GBS simulations of TCV-X23

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Swiss
Plasma
Center

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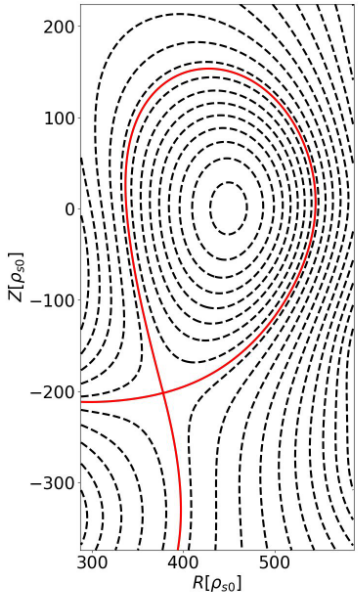
Simulations comparison with previous studies

For each configuration:

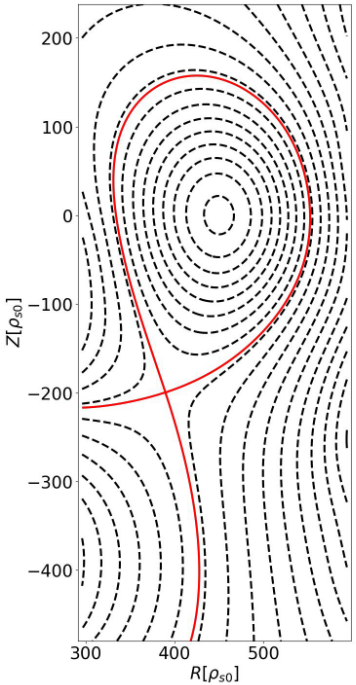
- Half TCV size
- 2 simulations, low and high density (GP D_2)
- e^-, D^+ and D_2^+ dynamics with D and D_2 interactions

Shape	B_t direction	Convergence
TCV-X21	FF	Yes*
TCV-X21	RF	Yes
TCV-X23	FF	Almost

PSI 2024



TCV-X21



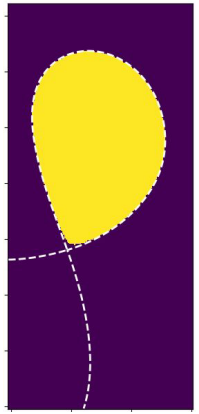
TCV-X23

*D. Mancini et al 2024 Nucl. Fusion 64 016012

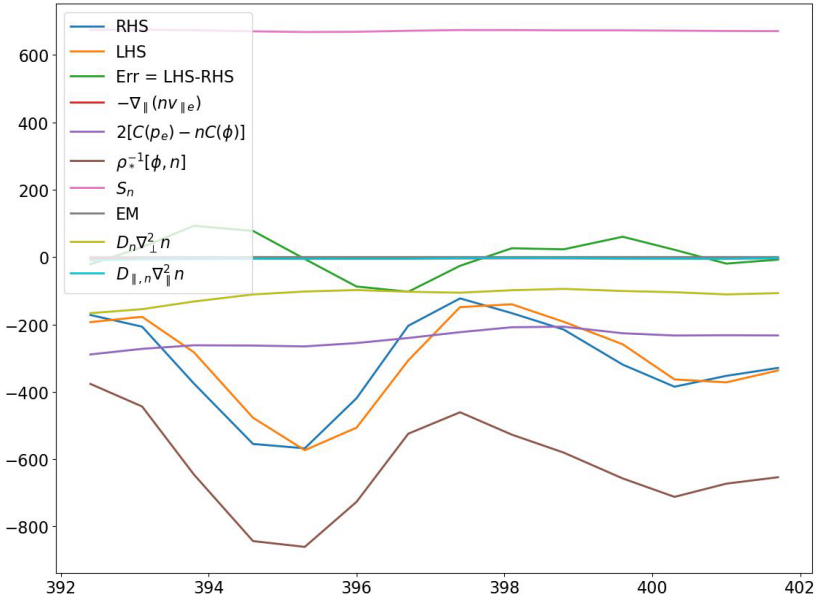
Simulations almost converged

Density equation in the core (yellow region):

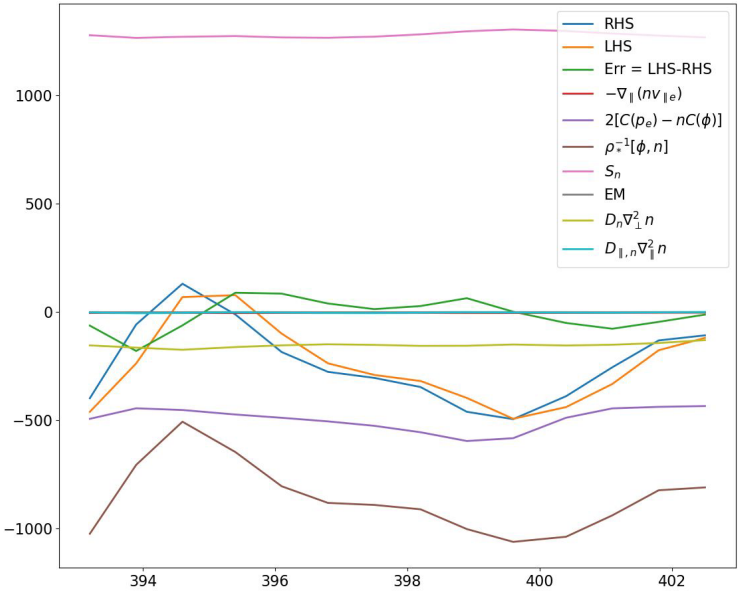
- Not exactly 0 but don't expect many changes ⟶ oscillating profiles
- Not yet long time trace for blobs



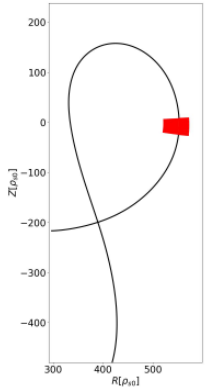
Low density



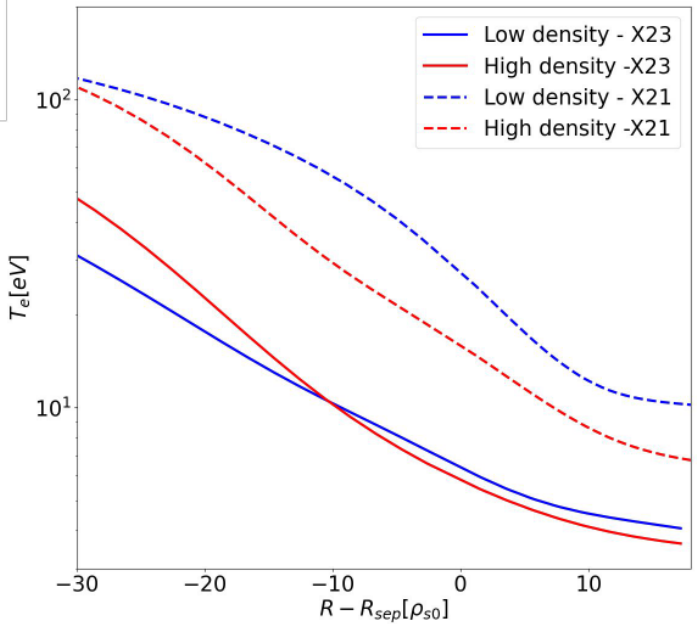
High density

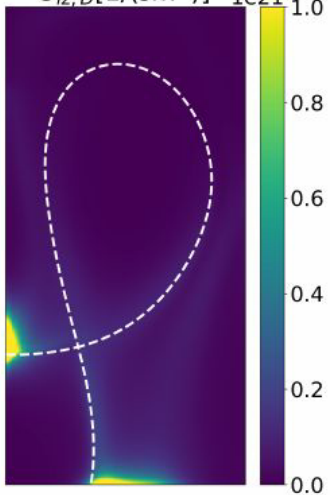


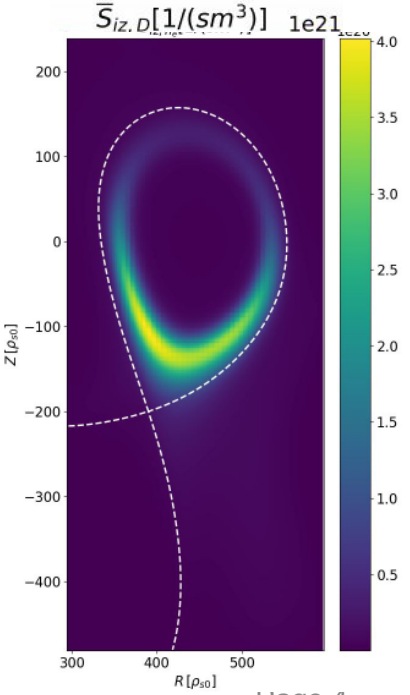
Lower plasma temperature in low density



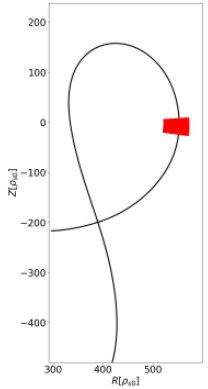
Low temperature in TCV-X23 leads to ionization far from target





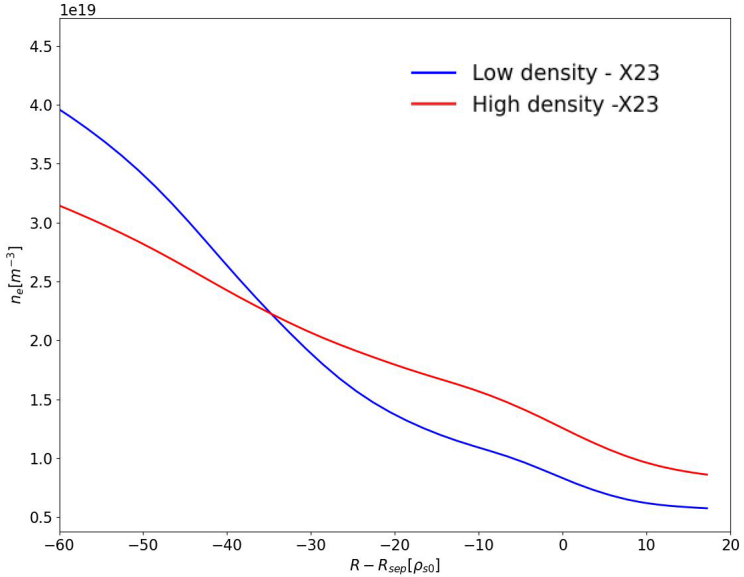


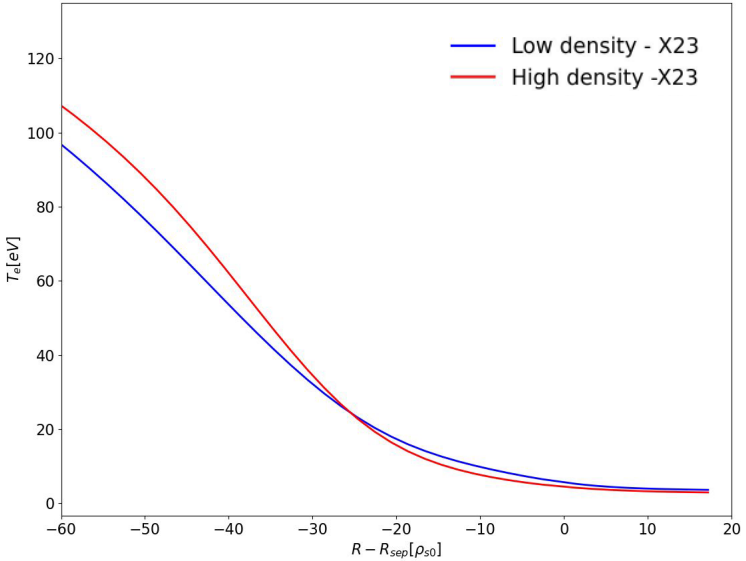
Higher plasma density in high density



The puff indeed increases the density

while keeping same Te sep through changed P source

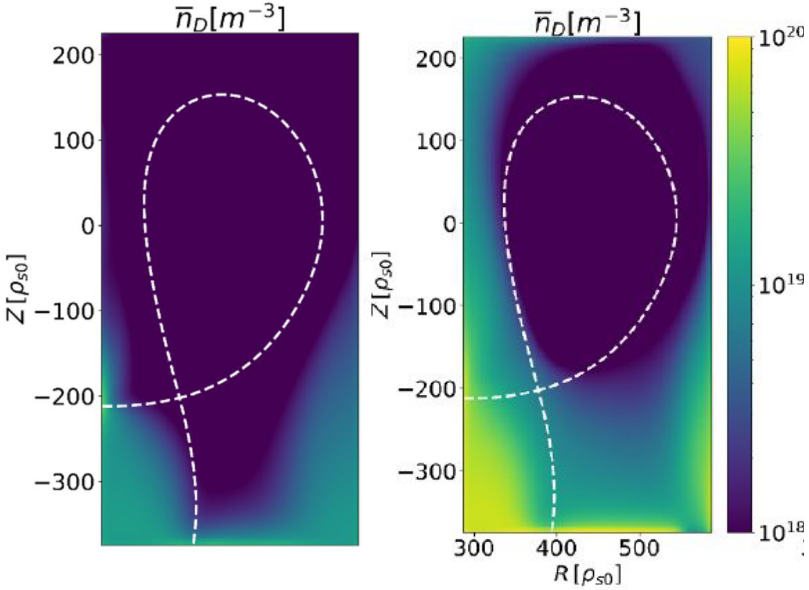




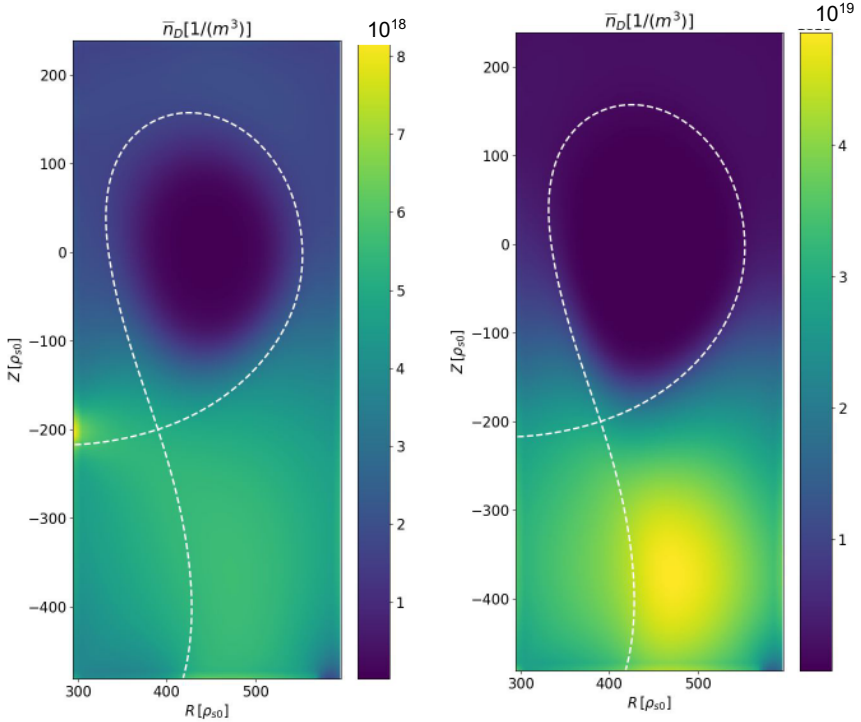
High D_2 density even with lower density

Higher penetration in the divertor volume with lower temperature

TCV-X21



TCV-X23

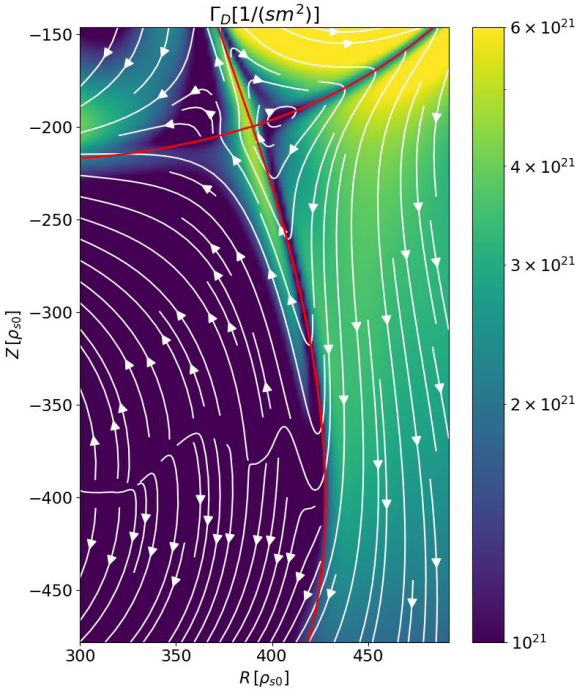


Fluxes in the divorter change drastically

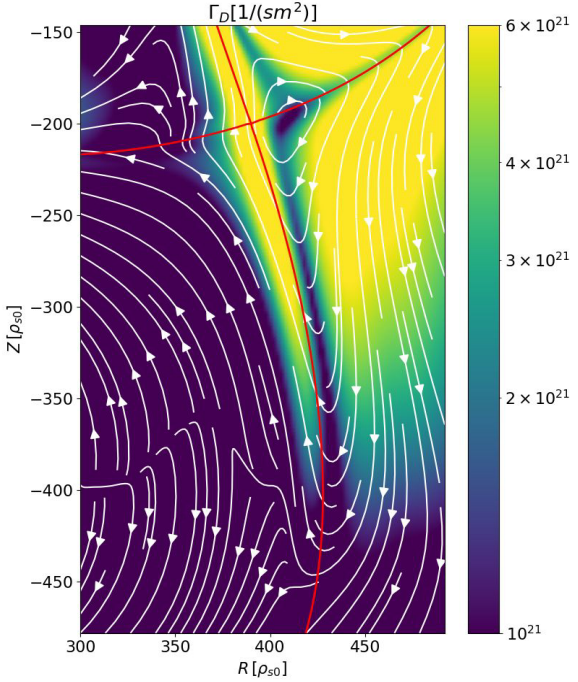
Low density: mostly parallel flow → attached

High density: decreased particle flux at both targets!

Low density



High density

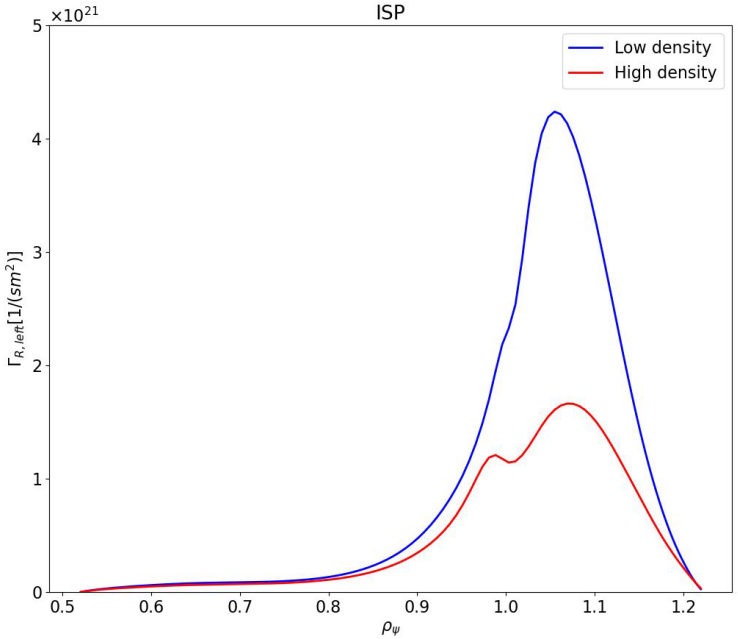


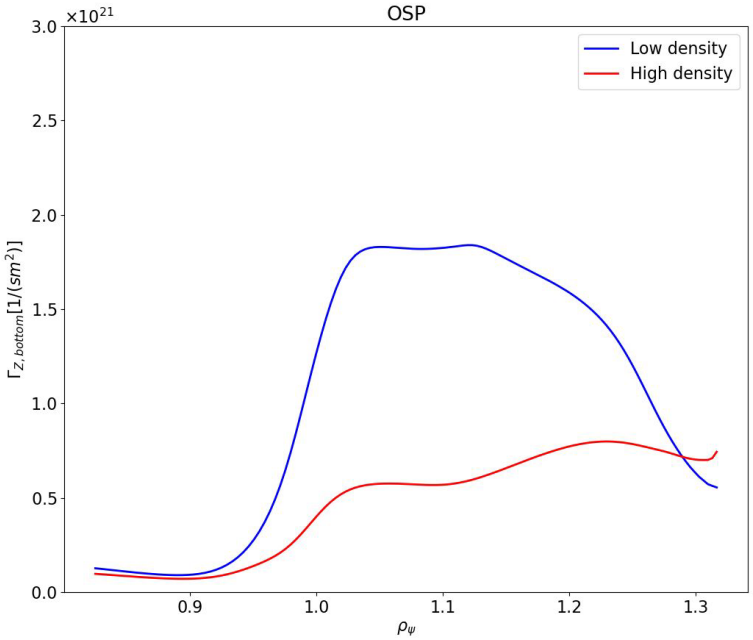
Ion fluxes at target decreases

At both target decrease with increasing density!

At OSP no peak even in low density

With high density clear drifts effect → already observed in TCV-X21

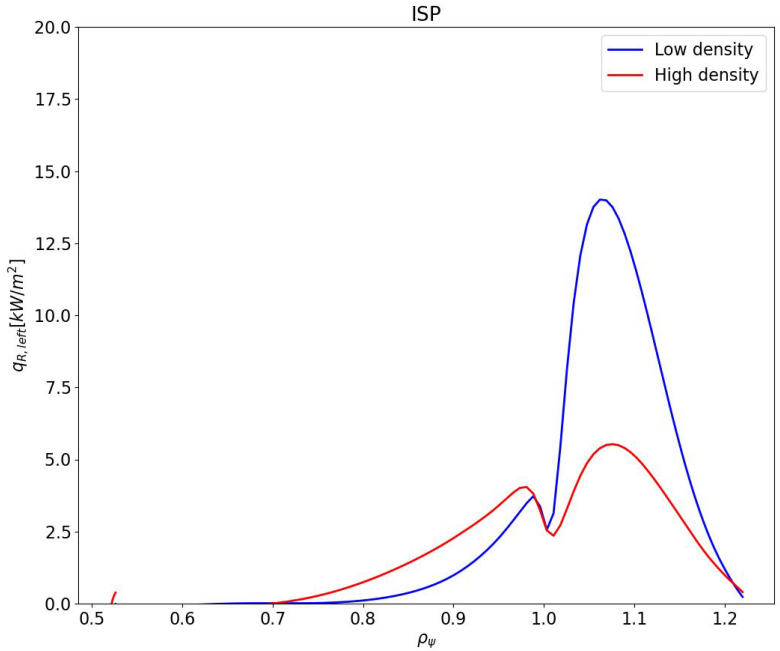


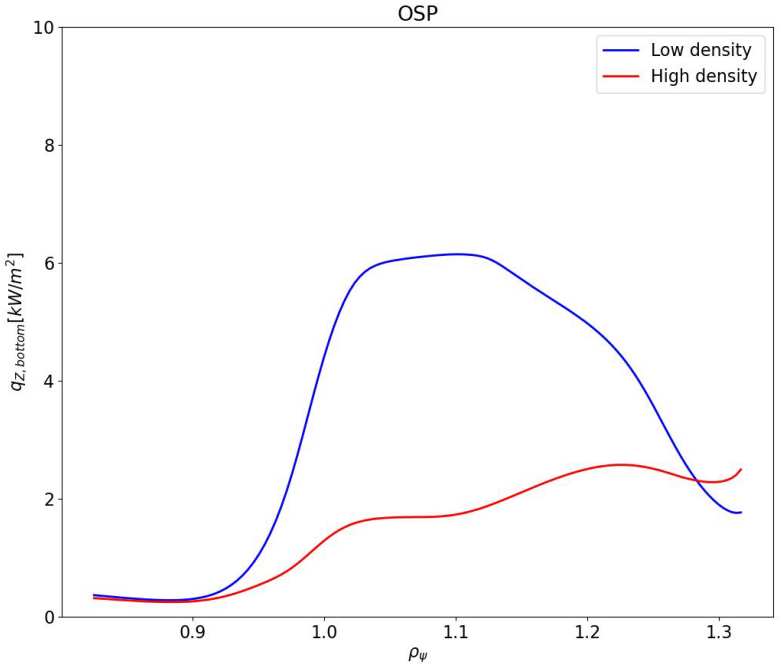


Heat fluxes at target decreases

At both target decrease with increasing density → very low values

Shape ~ ion flux shape → mostly convective heat fluxes

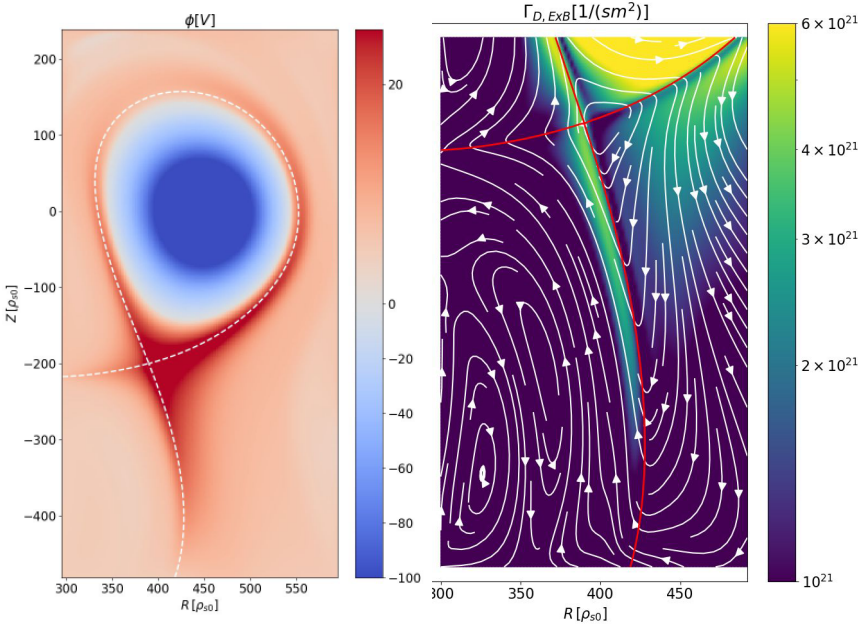




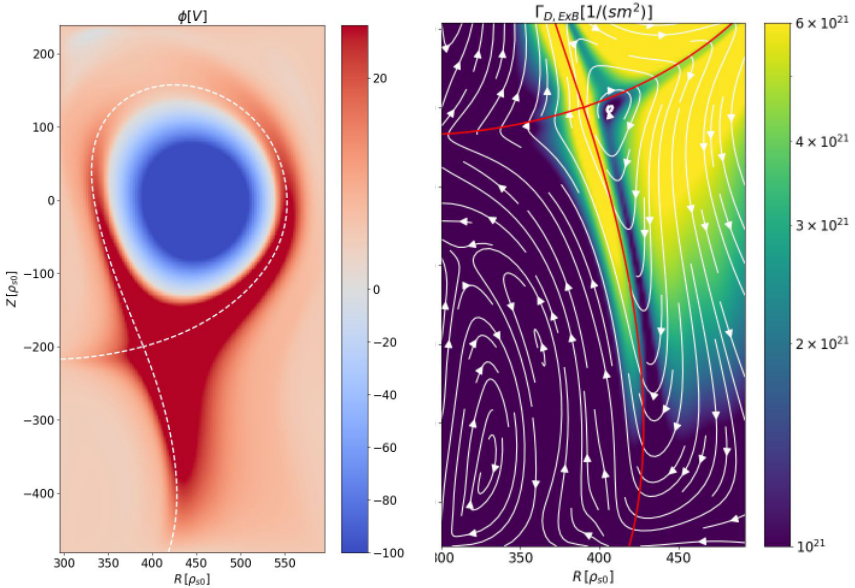
Drift effects important due to strong E field

Convective cell transport plasma from far SOL to OSP

Low density



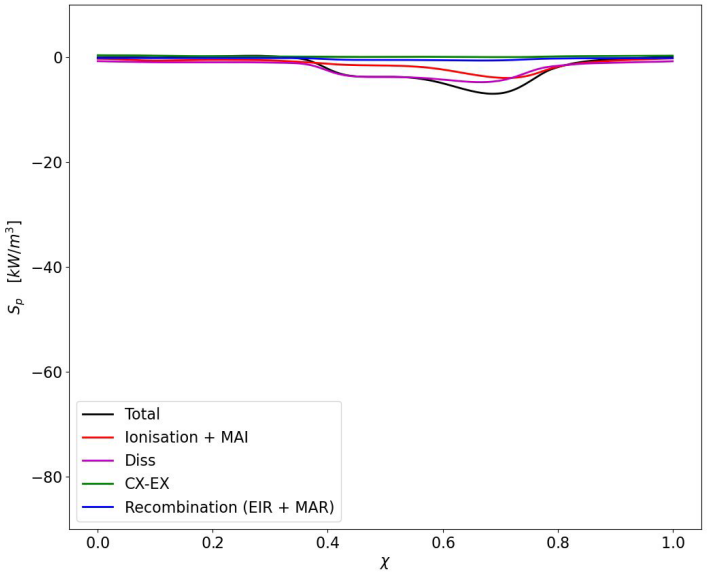
High density

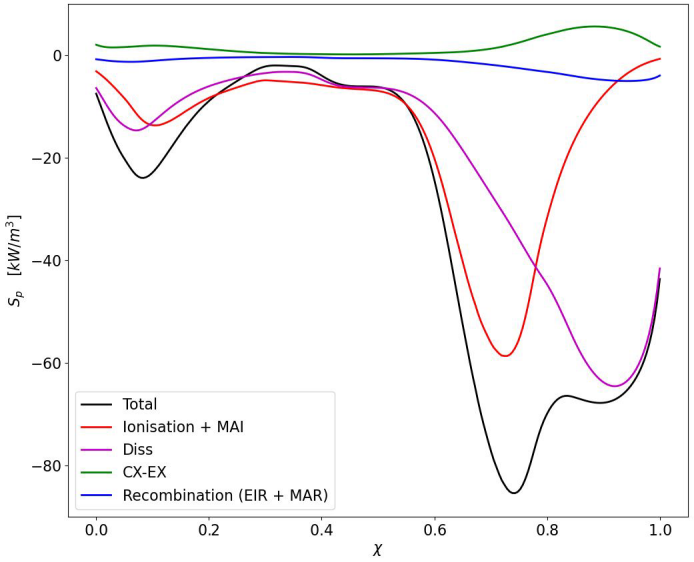


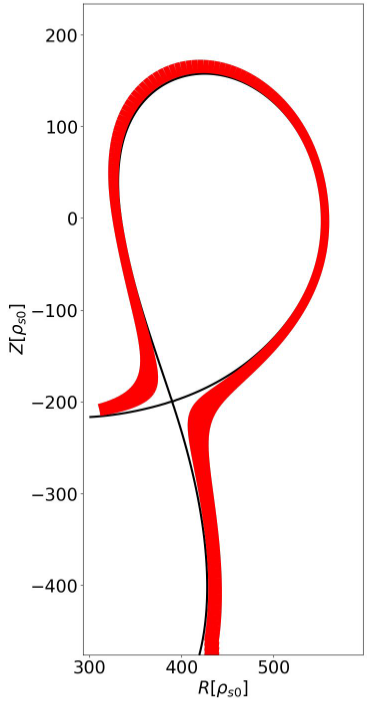
Strong neutrals interactions at higher density

Strong plasma-neutral interactions in high density TCV-X23:

- Ionization and dissociation peak far from target
- Dissociation losses important





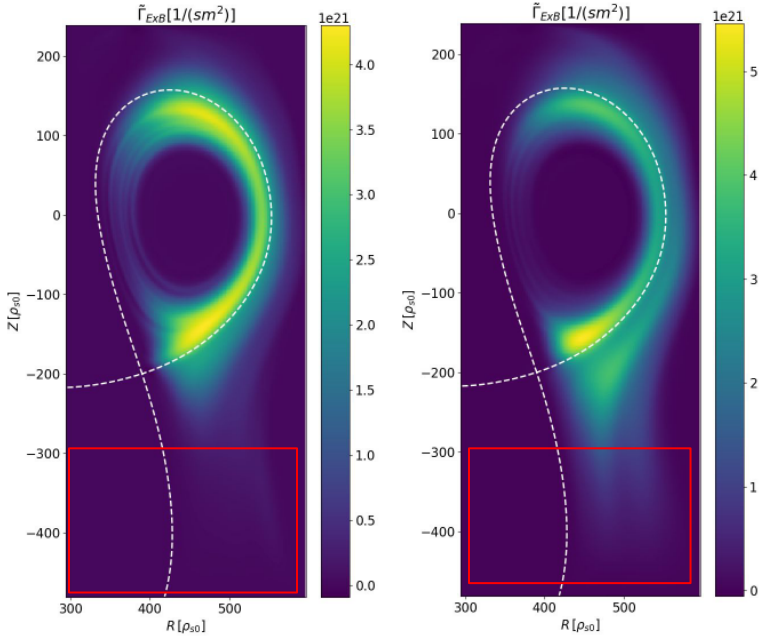


Turbulence increases in high-density

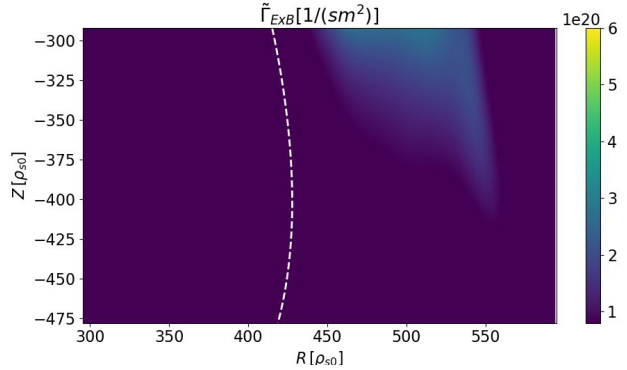
Turbulence growth stopped → waiting for more data

Increase in far SOL with density →not at the target where total flux lower

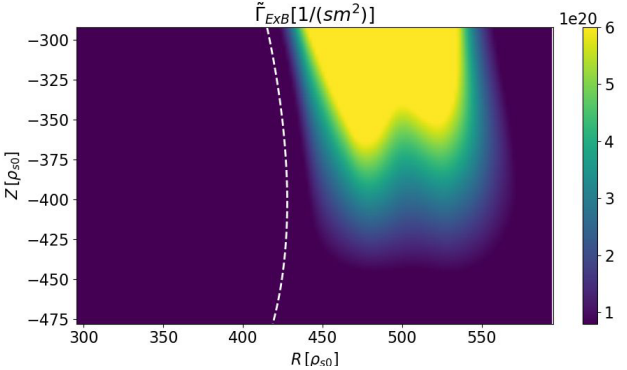
Low density



High density



Low density



High density

Conclusions

GBS simulations to reproduce experimental results of TCV-X23 shots are almost converged

Preliminary analysis of comparison low vs high density in TCV-X23 shows:

- Increased plasma and neutral density with puff (stronger than X21 case) →experiments?
- Low plasma temperature in both cases (compared to X21 case)
- Strong fluxes reduction with puffing → neutrals cloud in div region increases momentum and power losses
- Hints of enhanced turbulence up to neutral cloud region → below? Divertor loc blobs?

Next steps:

- Compare turbulence properties
- Compare (low vs high density X21) vs (low vs high density X23)