MAX-PLANCK-INSTITUT
FÜR PLASMAPHYSIK

ASDEX Upgrade

W Transport, Preliminary Results and Plans

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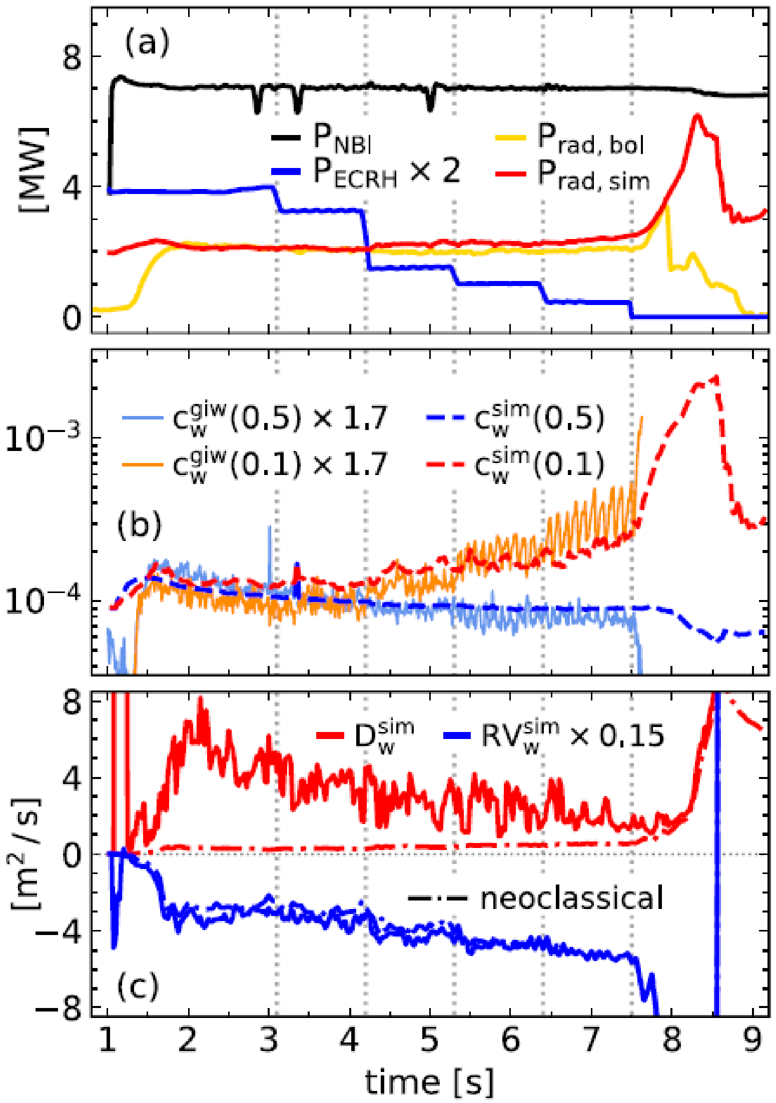
Goal: apply theory-based models to the prediction of W transport in the core of selected JT60-SA scenarios

- **Simulation workflow based on the combination of TGLF-SAT2 and FACIT with the code ASTRA**
- **Successful application and validation against ASDEX Upgrade NBI + ECRH / ICRH plasmas**
- **Quantitative prediction of RF power requirements to avoid W central accumulation**

[Fajardo et al NF 2024]



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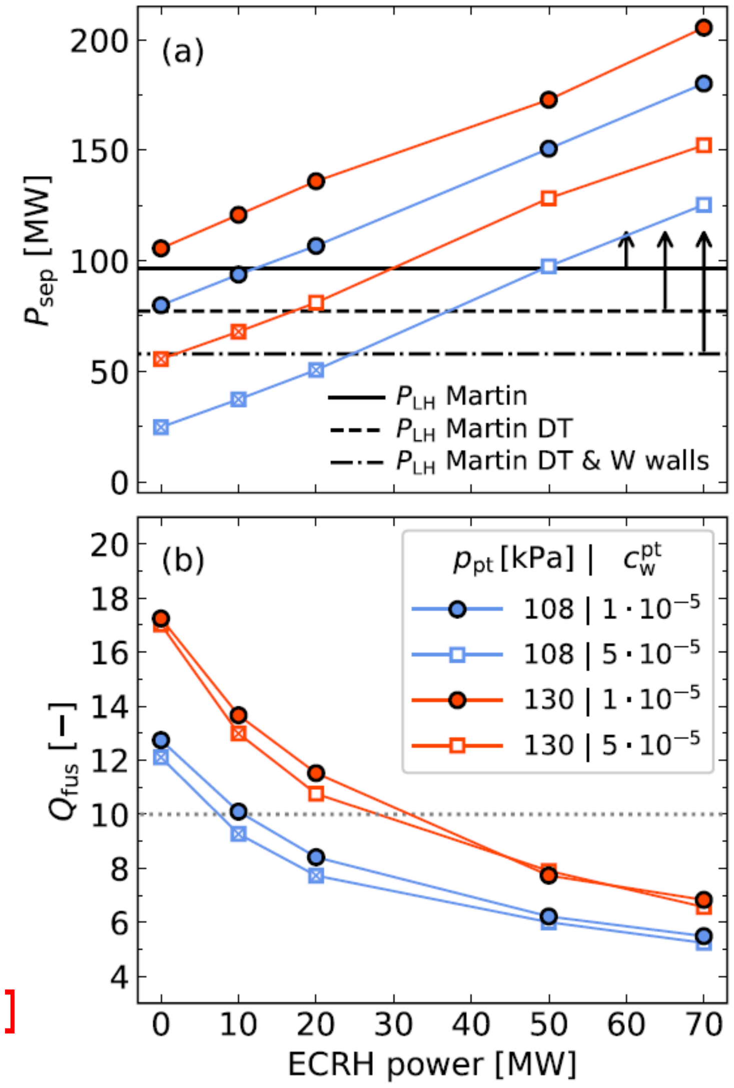
- Successful application and validation against ASDEX Upgrade NBI + ECRH / ICRH plasmas
- Quantitative prediction of RF power requirements to avoid W central accumulation
- Application to ITER confirmed that reactor conditions are in a different transport regime due to the combination of low rotation and low collisionality
- Dominance of turbulence removes the requirement of preventing central neoclassical accumulation
- H-mode sustainment provides the critical condition



[Fajardo et al PPCF 2025]

JT60-SA Baseline H-mode scenario (Scenario 2 in Research Plan)

- **Baseline H-mode scenario is at 5 MA / 2.25 T, with 34 MW NBI and 7 MW ECRH**

[Garzotti et al NF 2018]

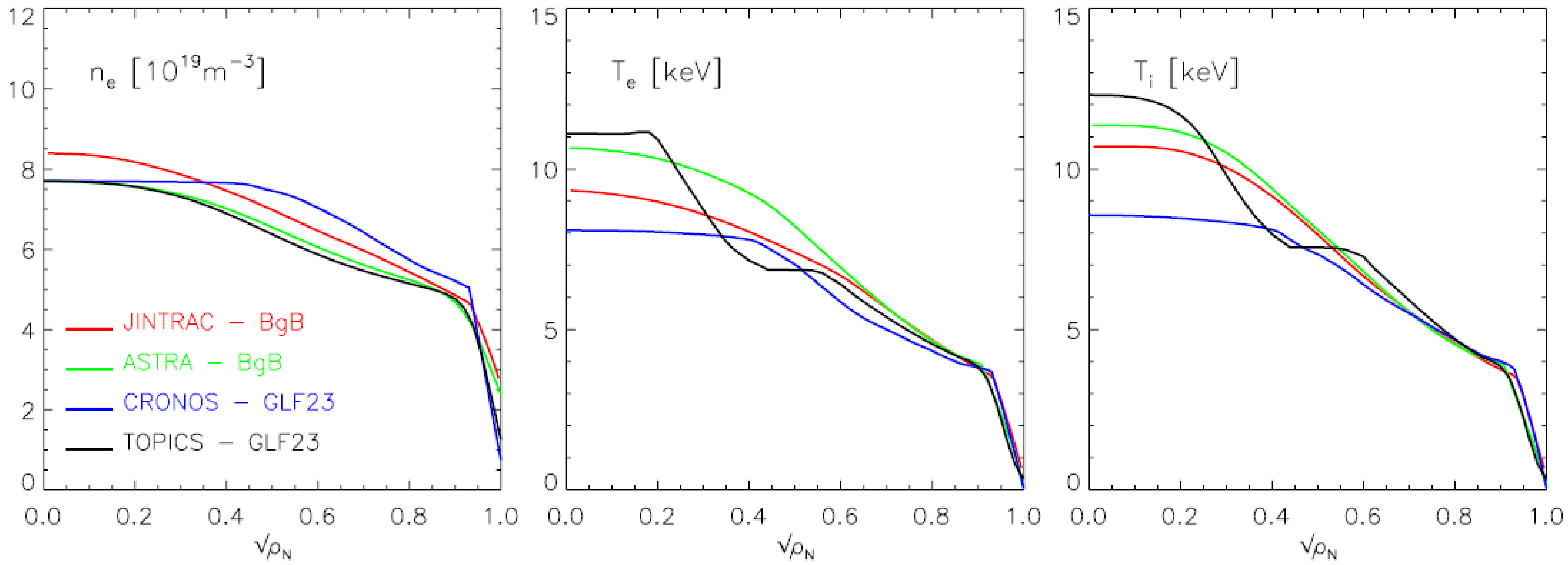
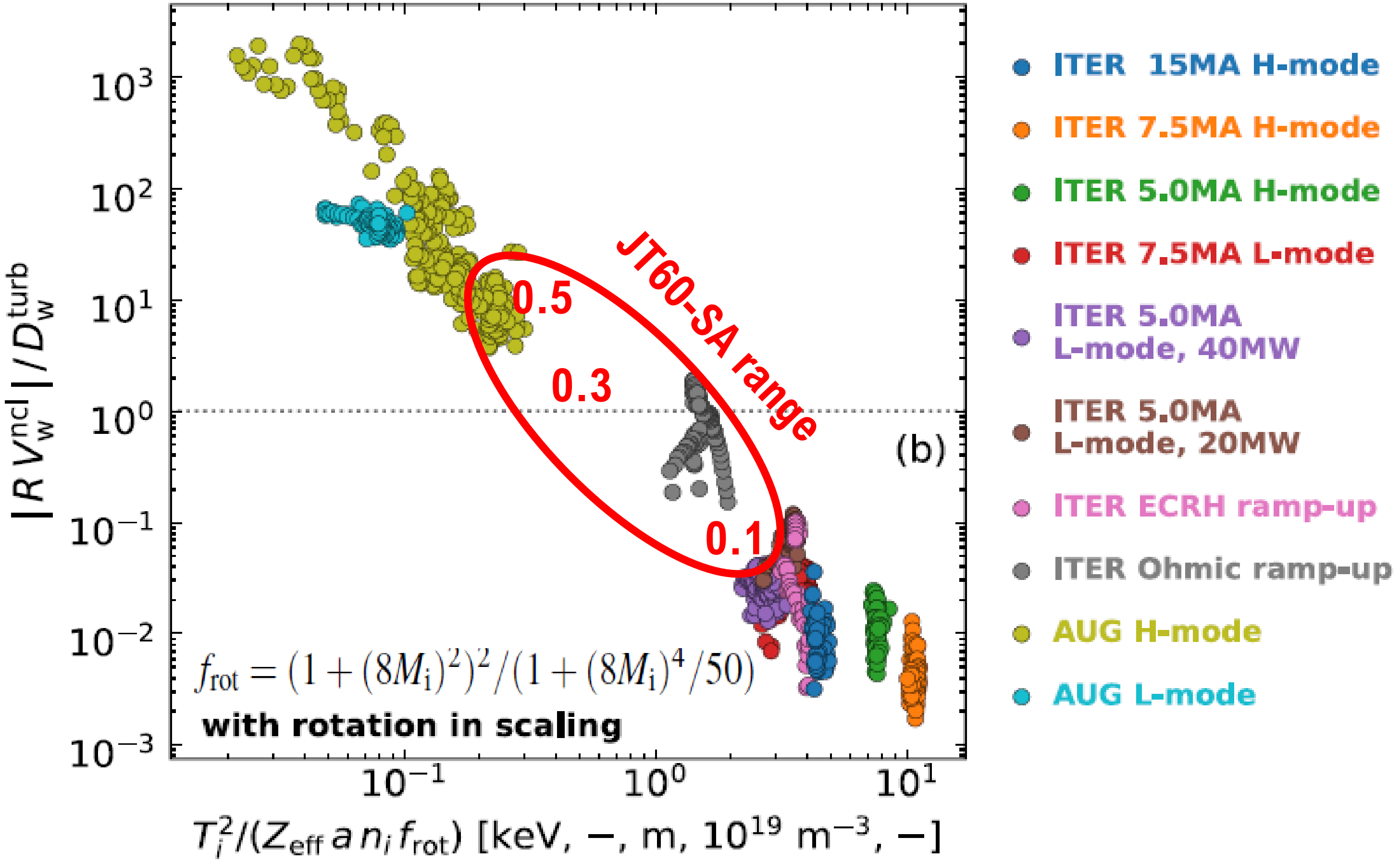


Figure 2. Predicted electron density, electron temperature and ion temperature profiles for a JT-60SA H-mode plasma (scenario 2). The codes and the transport models used in the simulations are indicated in the legend.

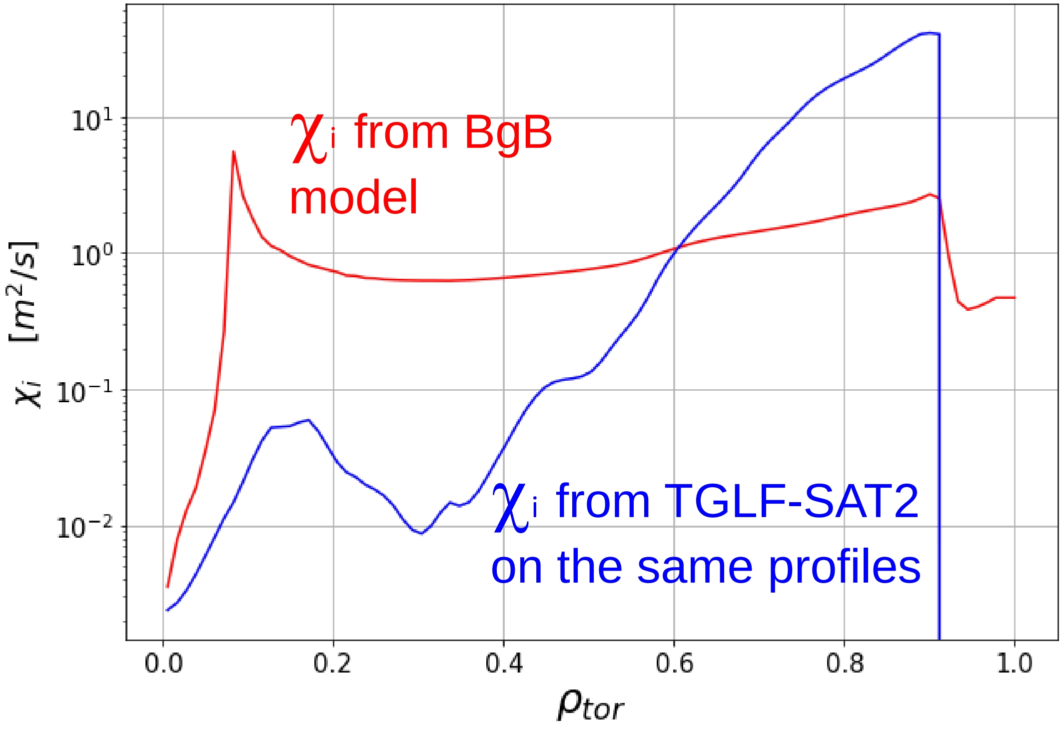
Current plan

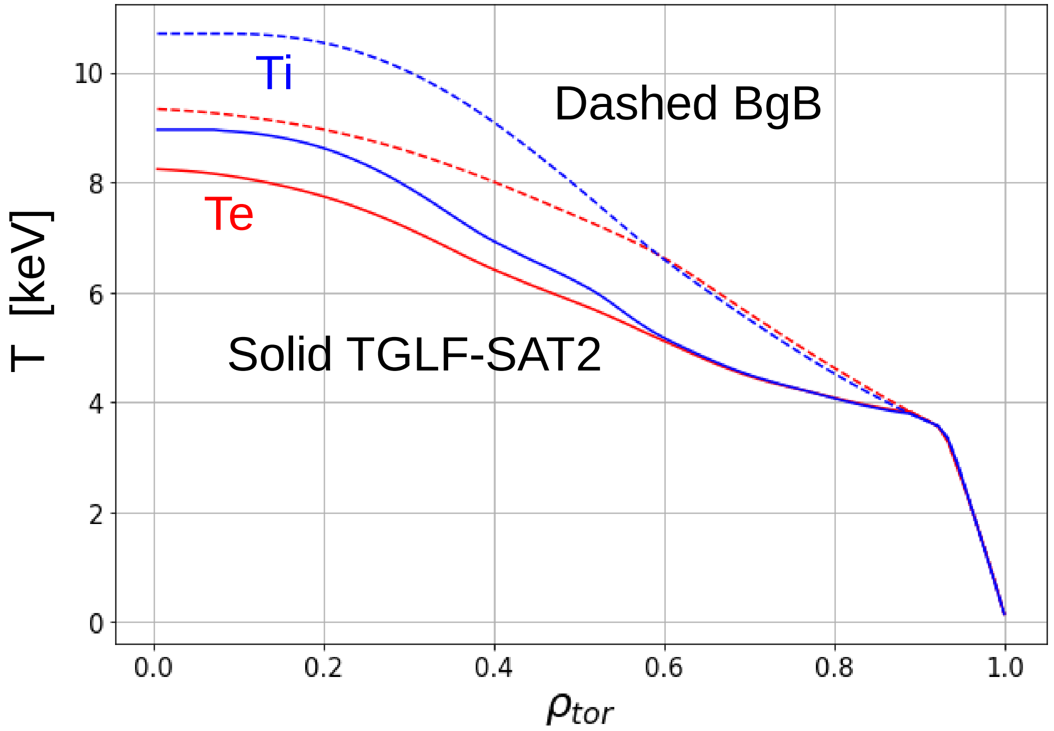
- Run Scenario 2 in ASTRA with TGLF-SAT2, NCLASS and FACIT and appropriate toroidal rotation model
- Toroidal rotation model we plan to apply most recent upgrades of model described in C.F.B. Zimmermann et al Phys. Plasmas 31, 042306 (2024)
- Vary W concentration at pedestal top and central ECRH
- Determine amount of ECRH power required to avoid central accumulation and to sustain H-mode
- Results are expected to significantly depend on predicted toroidal rotation level
- Uncertainties on JT60-SA rotation at plasma periphery suggest to also explore the impact of a variation of the toroidal rotation at pedestal top



First (and VERY PRELIMINARY) results

- Starting from profiles predicted with BgB model, TGLF-SAT2 develops very strong transport in the peripheral region just inside the pedestal





- Profiles evolve to significantly lower temperatures
- At later times density develops local hollowness just inside pedestal top (still to be understood / fixed)

Additional Plans

- Produce JT60-SA scenario 2 predictions with the IMEP workflow (ASTRA / TGLF-SAT2 + critical gradient pedestal transport and MISHKA) [M. Bergmann]

- Apply local neoclassical transport models (NEO and FACIT) to test relative strength of density gradient pinch and temperature gradient screening in JT60-SA predicted pedestals [D. Fajardo]