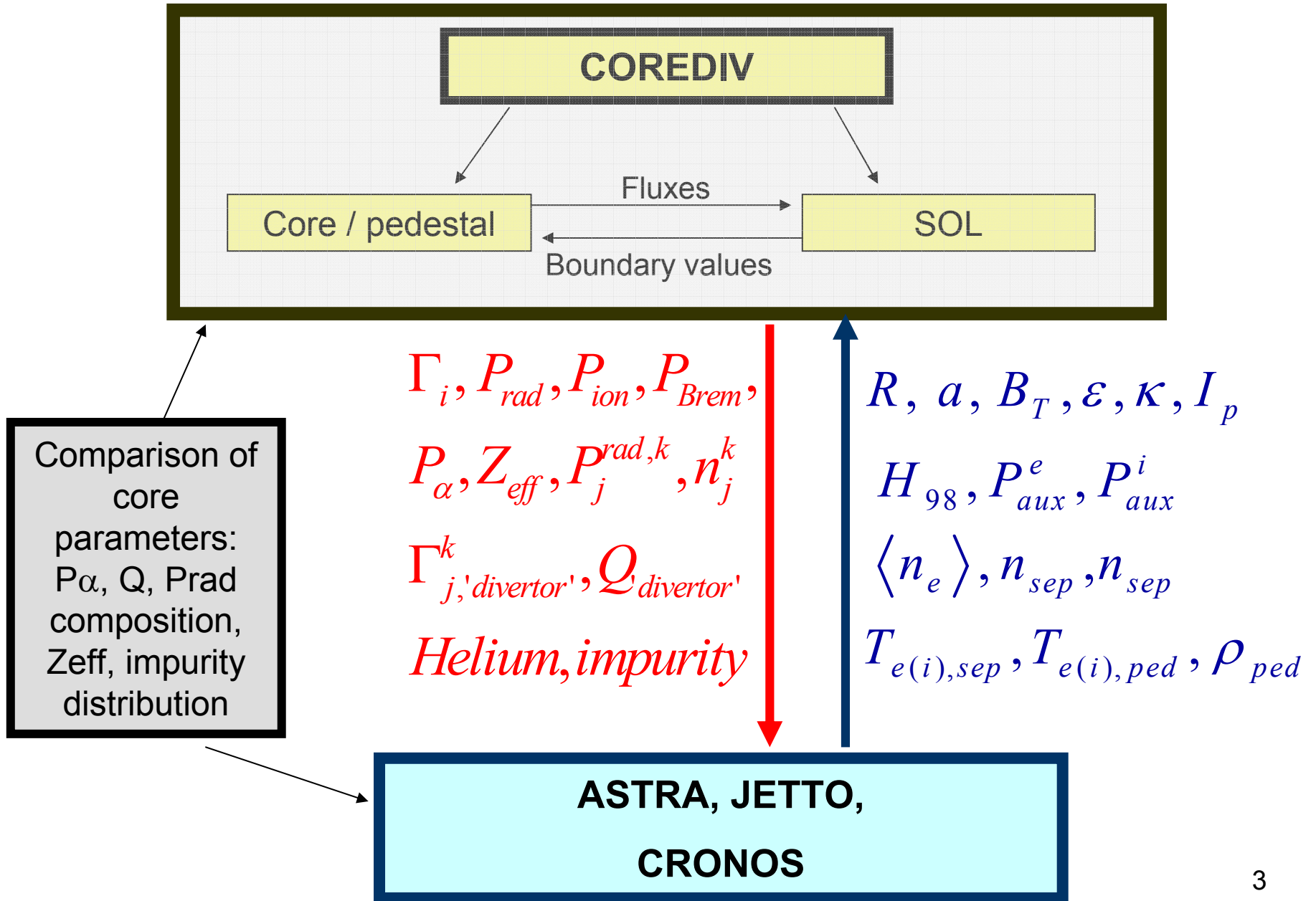
Core (1D):
- *Fixed H98 with parabolic radial dependence of χ ($\chi e \sim \chi I \sim Di$). Anomalous pinch to control density peaking. Prescribed D and V for impurity.*
- *Analytical heating profile normalised to total Pheat, Pe/Pi is given by H-mode scenario.*
- *Core particle source and recycling are controlled to maintain prescribed <ne> and ne at separatrix. Analytical neutral density.*

Pedestal (1D): *Di and χ can be adjusted to match pedestal*

SOL (2D, slab): *2D Braginskii eqs., classical parallel and anomalous perpendicular transport, plasma recycling and impurity sputtering.*

Not included: equilibrium, current diffusion, plasma rotation, H&CD modules, divertor configuration. Limited library of transport models. Steady state only.
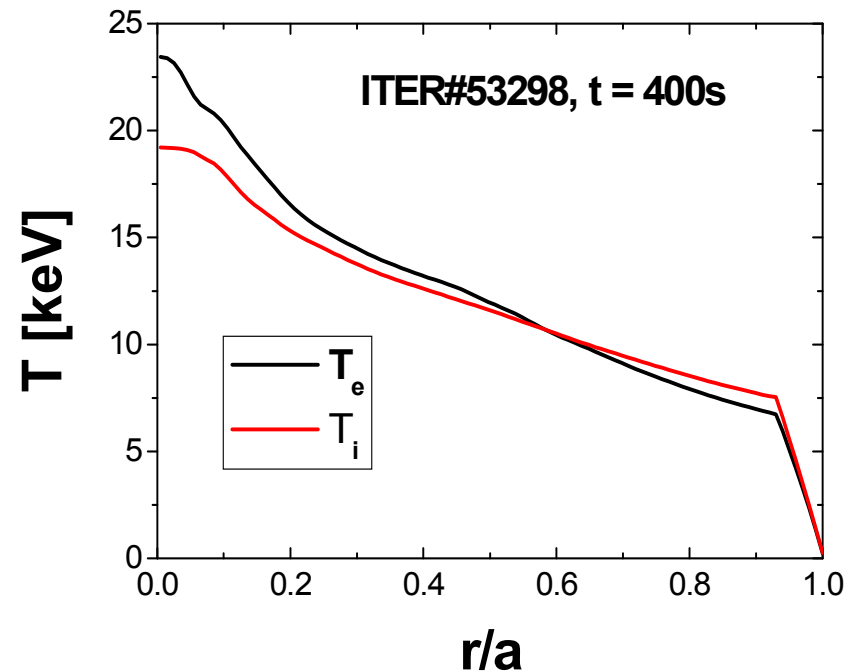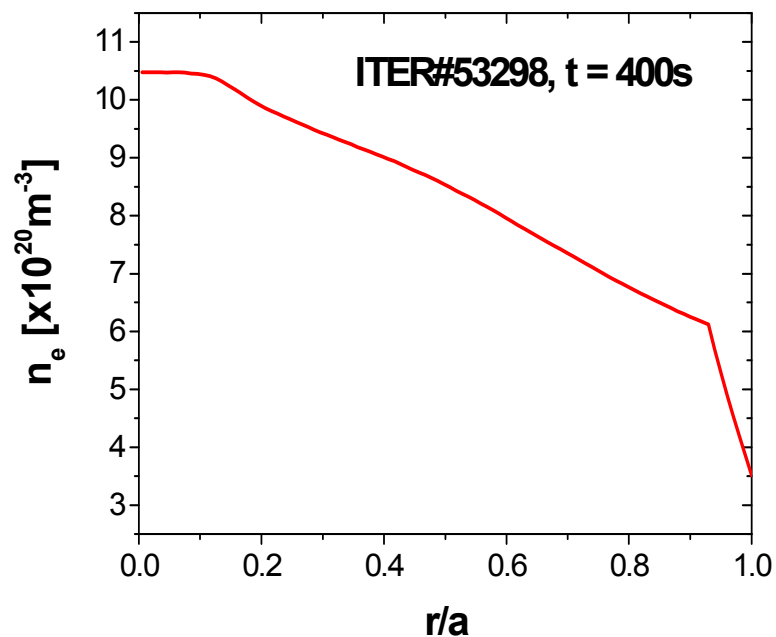
Coupled COREDIV – JETTO/ASTRA/CRONOS simulations

COREDIV

Core / pedestal ⟷ Fluxes / Boundary values ⟷ SOL

Comparison of core parameters: Pα, Q, Prad composition, Zeff, impurity distribution

$\Gamma_i, P_{rad}, P_{ion}, P_{Brem},$

$P_\alpha, Z_{eff}, P_j^{rad,k}, n_j^k$

$\Gamma_{j,'divertor'}^k, Q_{divertor'}$

$Helium, impurity$

$R, a, B_T, \varepsilon, \kappa, I_p$

$H_{98}, P_{aux}^e, P_{aux}^i$

$\langle n_e \rangle, n_{sep}, n_{sep}$

$T_{e(i),sep}, T_{e(i),ped}, \rho_{ped}$

ASTRA, JETTO,

CRONOS

3

Status of simulations

- **Reference ITER H-mode scenario (JETTO/GLF23/EPED-SOLPS)**

    Ipl = 15 MA, Btor = 5.34 T, Paux = 33 MW (NBI) + 20 MW (ECRH),

    Pα = 74 MW, H$_{98}$ = 0.9, Z$_{eff}$ = 1.74 (C only), $\langle n_e \rangle$ = 7.45e19 m^{-3}, peaked profile, n$_{e\_ped}$ = 6.12e19 m^{-3}, T$_{e,ped}$ = 6.7 keV, T$_{i,ped}$ = 7.5 keV

Stationary H-mode profiles

On-going and future actions

- **COREDIV with Be and W - in progress**

  - reproduce Te, Ti, ne profiles for reference scenario

  - calculate impurity distribution, radiative losses, P_α, particle (D, T) influx, boundary values, He ash, power & particle flux outside SOL

- **Comparison with JETTO**

- **Iterative COREDIV ↔ JETTO/ASTRA simulations with GLF23 for reference case and scan in GLF23 parameters**

- **ETS ITER runs:**

  1. prepare input CPO with this ITER run in 4.10a

  2. simulated Te, Ti, ni, impurity with boundary conditions and He4 taken from COREDIV.

  3. more flexibility for the choice of transport and H&CD models. Equilibrium and current diffusion are simulated. Time-dependent simulations.