TSVV-7 progress meeting

ERO2.0 simulation of W erosion in DEMO

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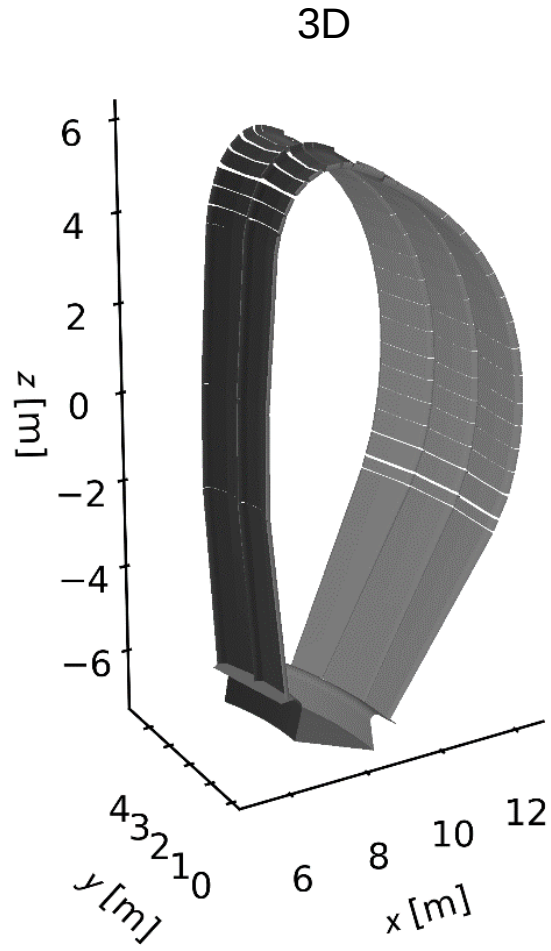
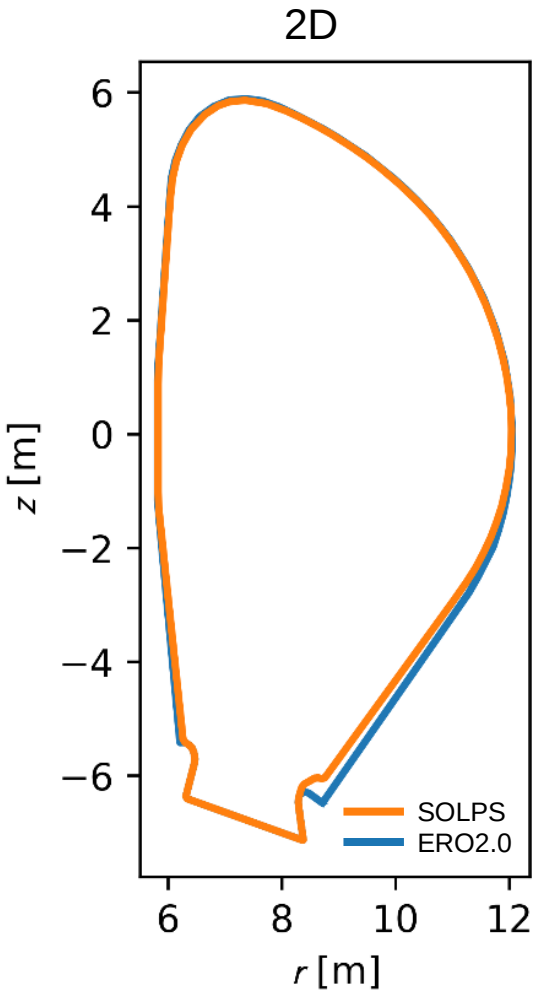
(Converted) raw data

Geometry, plasma background, neutrals

Geometry

Wall without additional limiters





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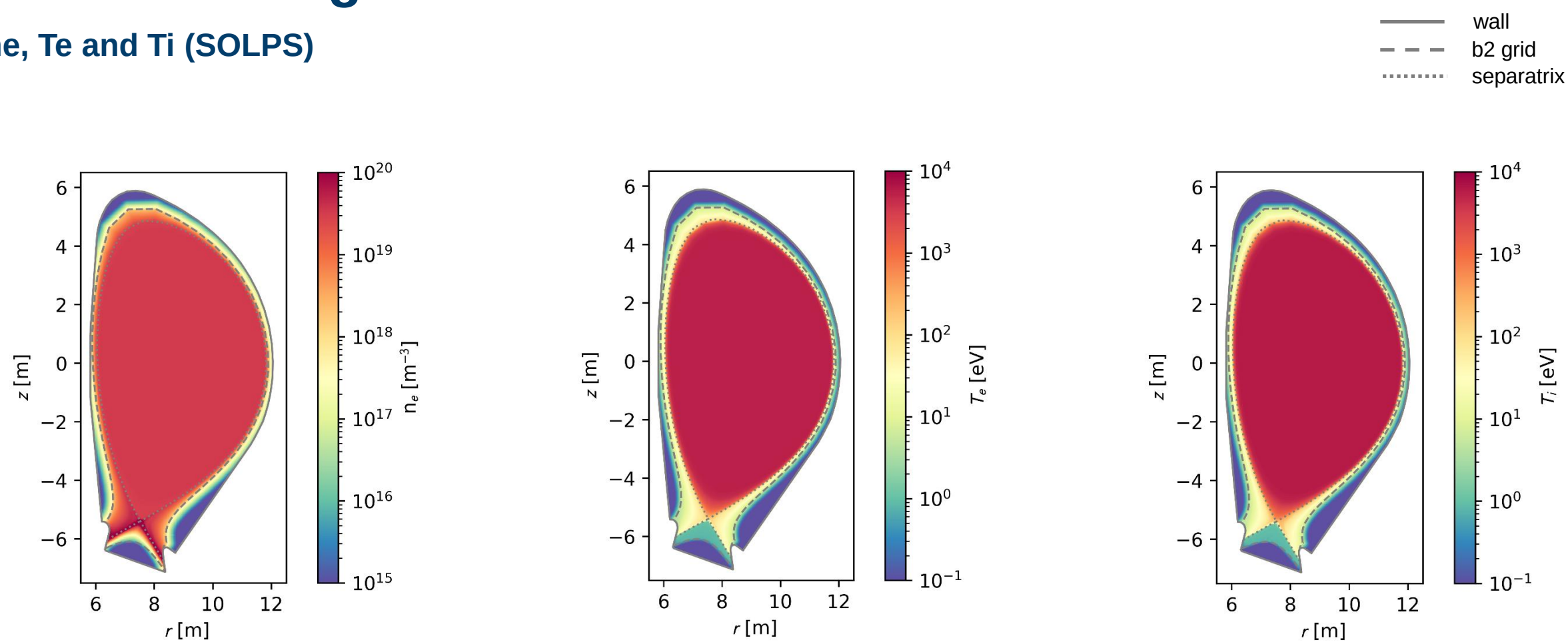
Plasma background

ne, Te and Ti (SOLPS)



exponential decay assumed for extrapolation (decay length 5 cm)

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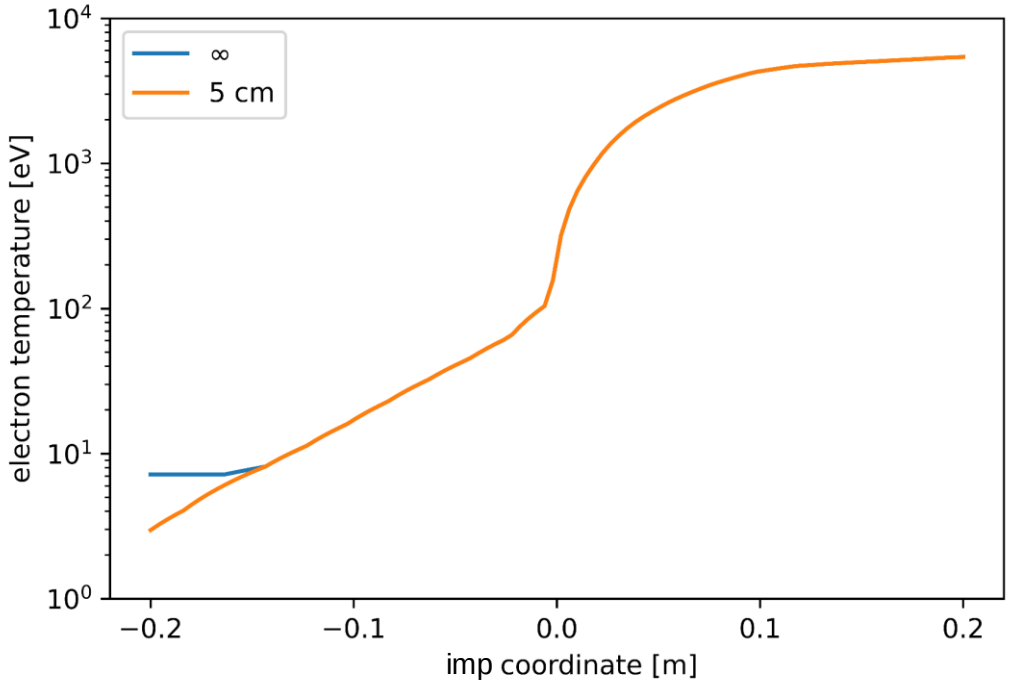
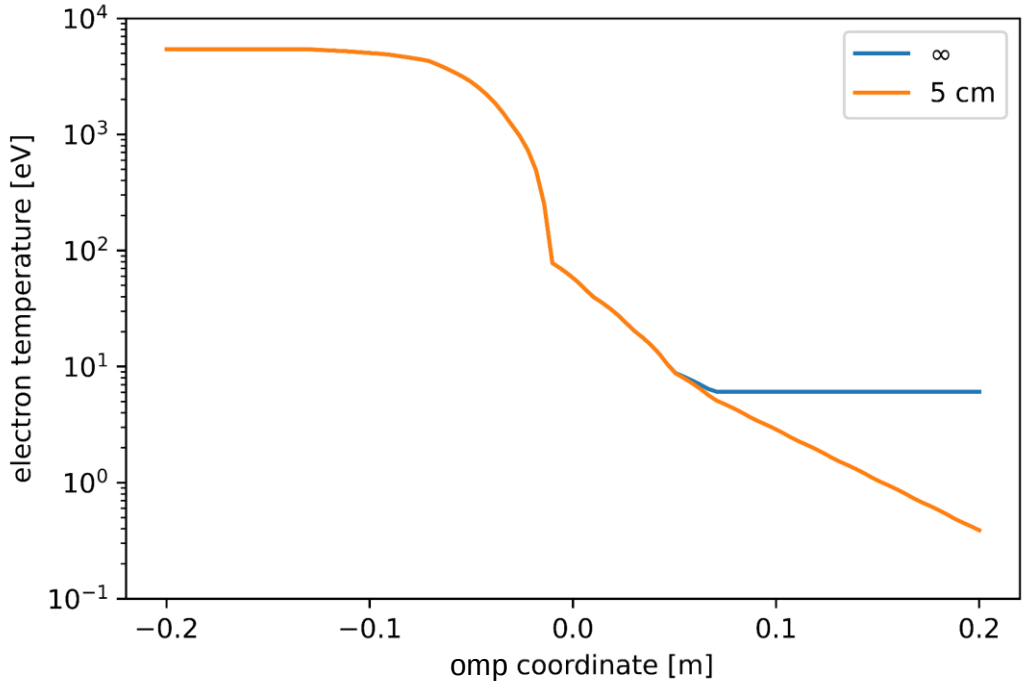
Mid-plane profiles

Electron temperature

inner mid-plane



outer mid-plane



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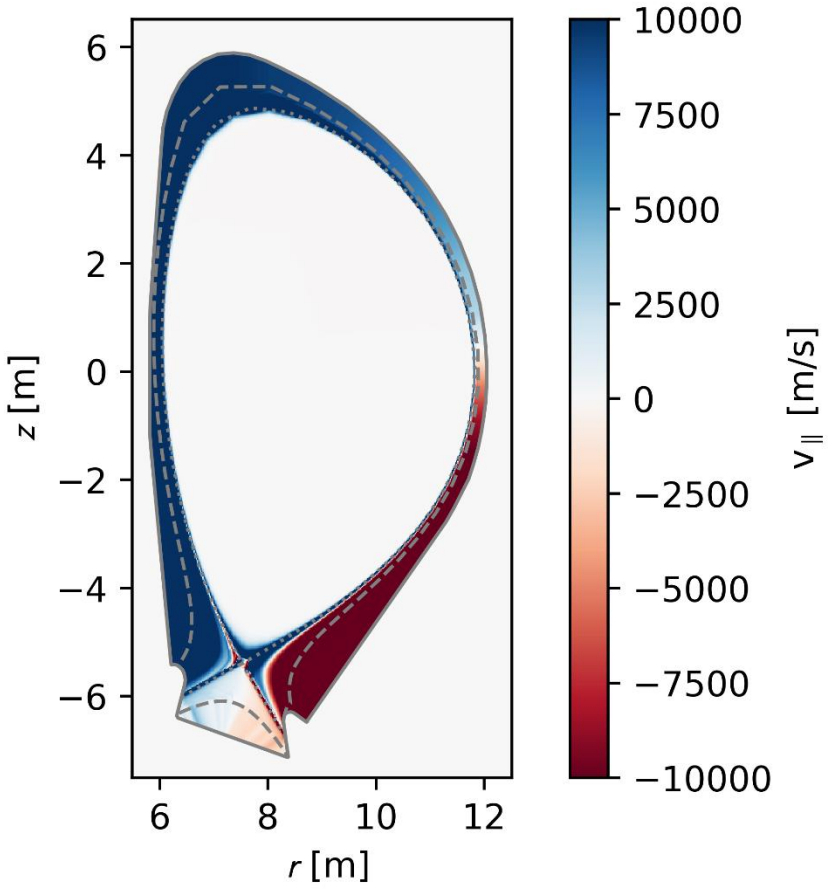
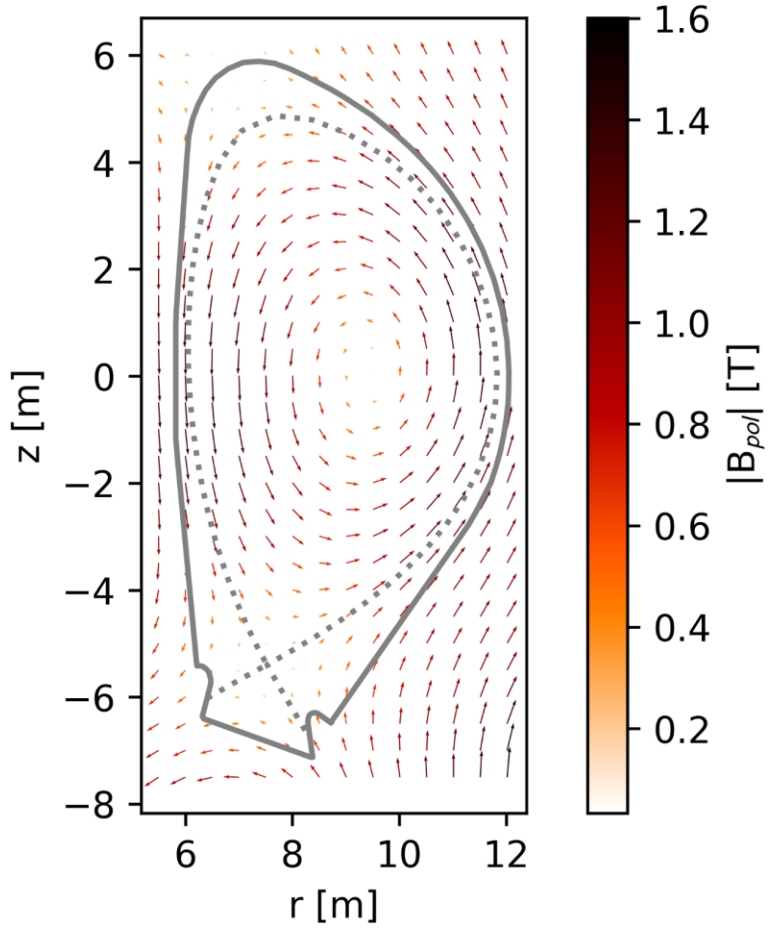
Plasma background

Parallel flow velocity (SOLPS), magnetic field (2017 baseline equilibrium)





constant extrapolation assumed for parallel flow velocity

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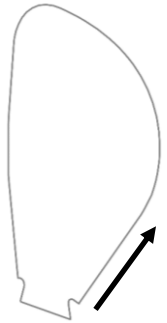
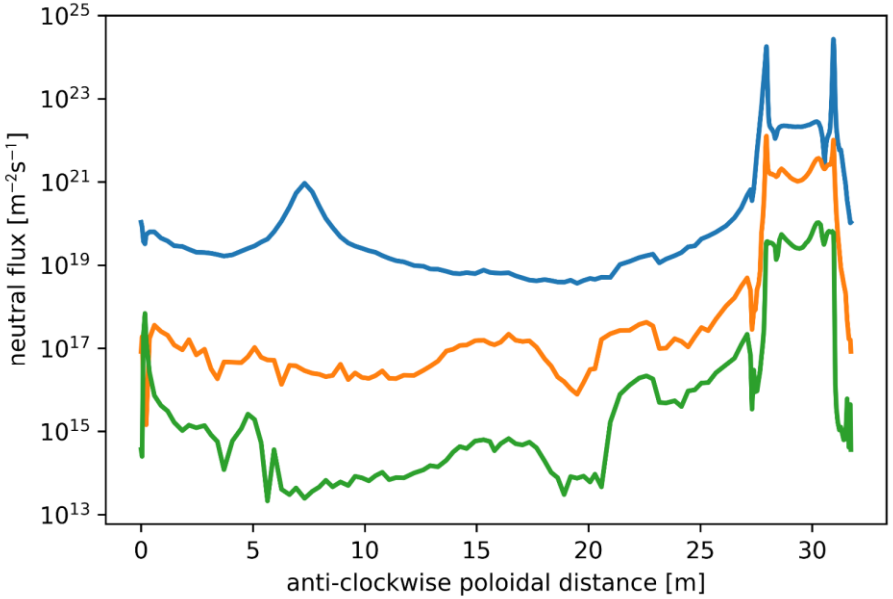
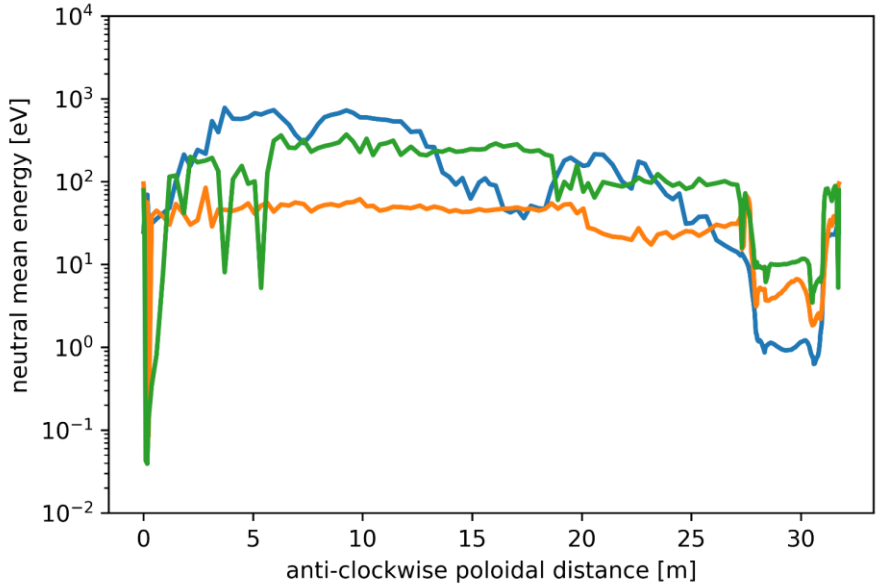
Neutrals

Fluxes and mean energies







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Field line tracing

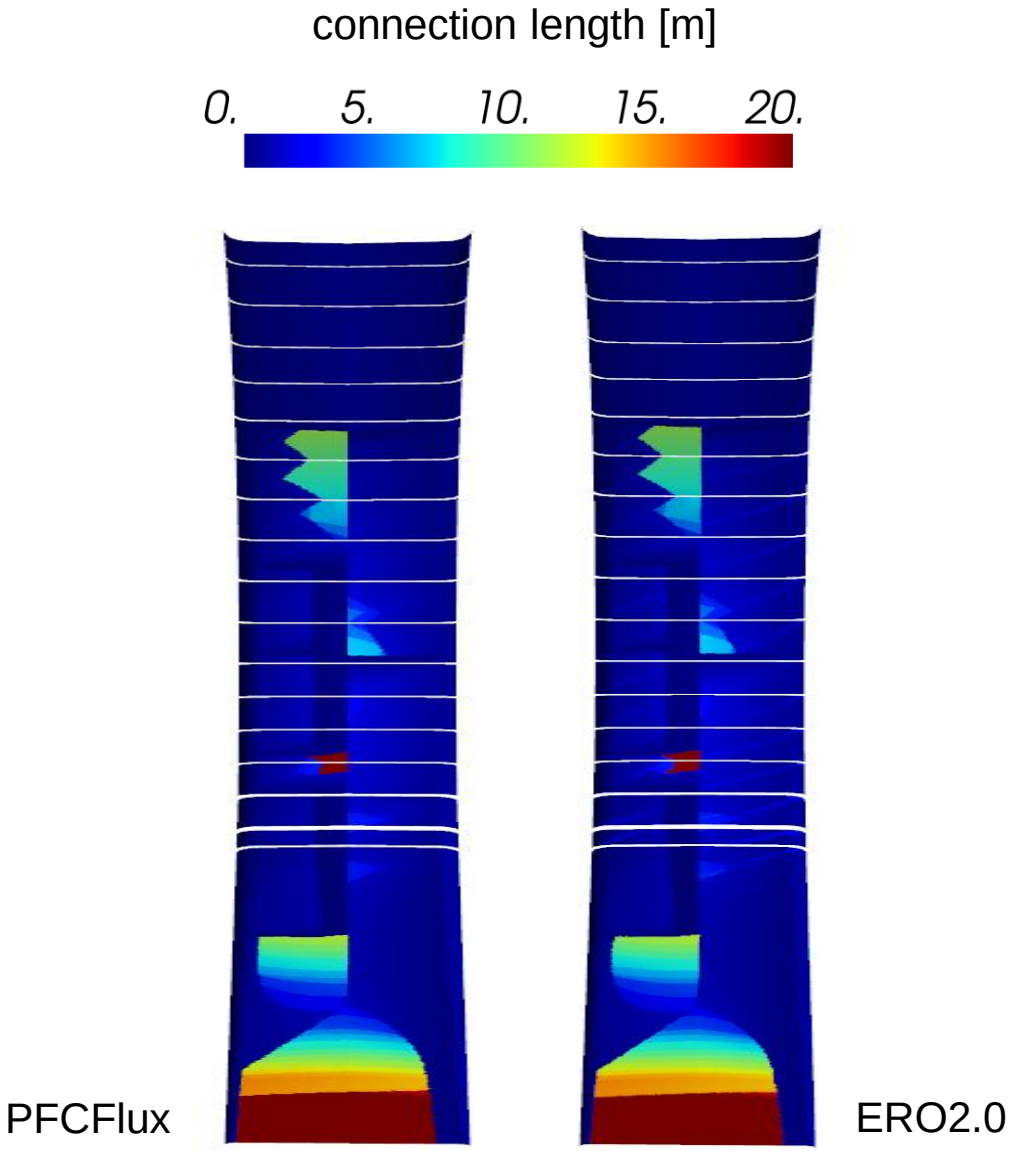
Connection length, shadowing

Field line tracing

Benchmark vs. PFCFlux (with additional first wall limiters)

- ERO2.0 field line tracing in very good agreement with PFCFlux (e.g. connection length on inner first wall)

confidence that magnetic background is transferred correctly



First runs

Assumptions

- neutrals impinge perpendicular to wall surface
- ions impinge at 60° to surface normal
- no limiters included in simulations!
- 10^6 test particles (low statistics)
  - majority of particles starts from divertor; main chamber statistically low resolved!

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Assumptions

Plasma background

- globally constant ion impurity concentration

- concentrations based on integrated volumetric SOLPS data
  - D^{+} ~ 0.855
  - He^{++} ~ 0.134, He^{+} ~ 0.008
  - Ar^{13+} ~ 0.003 (mean charge state of Argon)

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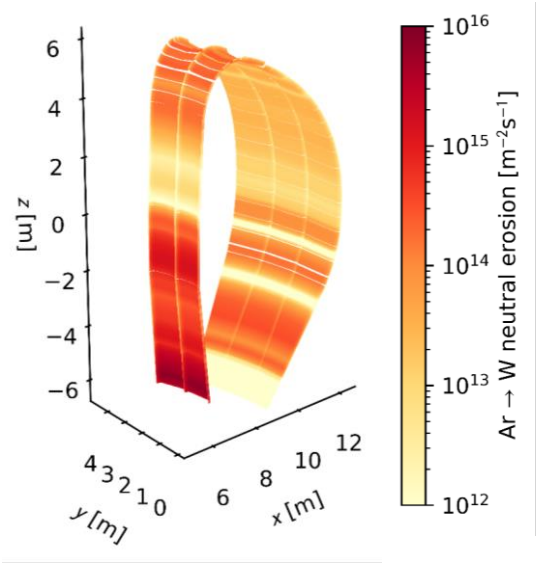
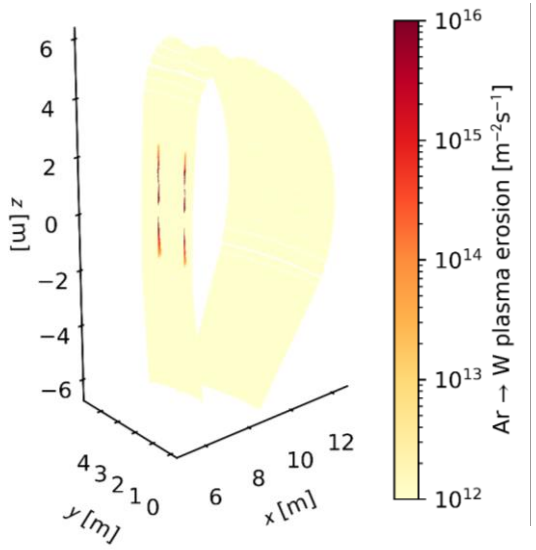
Species-resolved gross erosion

Main chamber

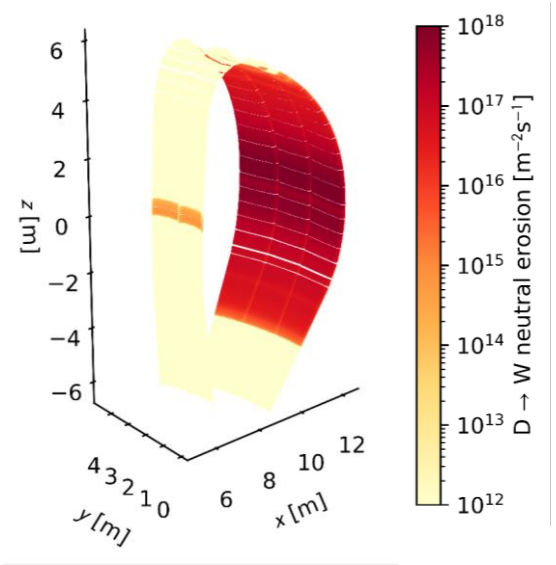
2.67×10^{16} #/s



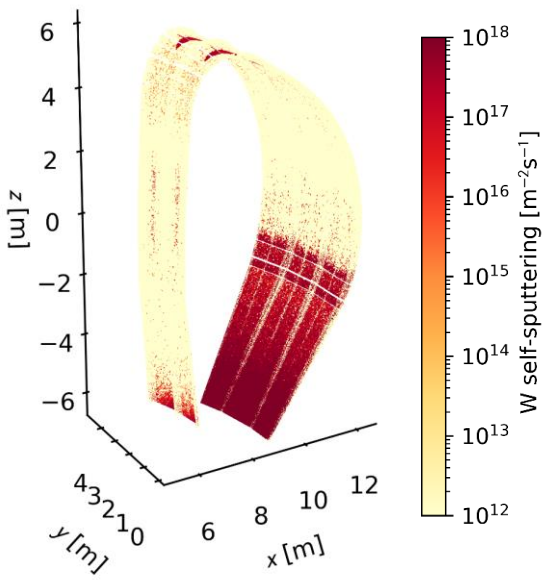
4.89×10^{15} #/s



1.18×10^{19} #/s



4.42×10^{19} #/s



Zero erosion by D^+, He^0, He^{Z+} !

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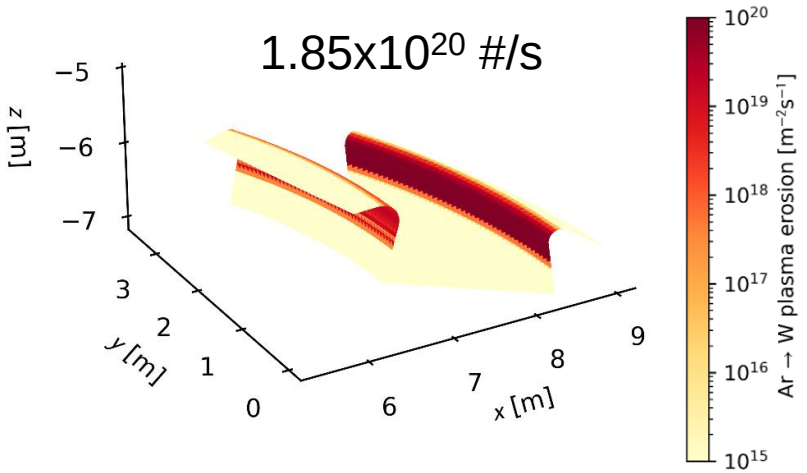
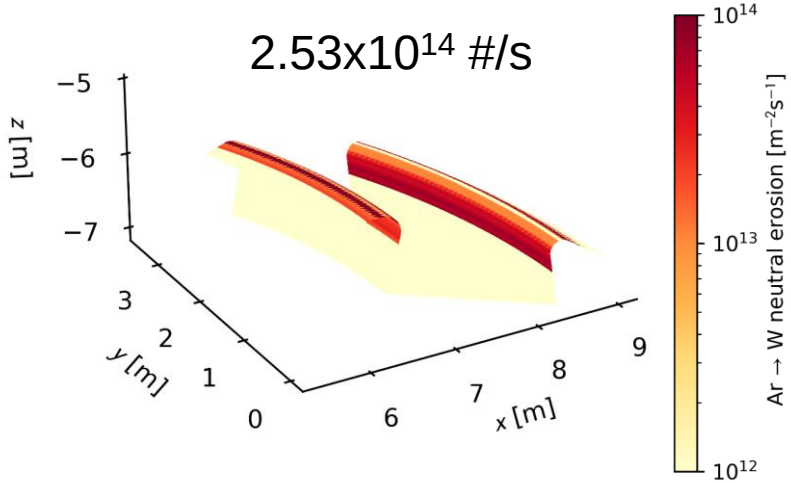
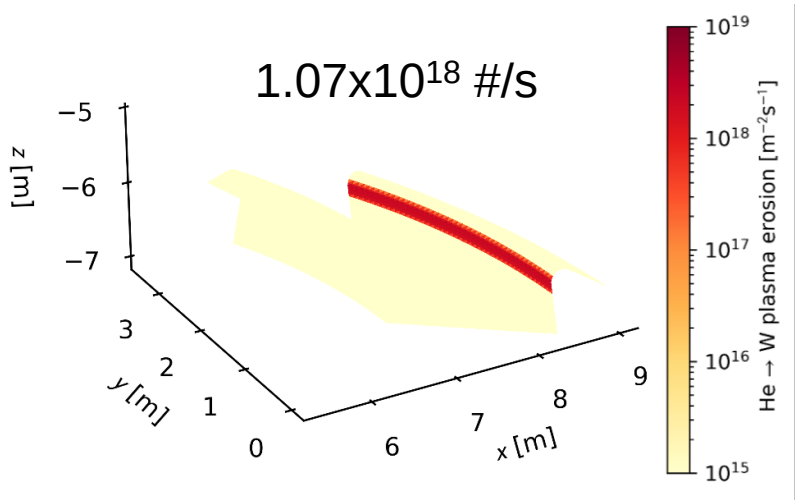
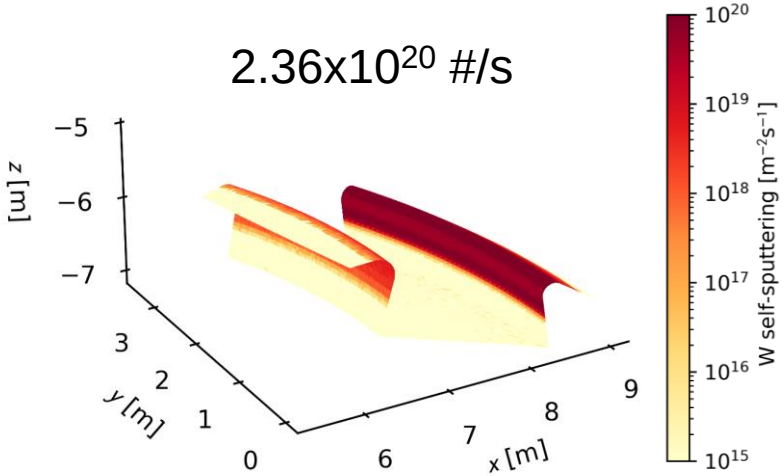
Species-resolved gross erosion

Divertor









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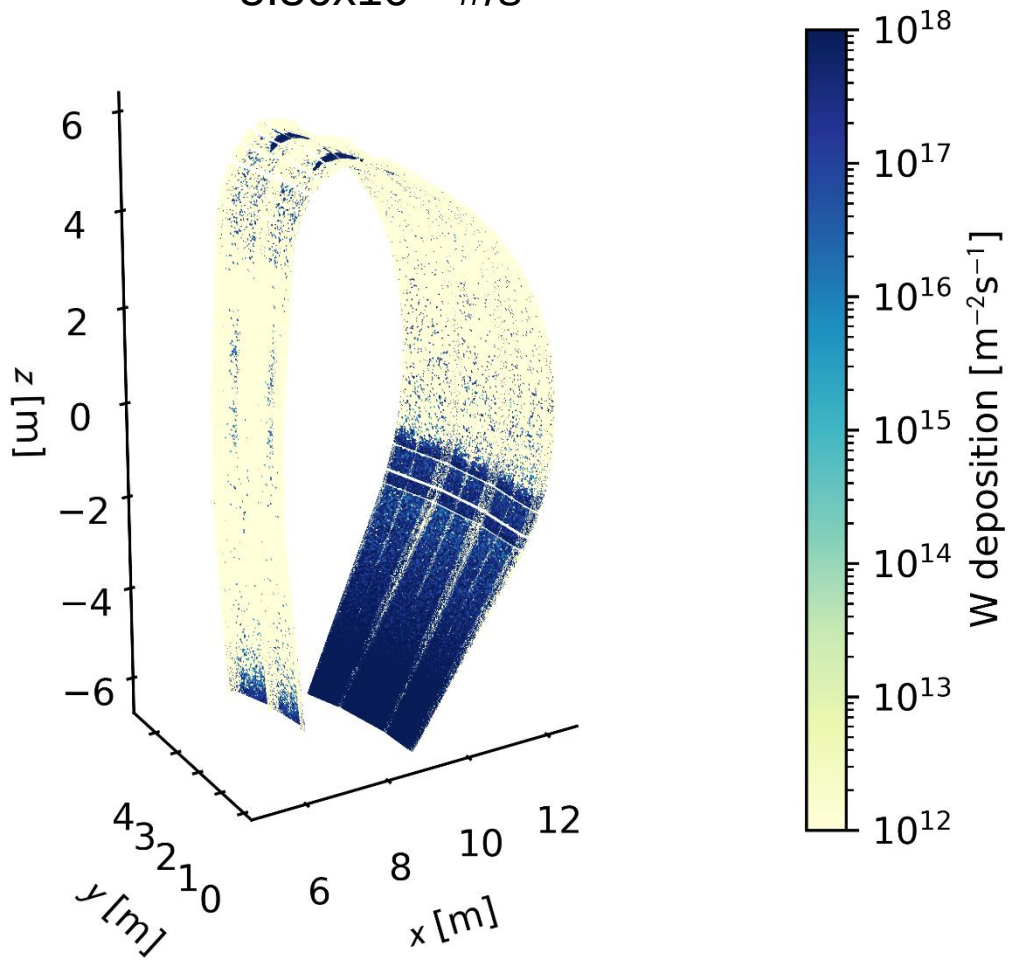
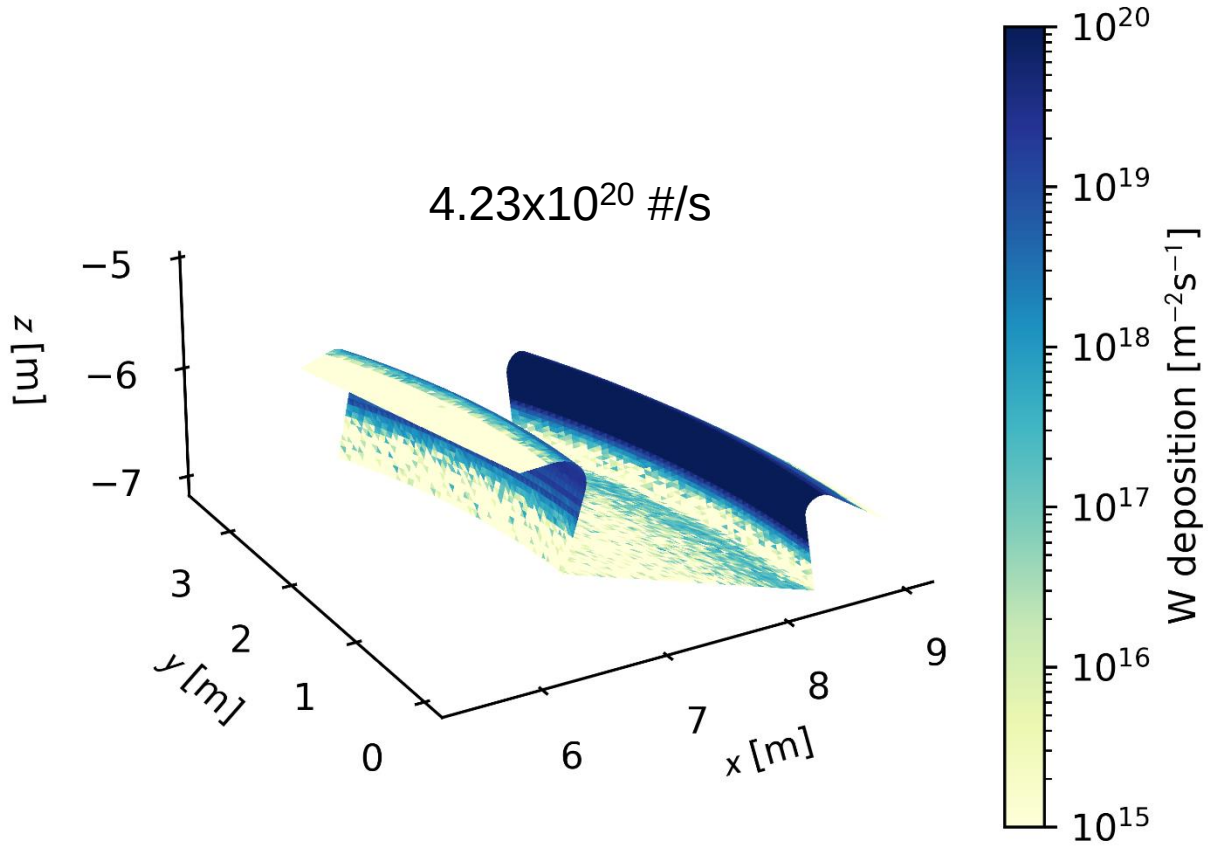
Tungsten deposition

5.36x10^{19} #/s



4.23x10^{20} #/s



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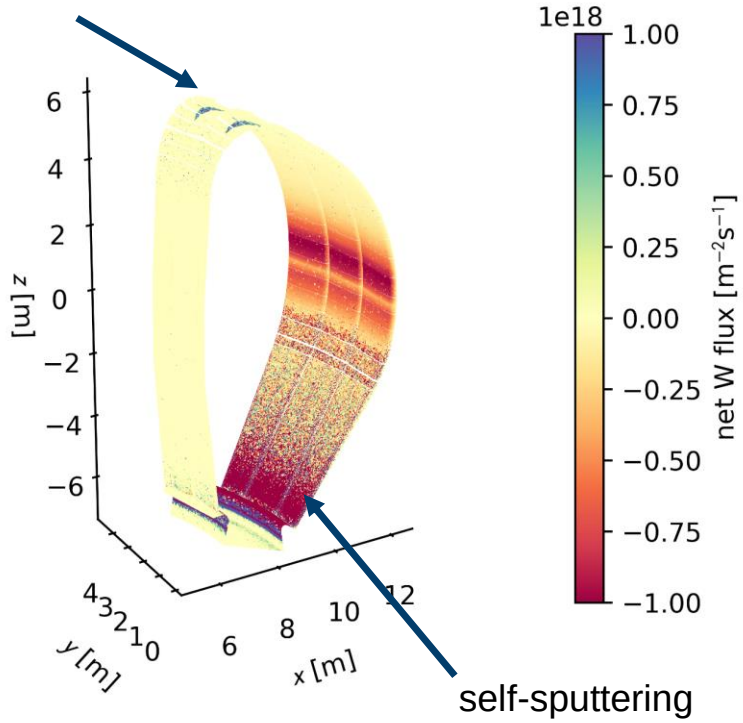
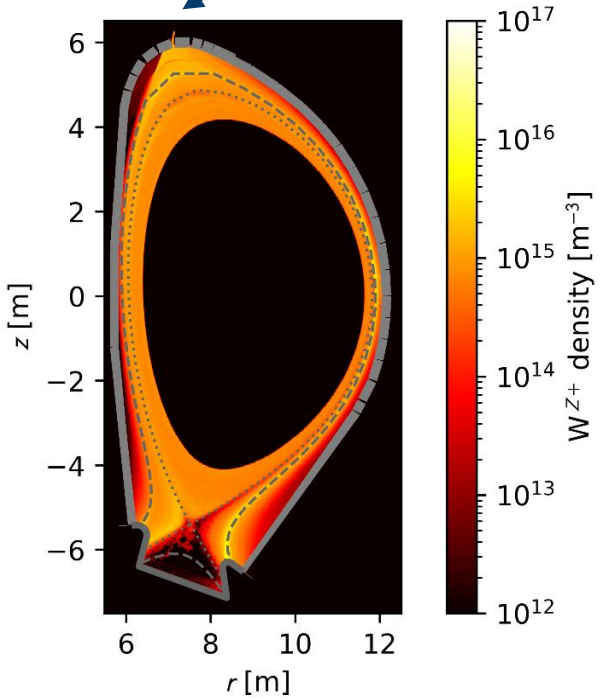
W net flux, impurity concentration

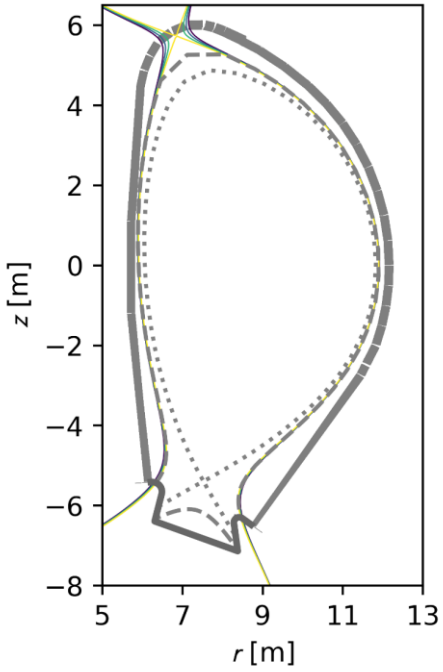
net deposition



self-sputtering

gap losses





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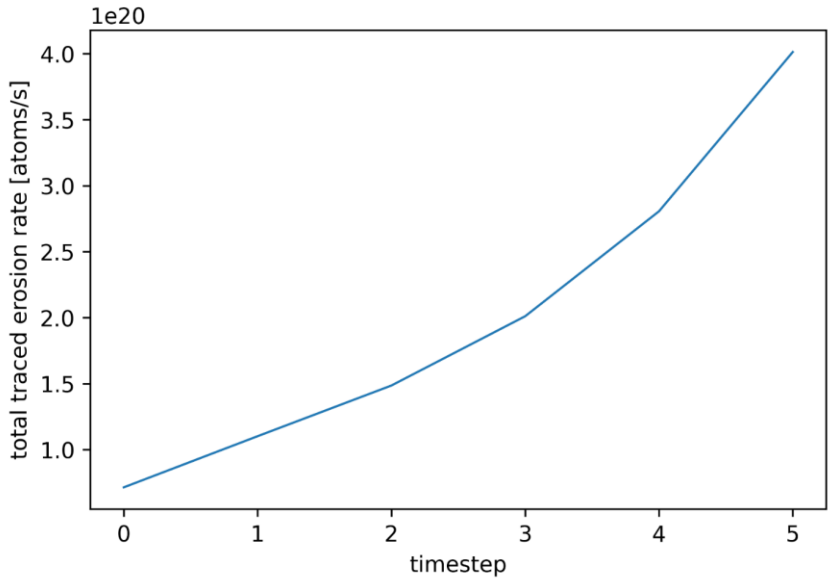
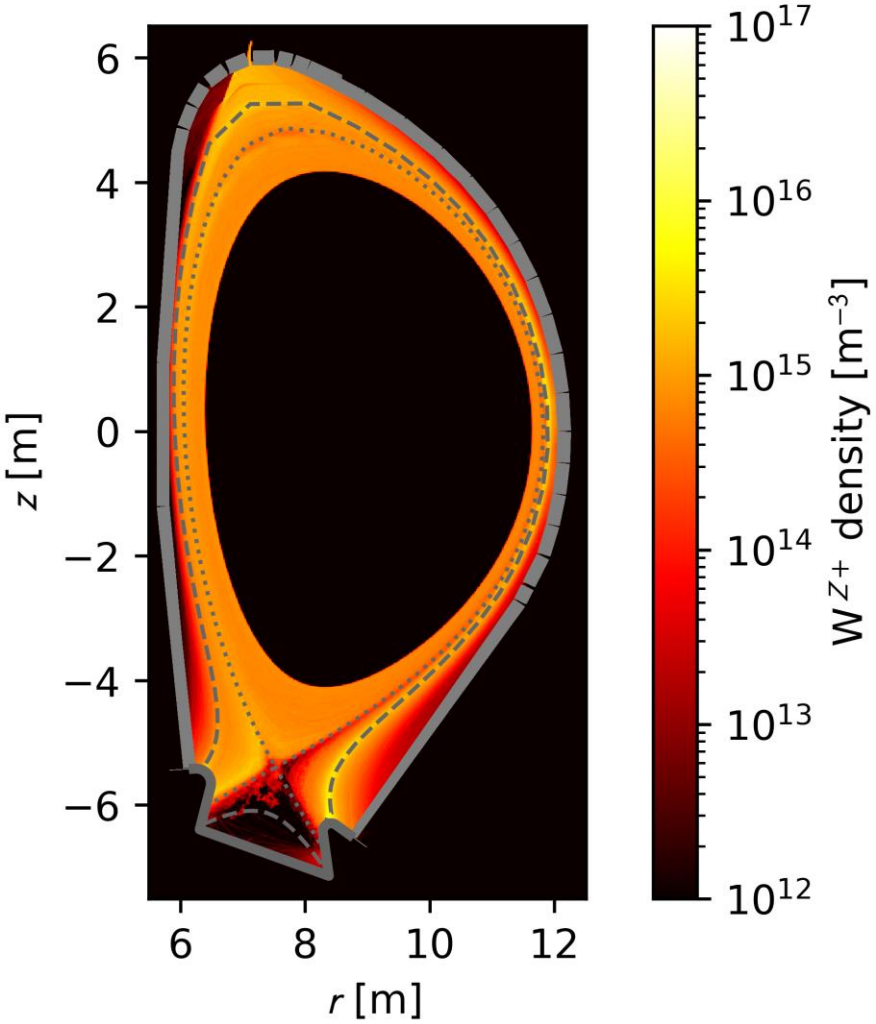
Time evolution

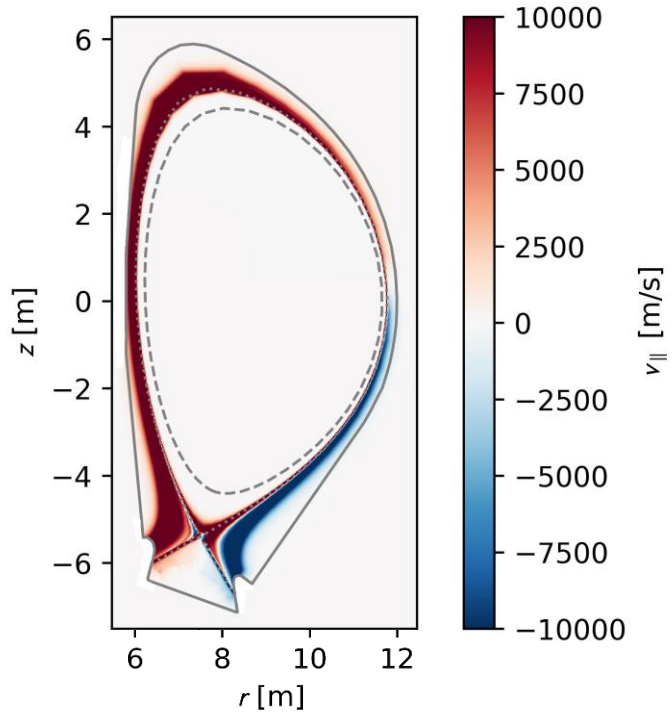


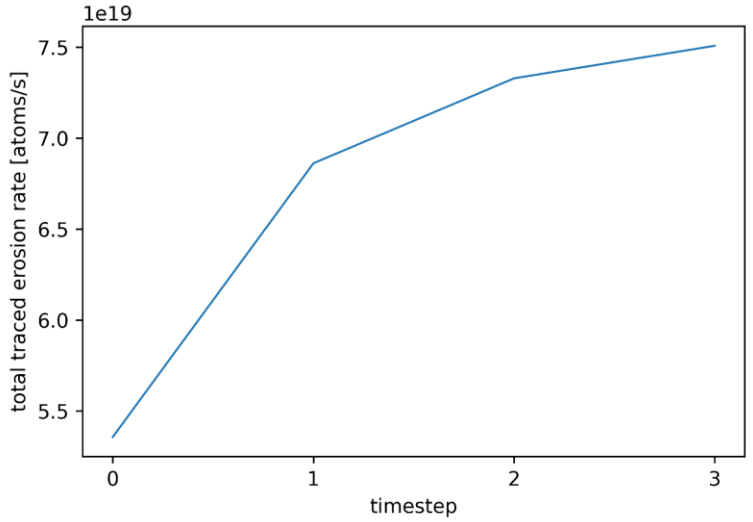


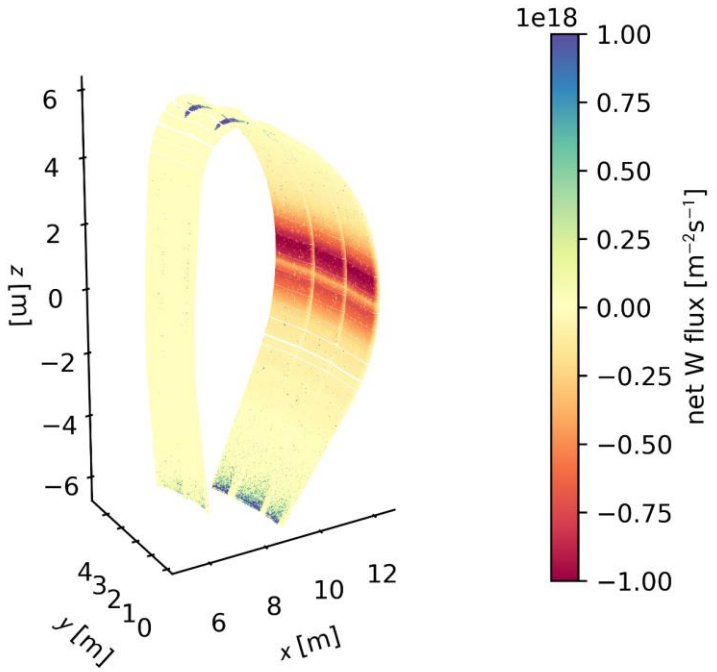
assumption of constant flow
extrapolation is not the best

Parallel flow velocity

use ion sound velocity scaling for parallel flow, i.e. ~ $\sqrt{T_e + T_i}$







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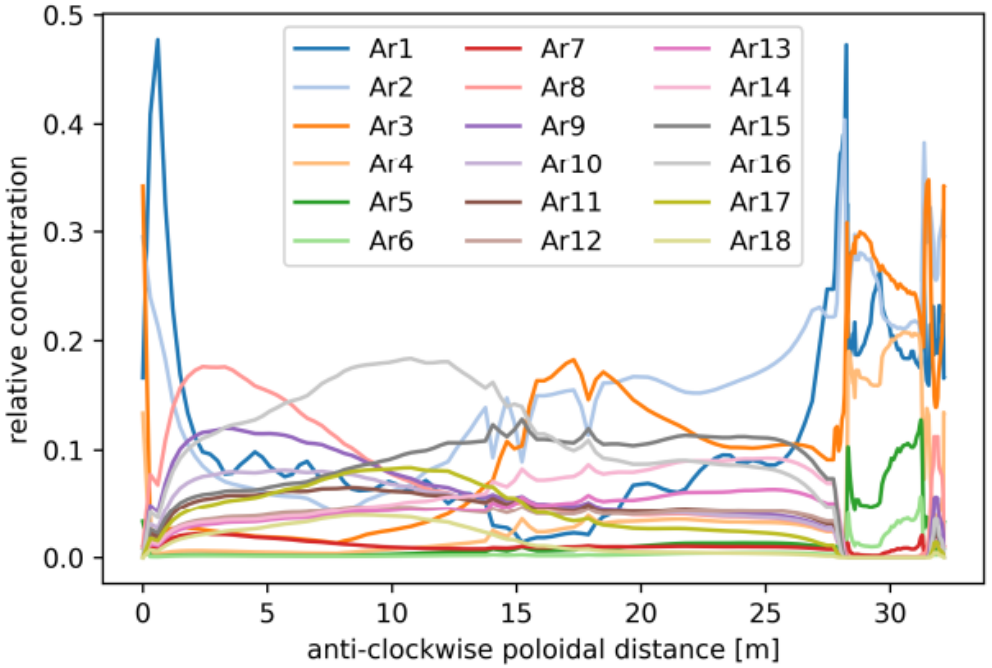
Next step

Locally charge-state resolved impurities

- Overestimation of Ar charge state in divertor

- will reduce sputtering due to lower impinging energies



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THANK YOU FOR YOUR ATTENTION!