• CEA AND AIX-MARSEILLE UNIVERSITY CONTRIBUTION TO WP PWIE SP D ACTIVITIES

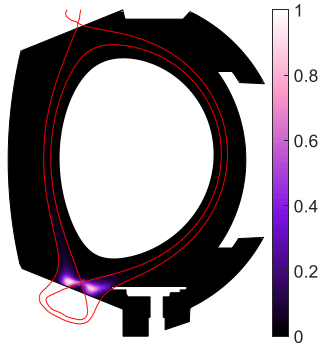
G. Ciraolo, N. Fedorczak, S. Di Genova, H. Yang ,Y. Marandet, M. Raghunathan

• SP D.1 "PLASMA BOUNDARY MODELLING": PLASMA BACKGROUND PARAMETERS OF WEST FOR MODELLING OF IMPURITY MIGRATION EXPERIMENTS (FOCUS ON D AND HE DISCHARGES)

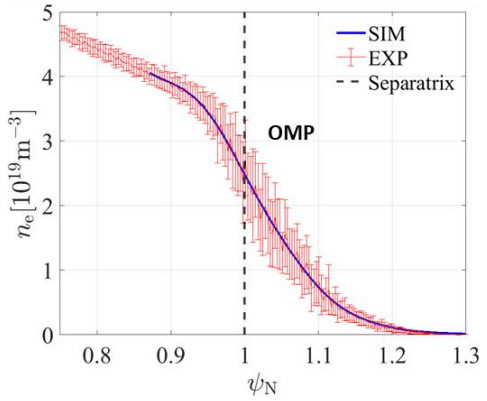
- For **Deuterium plasma discharges** : The set of 2D plasma backgrounds simulated with SOLEDGE-EIRENE has been increased with new cases compared with experimental data

Example:
WEST #56420

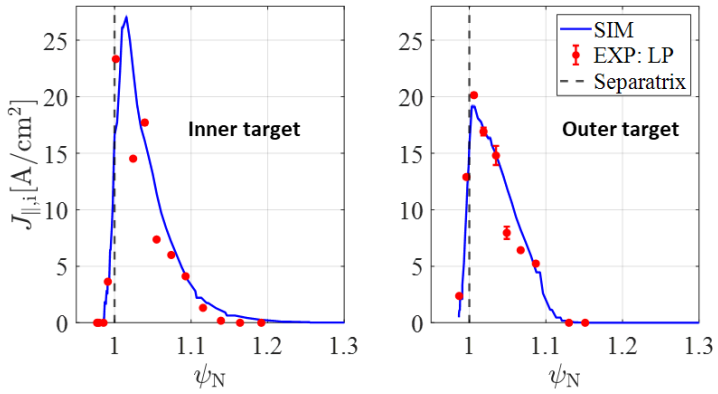
Prad [MW/m³]



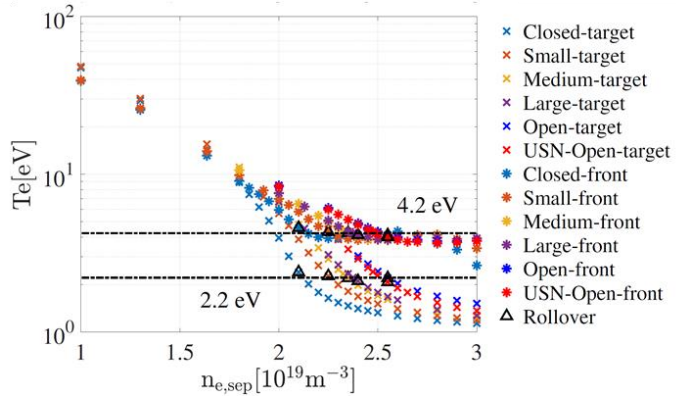
electron density profile at the outer mid-plane



Parallel ion saturation current at the inner (left) and outer (right) divertor targets



- **Extensive scans of divertor conditions** (in connection with PhD Work by **Hao Yang**)
  - At given power, scan gas fueling
  - Continuous variation of steady-state divertor conditions
  - divertor detachment well identified
  - Power scan also performed,
  - with light impurity (Oxygen)
  - With and without drifts



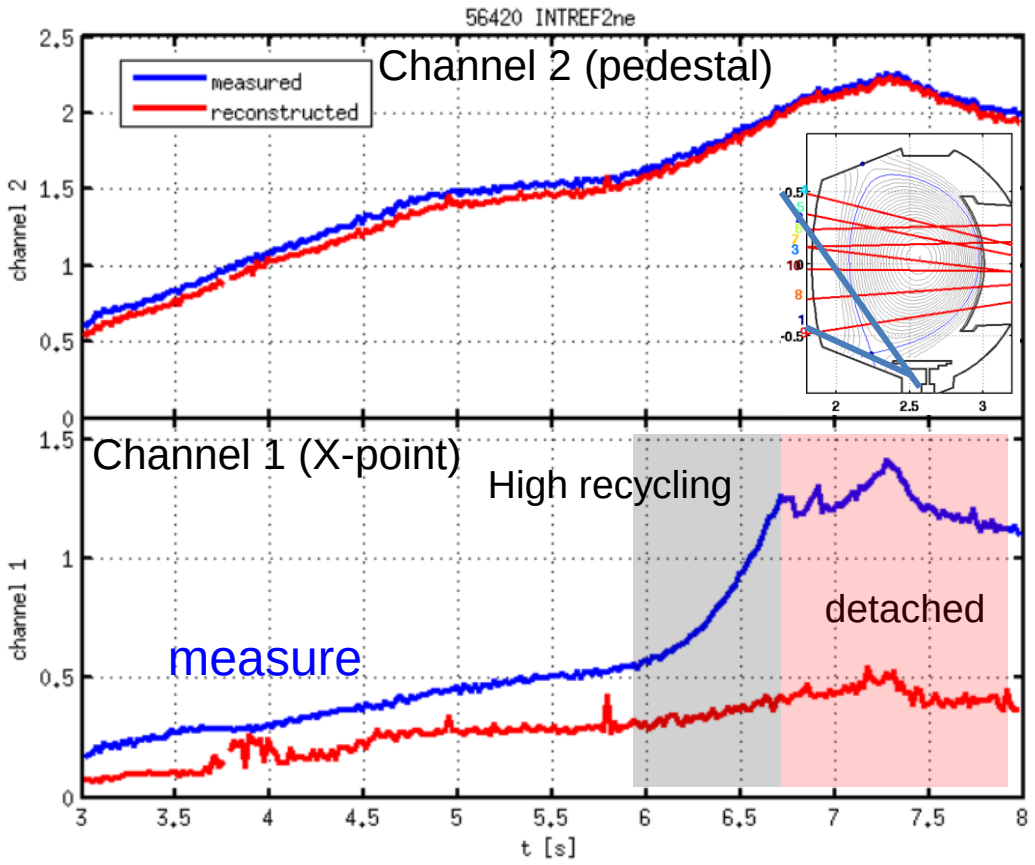
Target temperature as a function of separatrix density (and wall geometry)

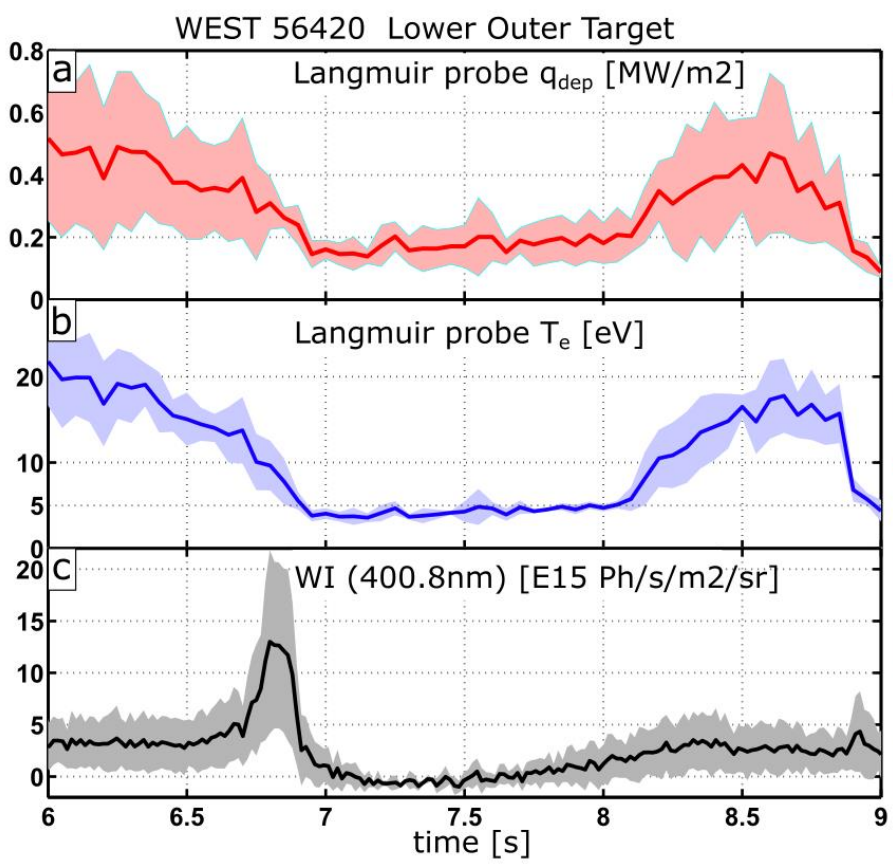
Ohmic X-point radiator in WEST and SOLEDGE plasma background

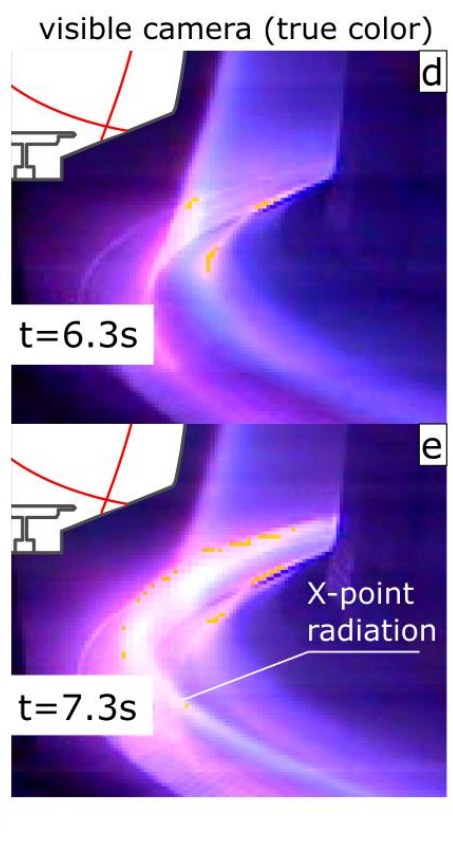
WEST #56420 (ohmic scenario)

→ X-point localised visible radiation + specific signature on horizontal bolometry ?

→ Strong X-point density cloud (interferometry)

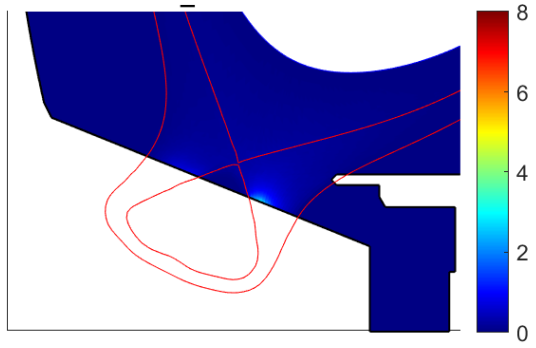




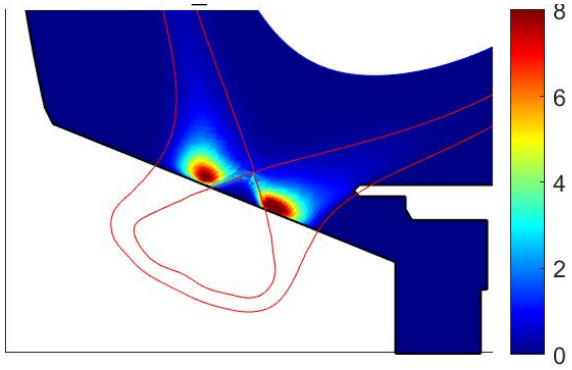


Ohmic X-point radiator in WEST and SOLEDGE plasma background

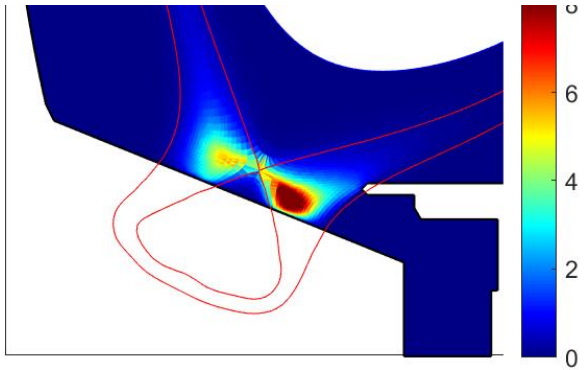
Evolution of the radiated power as a function of upstream density in soledge simulations



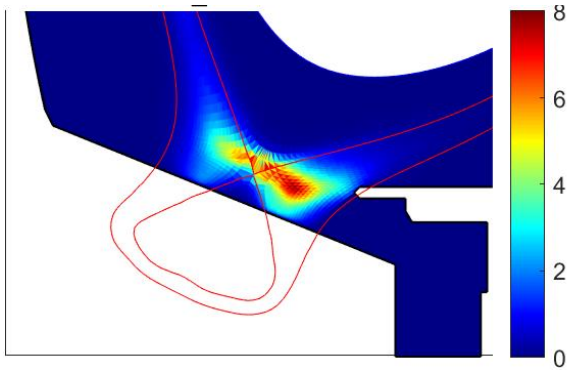
Nsep = 1 e19 part/m3



Nsep = 2 e19 part/m3

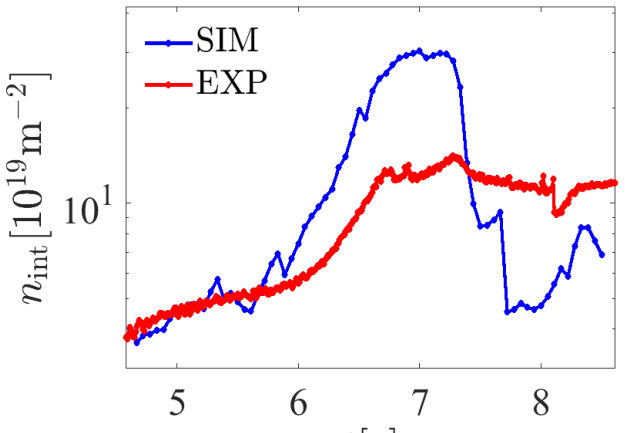


Nsep = 2.40 e19 part/m3

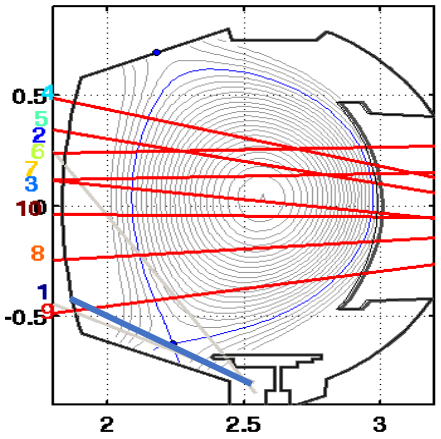


Nsep = 3 e19 part/m3

Comparing simulation and experiments using also interferometry, bolometry etc.. signals



Interferopolarimetry signal Channel 1



• SP D.1 "PLASMA BOUNDARY MODELLING": PLASMA BACKGROUND PARAMETERS OF WEST FOR MODELLING OF IMPURITY MIGRATION EXPERIMENTS (FOCUS ON D AND HE DISCHARGES)

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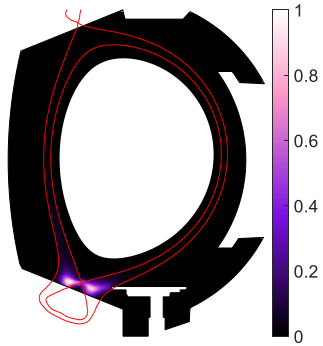

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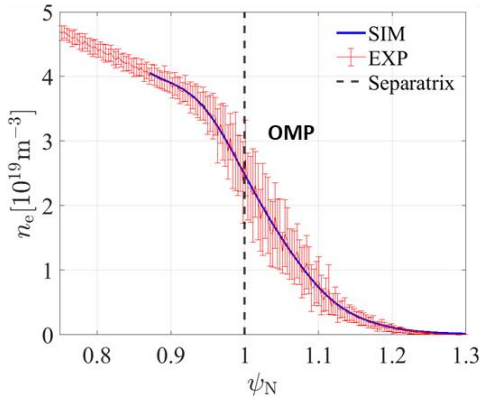

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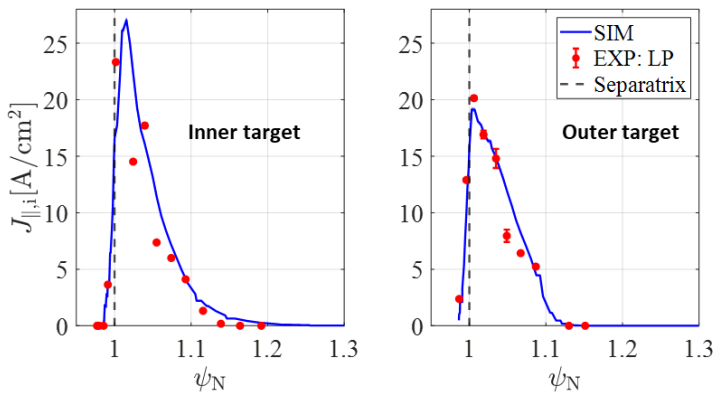
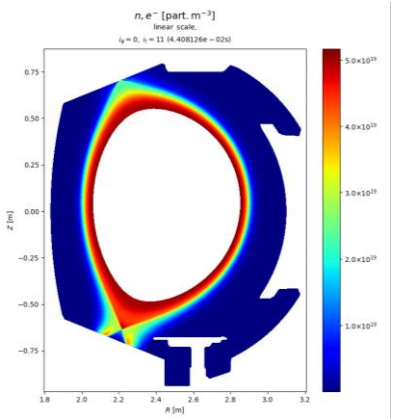
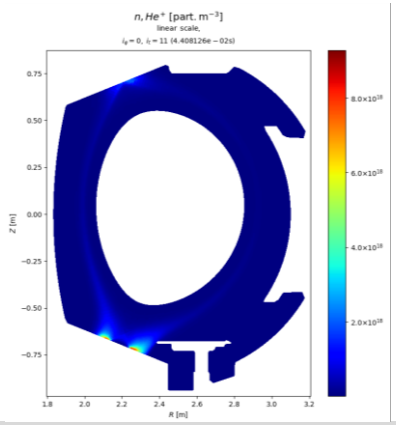


- We have also started to simulate **Helium plasma backgrounds**, see a first example below

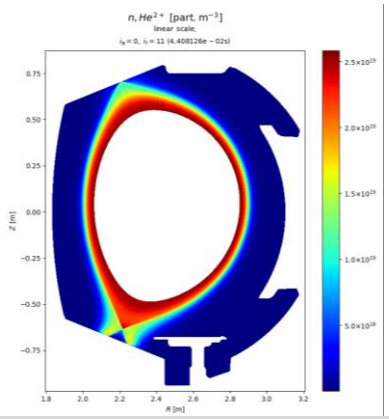
2D map of electron density



2D map of He+ density



2D map of He++ density



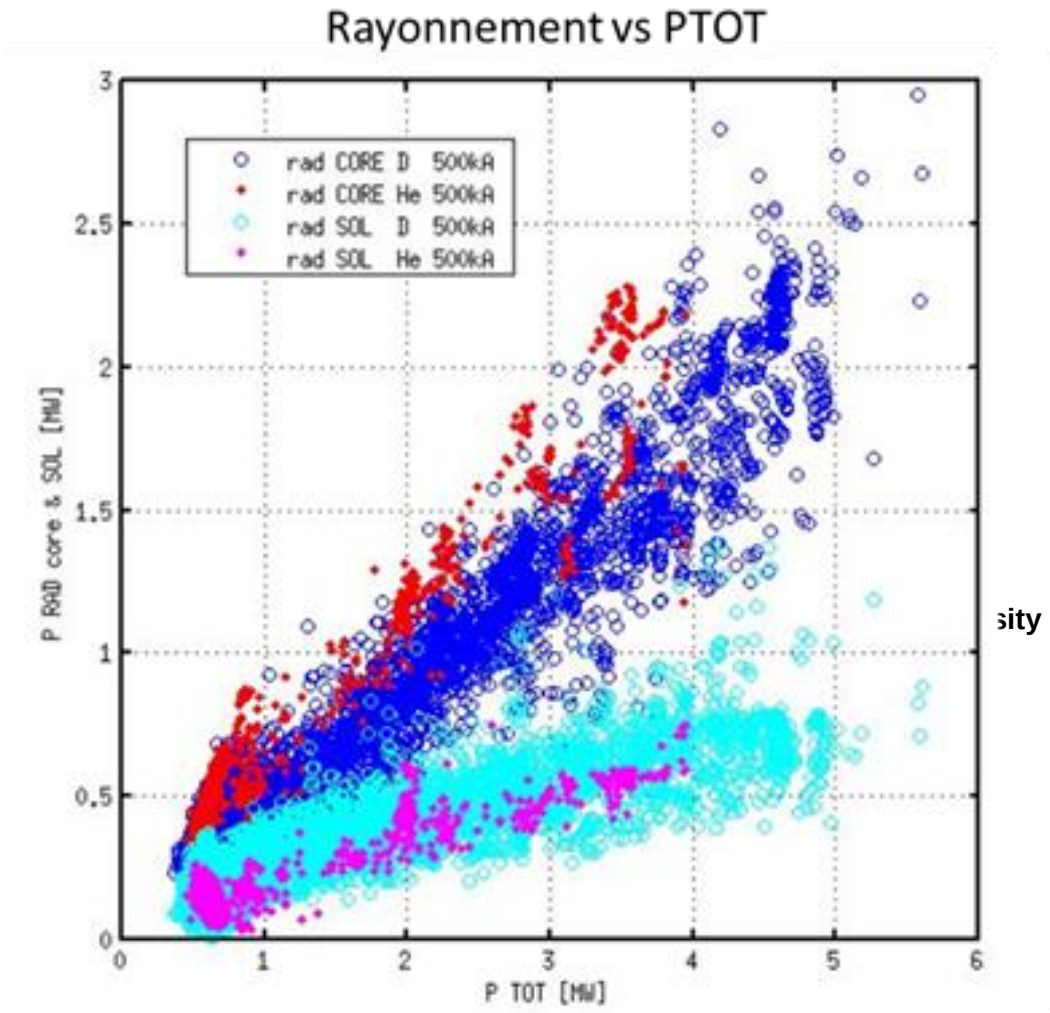
Reaction setup in EIRENE for pure He plasmas

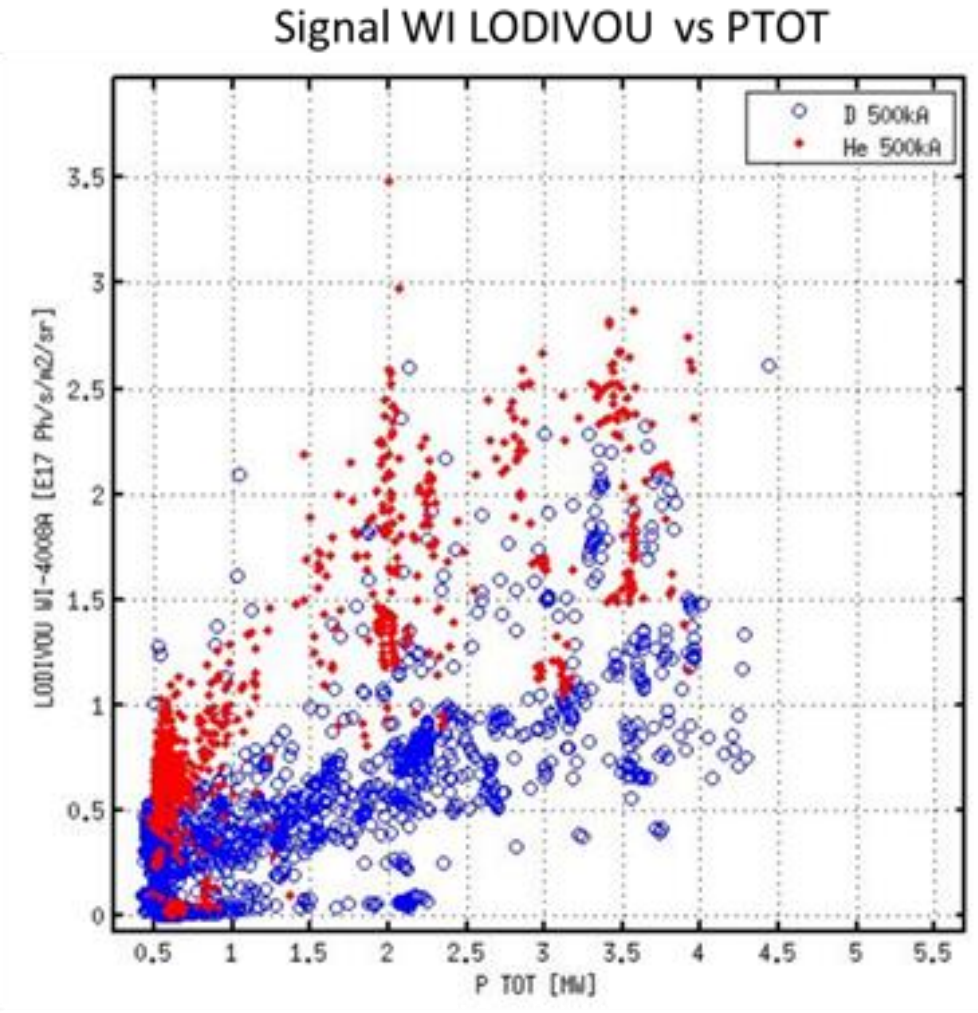
Setup:

Reaction Code	Reaction
1 AMJUEL H.4 2.3.9a	Iz: $He + e^- \rightarrow He^+ + e^-$
2 HYDHEL H.1 5.3.1	CX He^+ : $He + He^+ \rightarrow He^+ + He$
2 HYDHEL H.3 5.3.1	
3 HYDHEL H.1 6.3.1	CX He^{2+} : $He + He^{2+} \rightarrow He^{2+} + He$
3 HYDHEL H.3 6.3.1	
4 AMJUEL H.4 2.3.13a	RC: $He^+ + e^- \rightarrow He$
5 AMJUEL H.10 2.3.13a	
6 CONST H.2	Neutral-Neutral elastic collision

Large database for investigating He plasma backgrounds in WEST

LSN, 500kA





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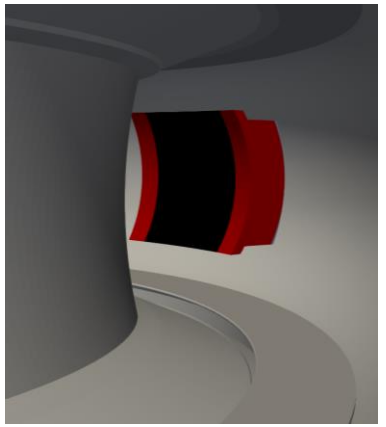
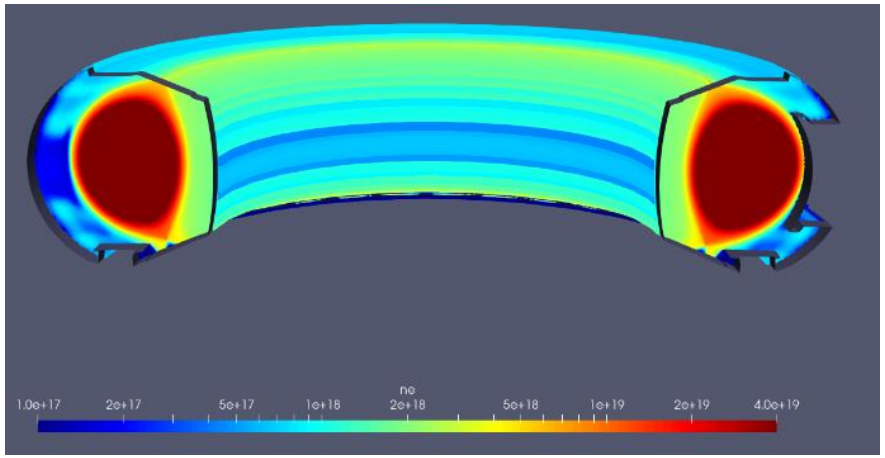
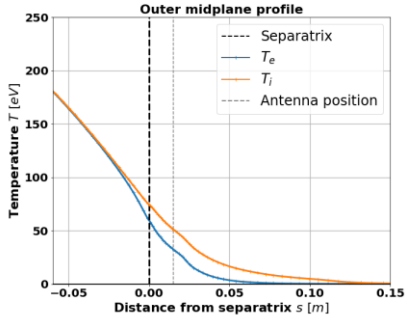
- For Deuterium plasma discharges : In order to investigate the role of toroidally localized objects, we are **performing 3D transport SOLEDGE simulations** with a **non-axysimmetric wall**

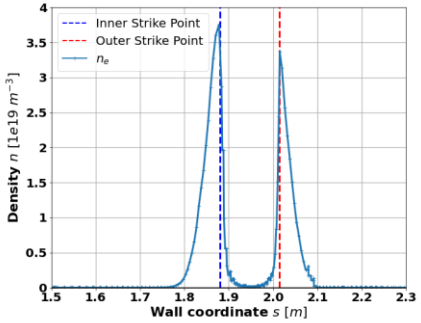


3D map of the electron density obtaind with a toroidally localized antenna limiter

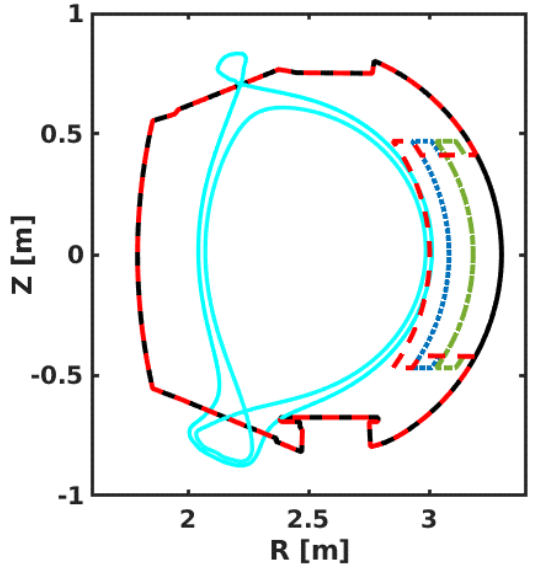


Example of outer midplane and target profiles





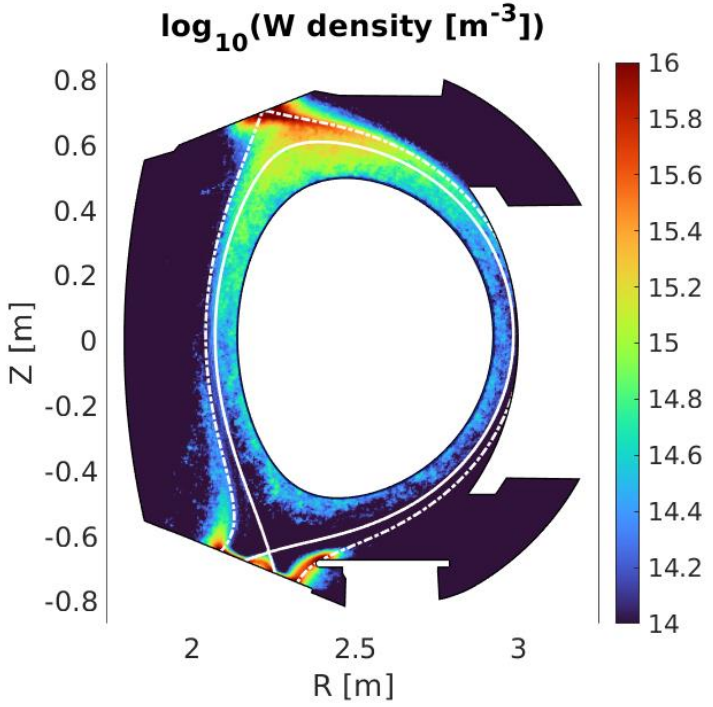
Ongoing 3D plasma background transport simulations considering several positions of the antenna limiter



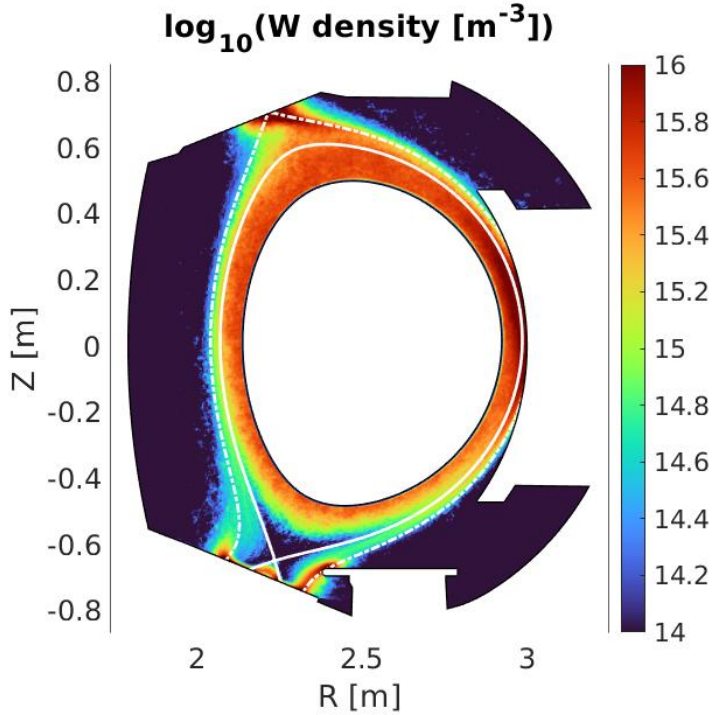
SP D.3 "Impurity Migration Modelling“: see next presentation by Stefano Di Genova

- **Modelling W erosion and migration with ERO2.0: an example on the role of Antenna limiter**

Without Antenna erosion



With Antenna erosion



Example of the set up of a simulation	
radial transport	Diffusive process with $D_{an} = 0.3\ \mathrm{m}^2/s$
Collisional forces	Kinetic friction forces F_0, Kinetic thermal forces $F_{\nabla T}$
Sheath physics	Electron density and electrostatic potential linked with Boltzmann factor: $n_e = n_0 \exp\left(-\frac{\phi}{k_B T_e}\right)$
Plasma impurities	Uniform 3% Oxygen mixture from O^{1+} to O^{8+}

- Investigation of the erosion of each « main PFC » (lower divertor, upper divertor, antenna limiter etc..) and in the contamination of core plasma
- Ongoing comparison between the results obtained from 2D and 3D plasma backgrounds