DIFFER LMD activities 2022 and plans 2023

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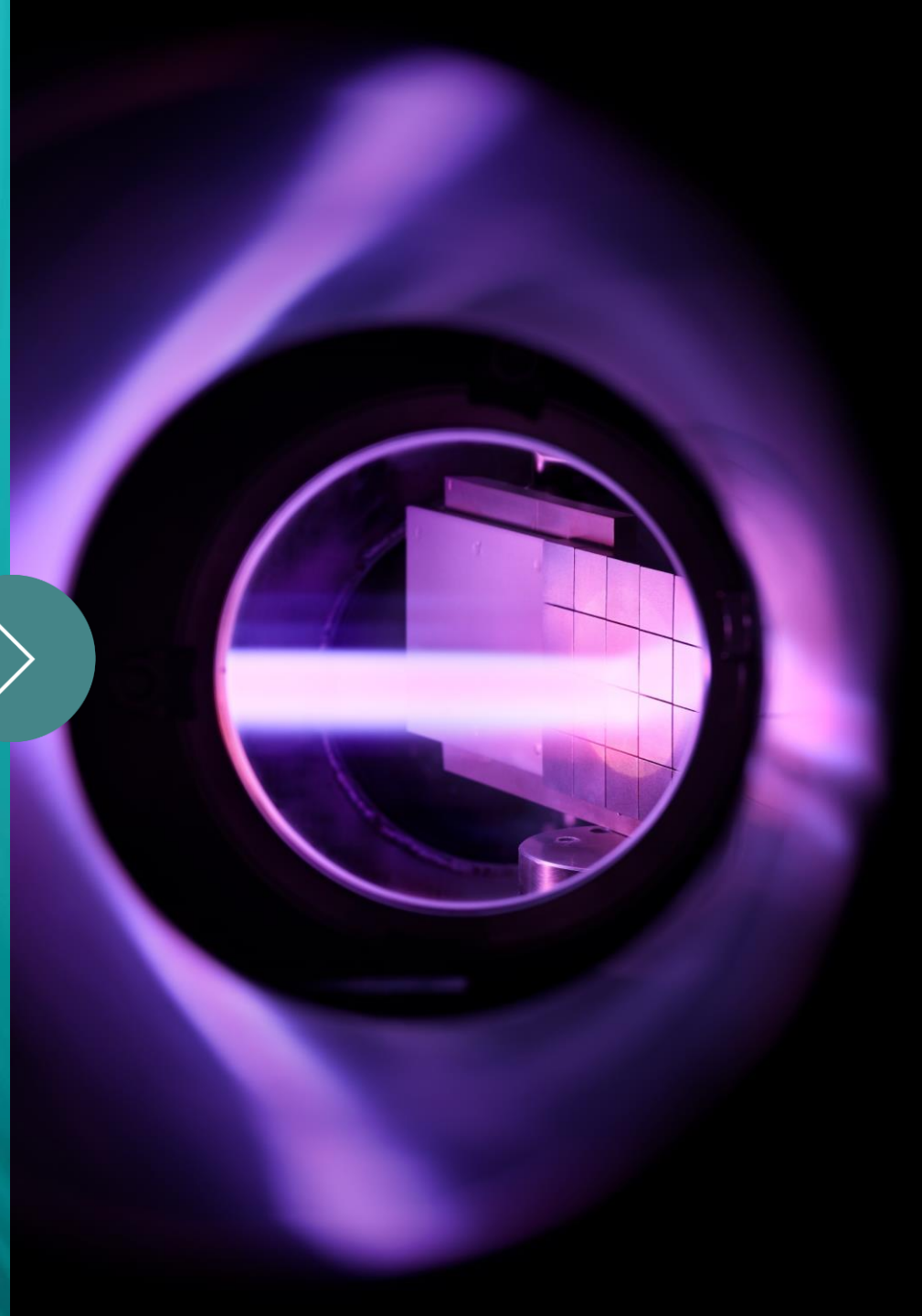
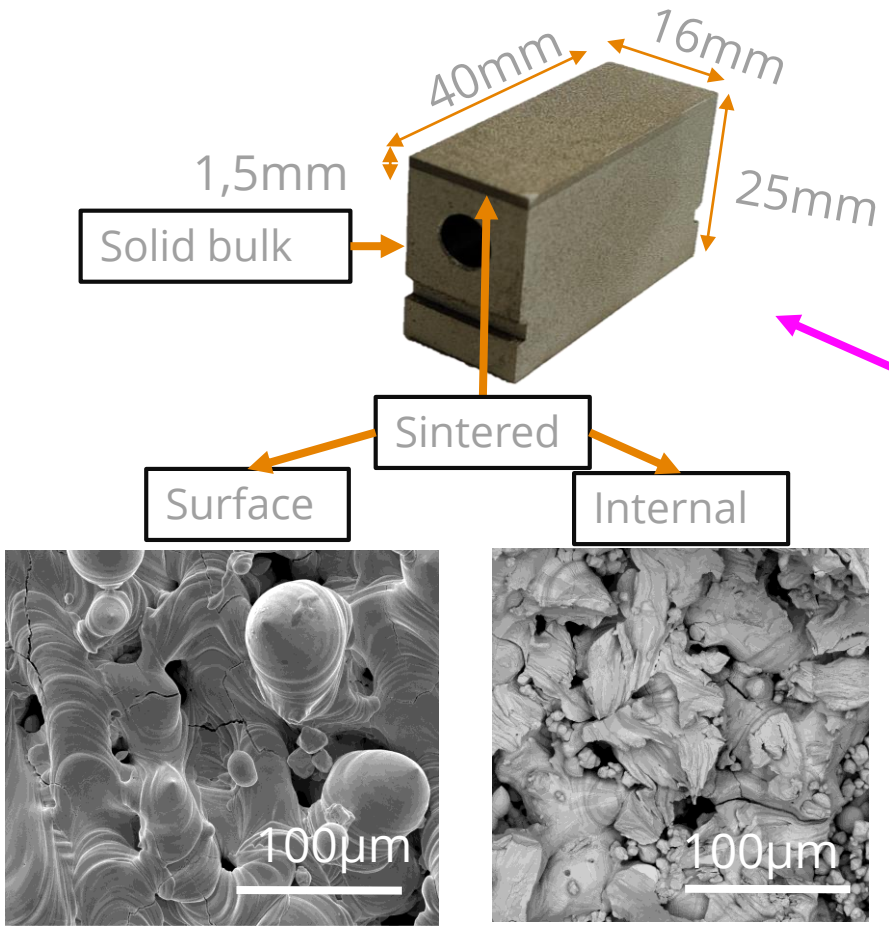
DIFFER

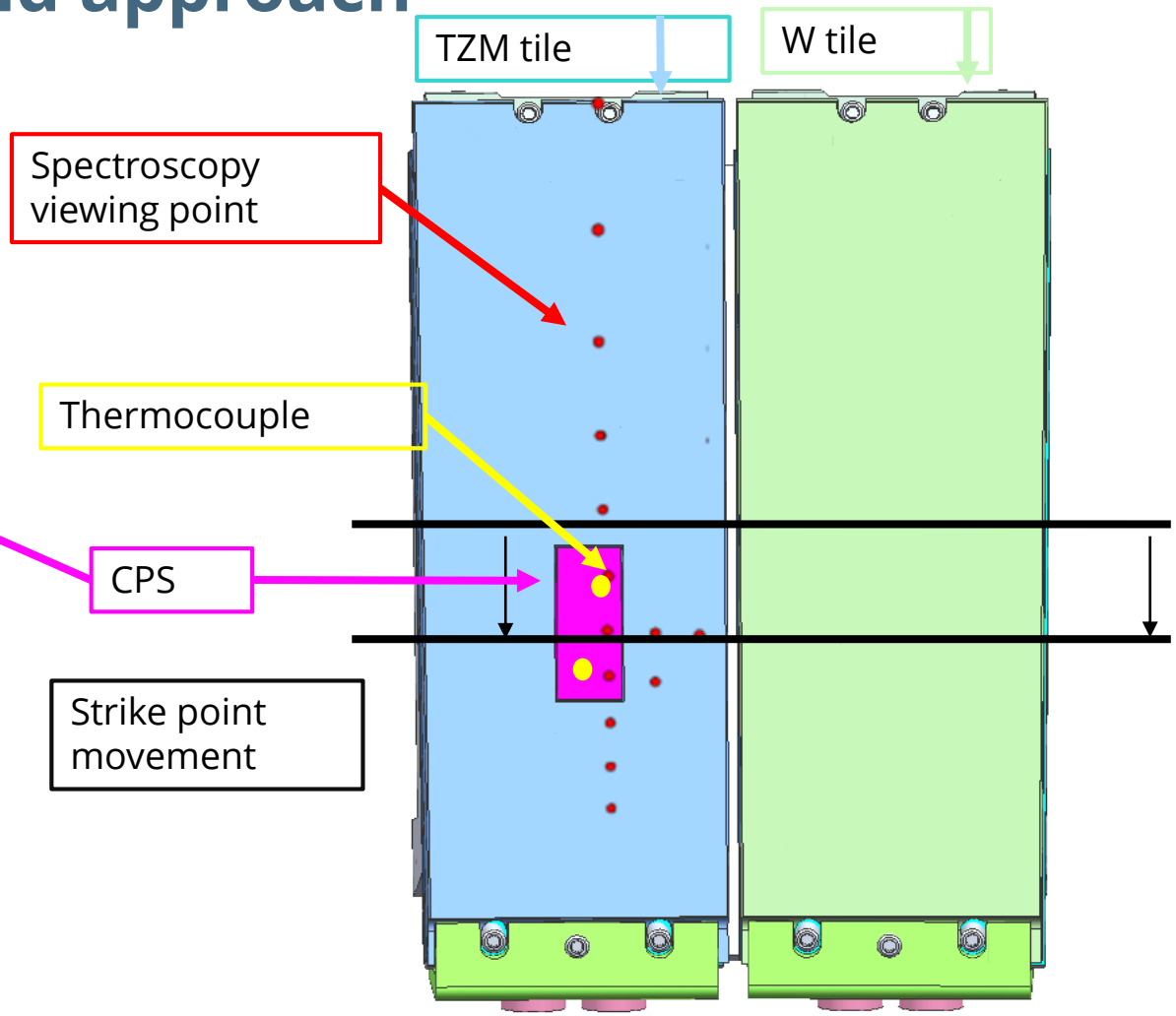
NWO



2022: Results in ASDEX Upgrade

Target manipulator, diagnostics and approach



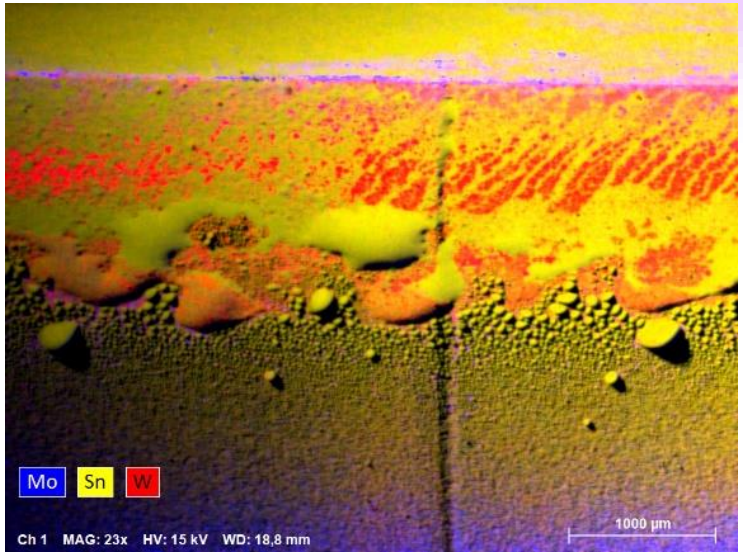


Tin leakage from the edge of the CPS after H-mode discharges

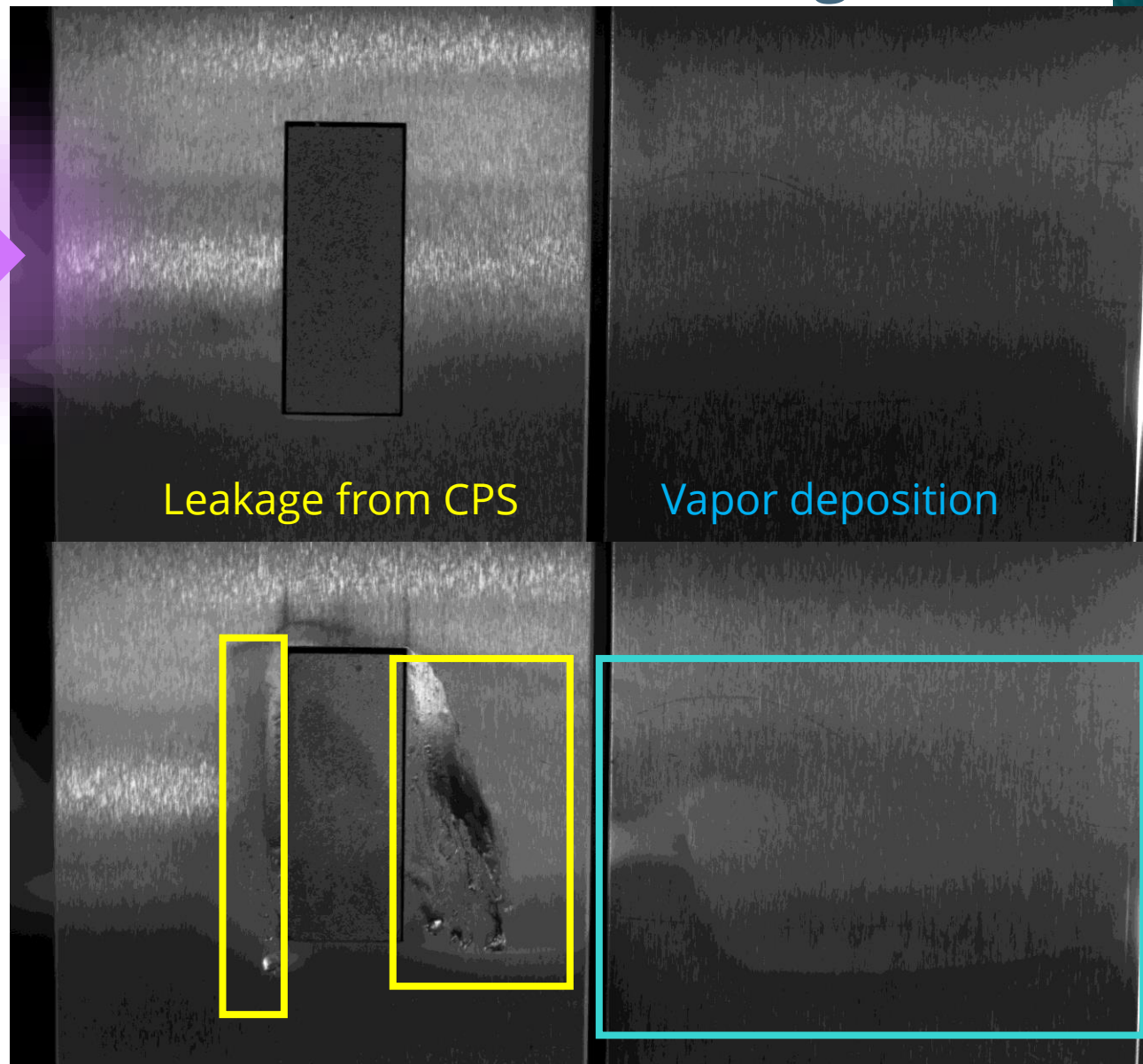
EDX image inner edge TZM tile

Plasma

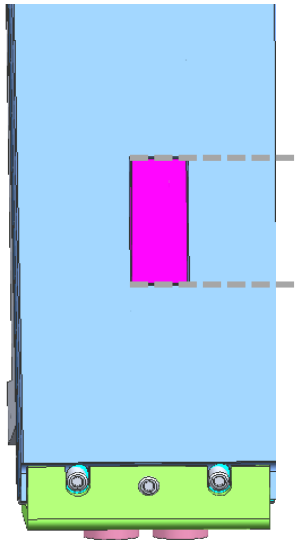
1,5 mm, CPS layer

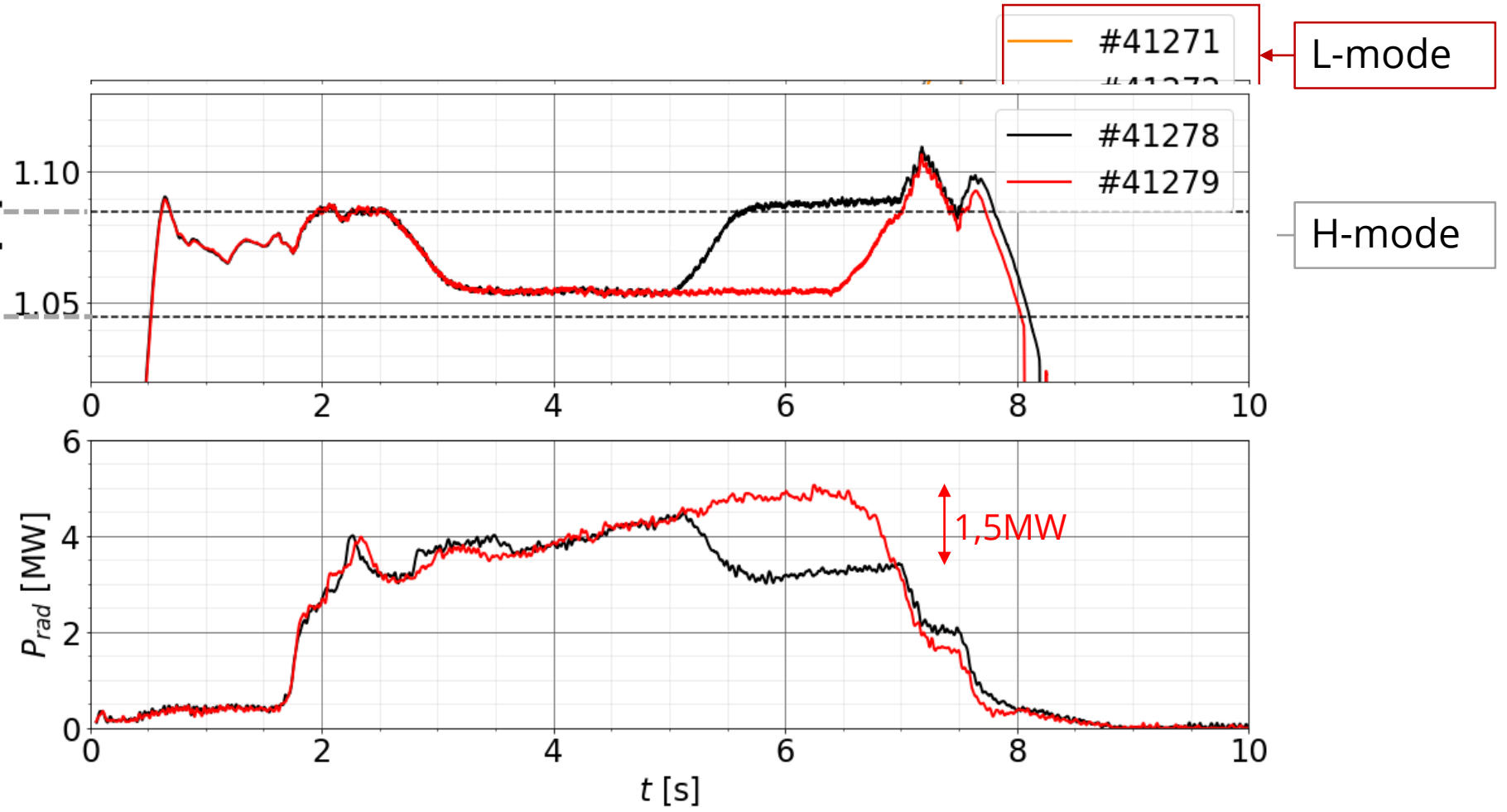


1mm



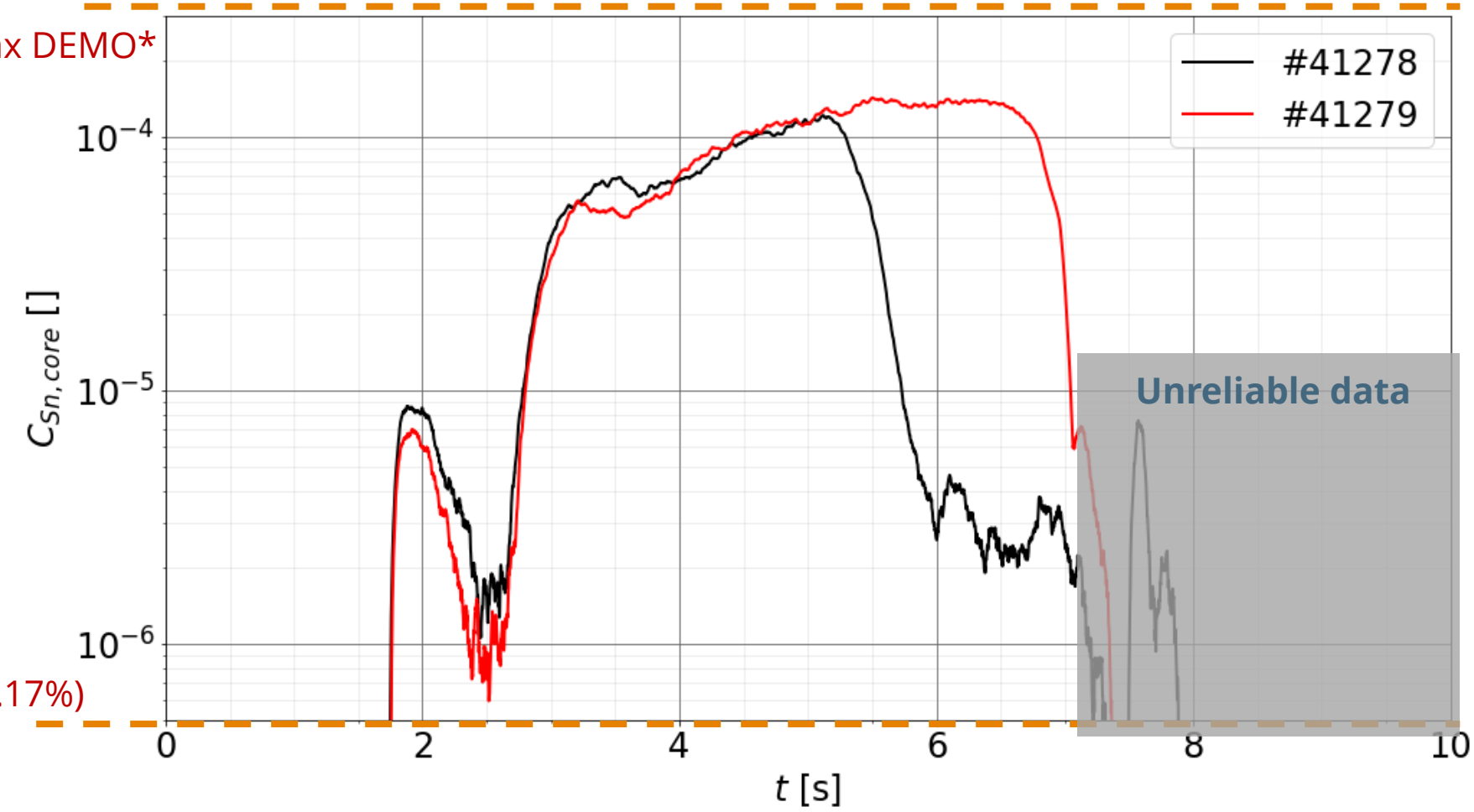
P_{rad} directly proportional with strike point position





Sn core contamination beyond an acceptable level

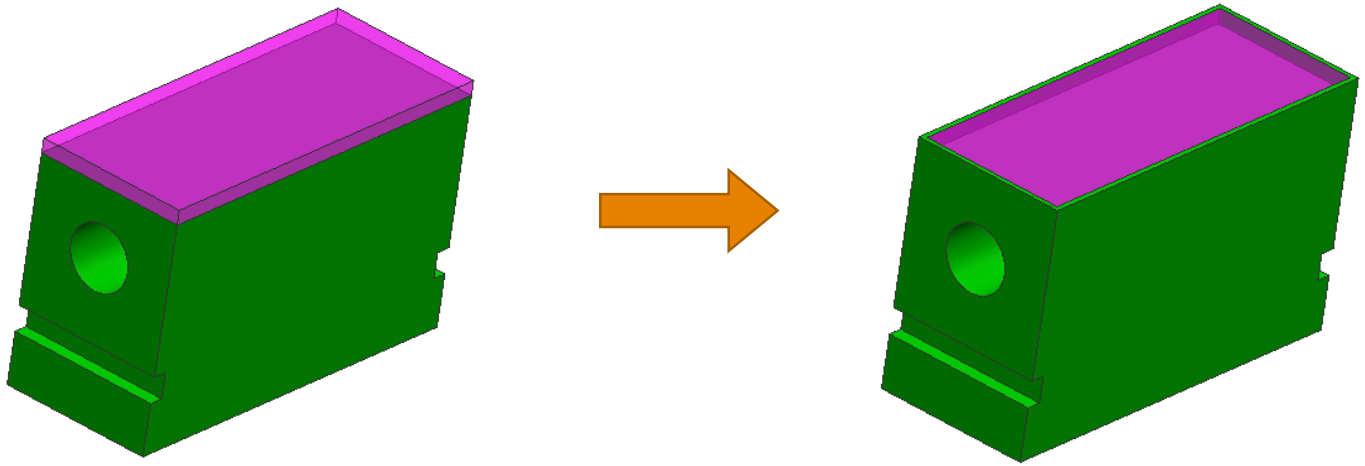
T. Pütterich et al 2019 Nucl. Fusion 59 056013 0D model assuming τ=7,5



2022: Replication study in Magnum-PSI

Goal of the experiment

1. What is the reason for the extensive leakage ?
   - Can we prevent them?

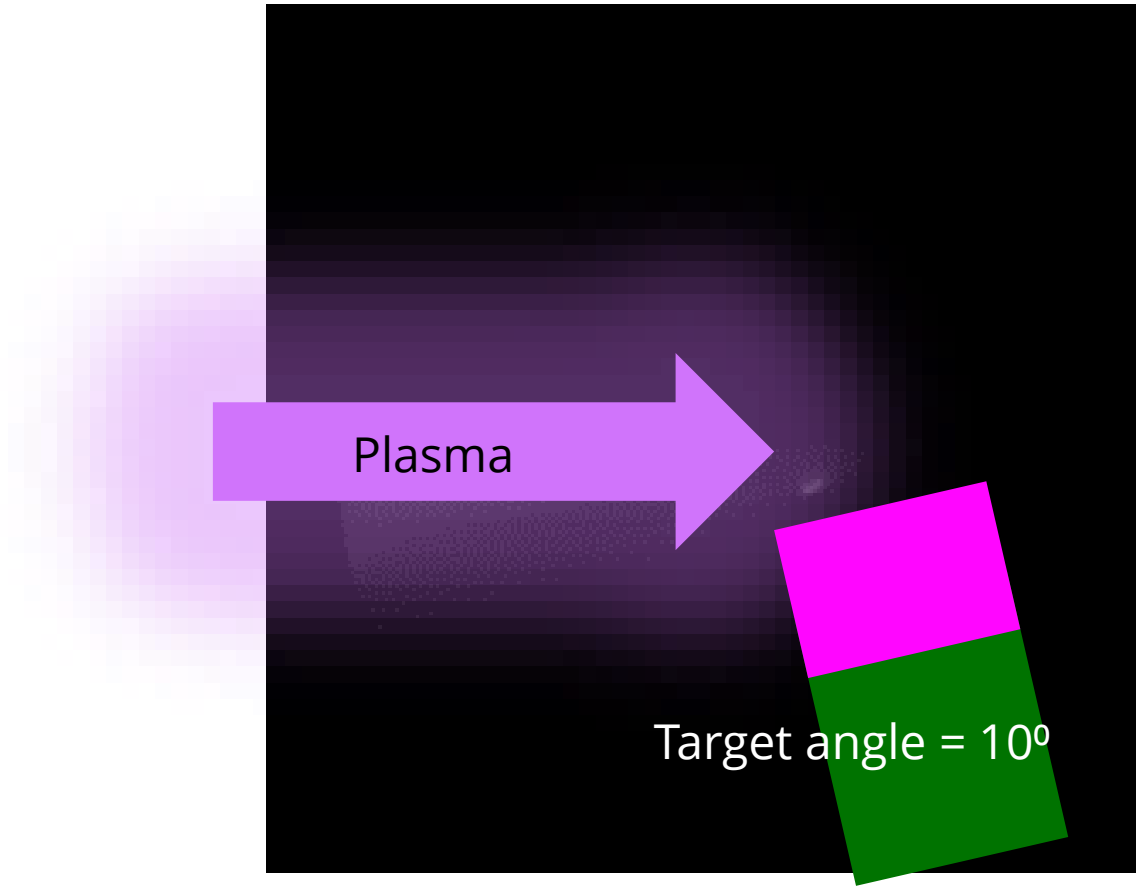


CPS with open edges

CPS with closed edges

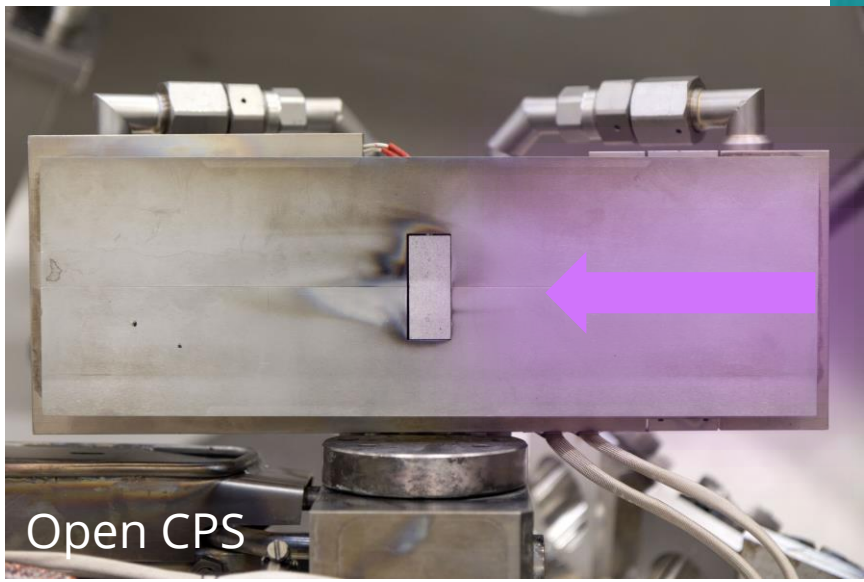
2. Do we indeed have droplets?

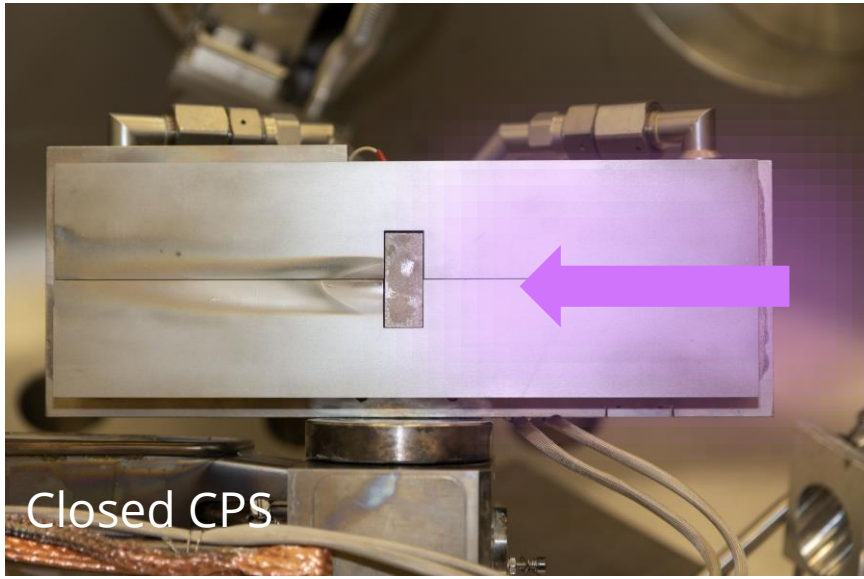
Droplets are observed on the fast image camera



Post-mortem picture TZM tile open CPS

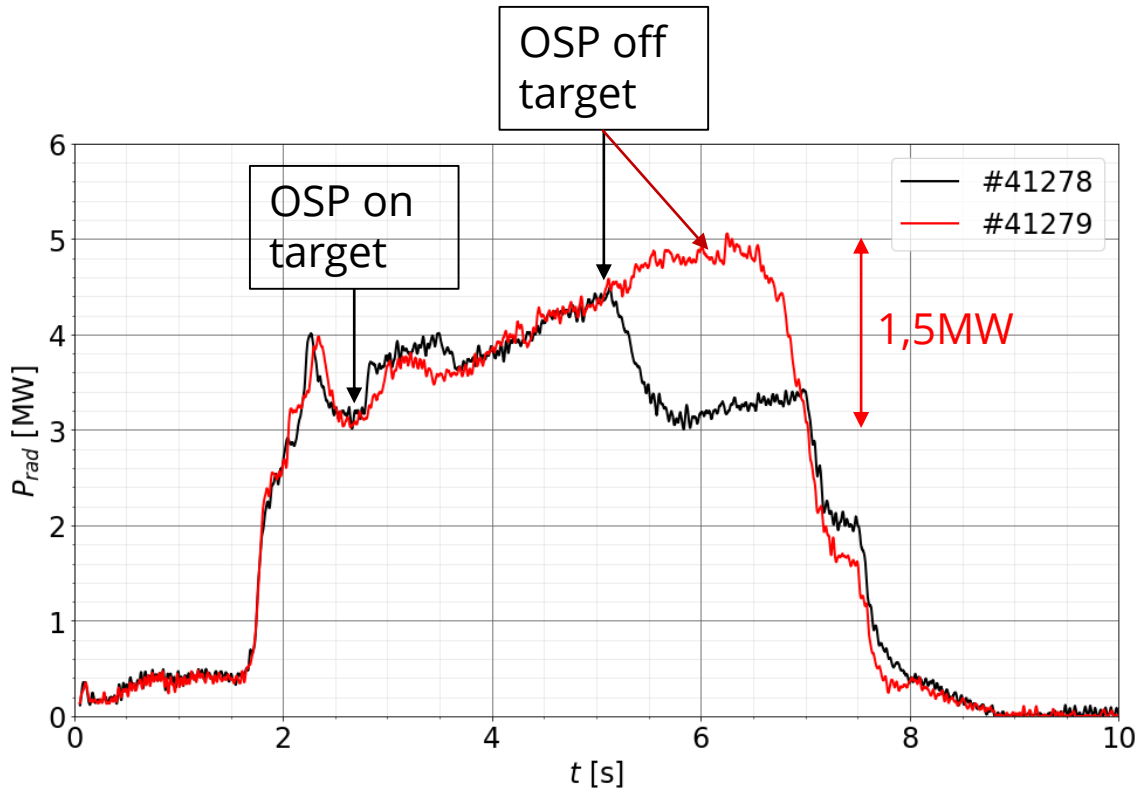
- Quite some Sn on the TZM tile
- Mainly vapor
- Nothing upstream
- No big drops
- No difference open and closed CPS



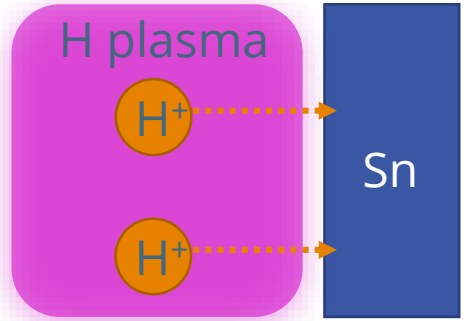


Plans 2023

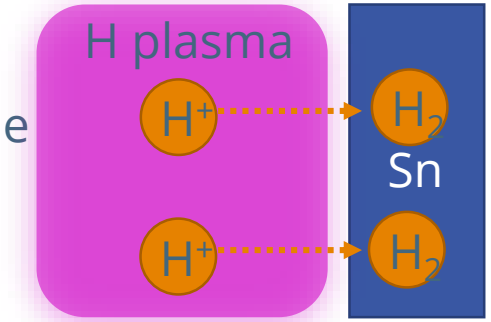
Sn droplet ejection contaminating the main plasma



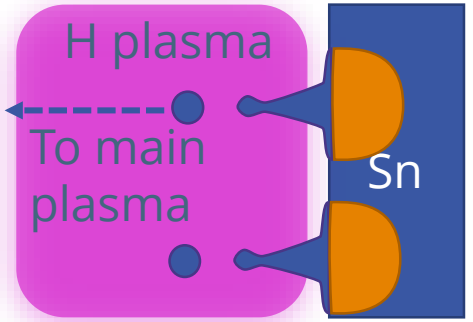
H dissolves in Sn



H2 gas bubble formation



Gas bubble collapse



Potential solutions

1. Not entirely clear whether droplet formation happens because Sn not confined properly in mesh, or if droplets occur anyway.

   Use small pore sizes to suppress bubble growth

   Deliberately underfill to avoid free surface by thermal expansion

2. Previous tests with steel meshes were able to suppress droplet production: W not yet proven so W-Sn wetting issue?

   Try different material than W (e.g. Mo)

3. Is this a fundamental property of Sn (not seen with Li)?

   Try Sn-Li to see if Li will allow higher solubility of H and suppress droplets

Approach

Screening testing using Magnum-PSI (high flux H plasma)

Pre-treatment by low flux plasma to remove oxides and improve wetting on W

- ENEA felt (showed promising performance)
- Sintered surface 3D design
- Commercially sintered W
- 3D printed Mo sample
- Sn-Li sample

Surround targets with witness plates → RBS → determine Sn on plates

Fast image camera with Sn filter → see droplets

Optical emission spectroscopy → observe Sn emission evolution