W7-X in 2022

M. Mayer

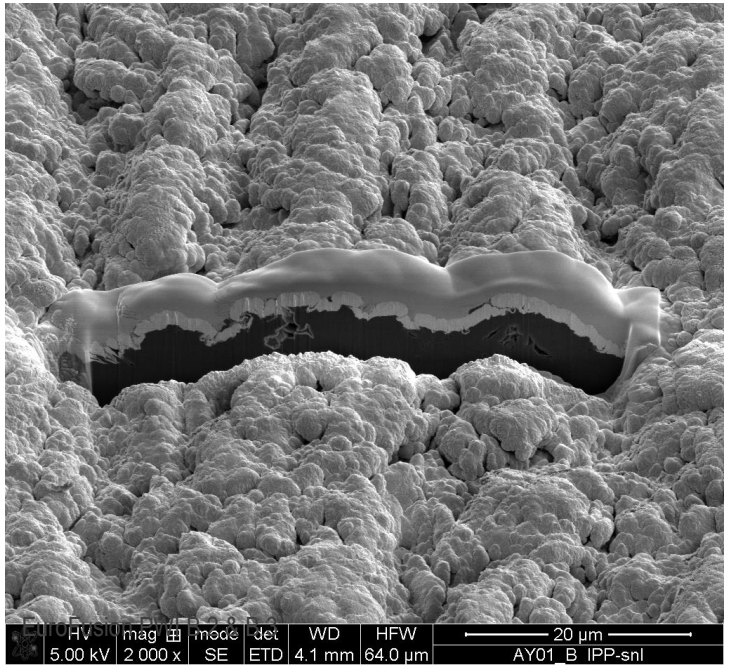
Max-Planck-Institut für Plasmaphysik, Garching, Germany

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

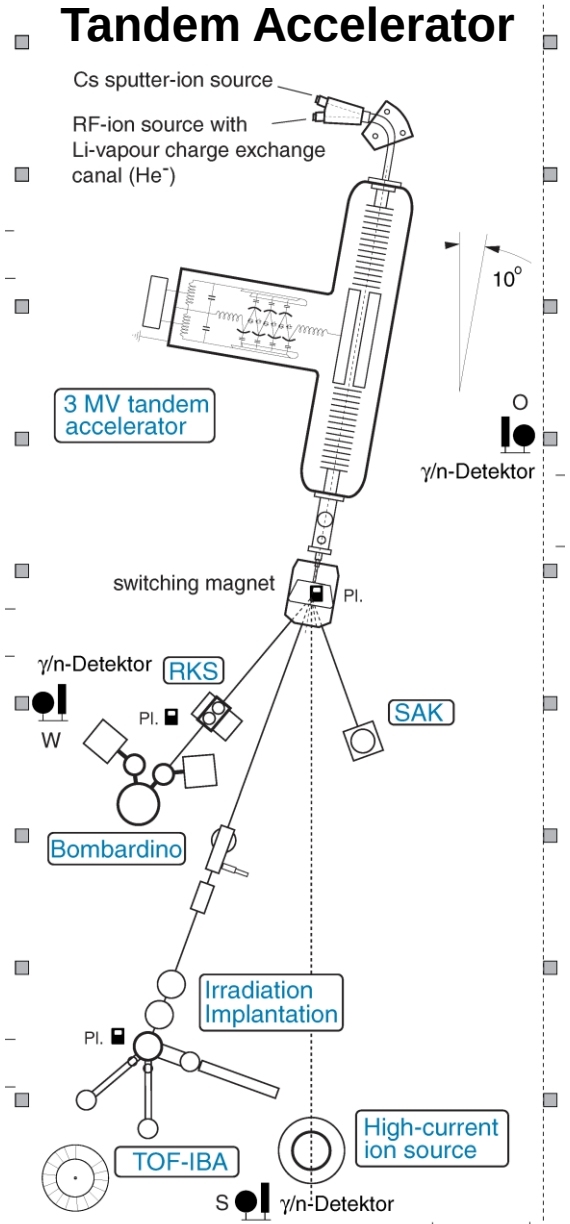
Analytical possibilities at IPP Garching

- **3 MV Tandem accelerator**
  - Small samples (12 x 60 mm²): RBS, NRA, ERDA, PIXE
  - Large samples (up to 300 x 200 mm²): RBS, NRA
- **2 electron microscopes with FIB**
  - Large samples, sample weight up to 5 kg
- **TDS possibilities**
- **Various surface profilers**
  1-dimensional, 2-dimensional
- **Thin film deposition for marker layers**
  - Evaporation
  - 2 sputter deposition devices
  - a-C:D layers by plasma deposition

SEM/FIB



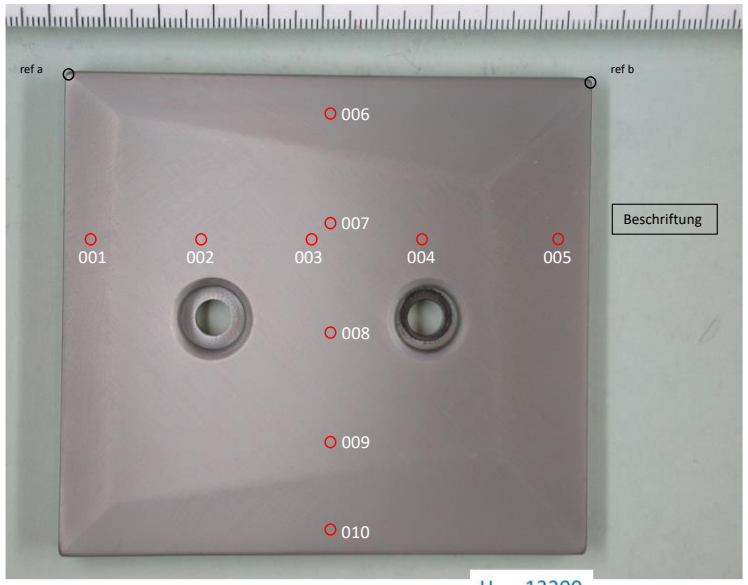
Tandem Accelerator



Samples inside W7-X in OP2.1 and 2.2

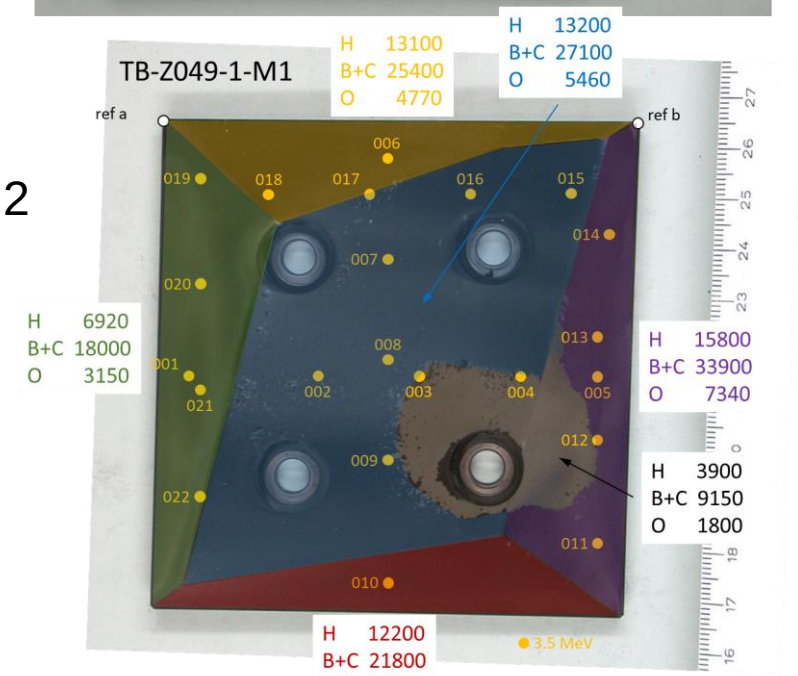
Erosion of W at inner heat shield

- 18 inner heat shield tiles coated with W / 600 nm Mo / 100 nm W marker
- W marker layer thicknesses pre-characterized with RBS
- **Goals**
  - **Erosion of W at inner heat shield**
  - **Deposition of B, C**



Deposition of B and C on baffle and inner wall

- Analysis of regular C baffle and inner wall tiles after OP2.1 and/or OP2.2
- Analysis with RBS (NRA if necessary, SEM/FIB if necessary)
- **Goals**
  - **Deposition of H, B, C**



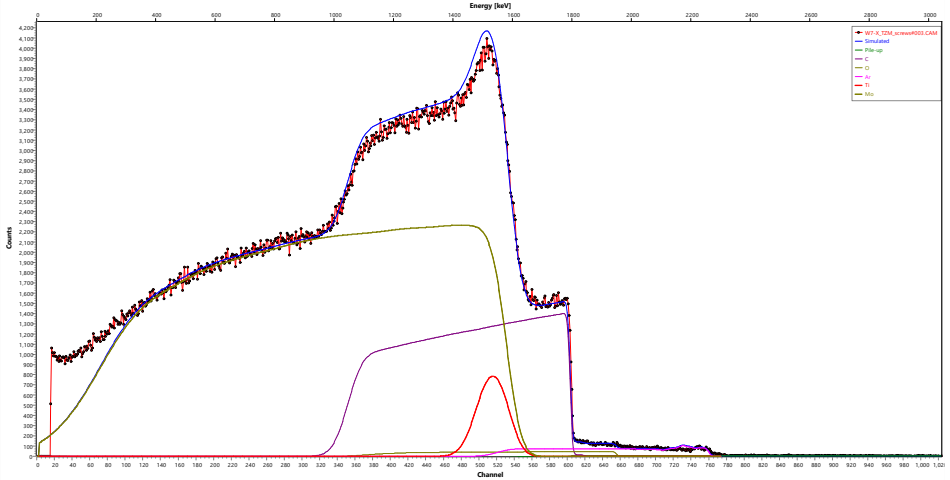
Samples inside W7-X in OP2.1 and 2.2 (2)

W heavy alloys

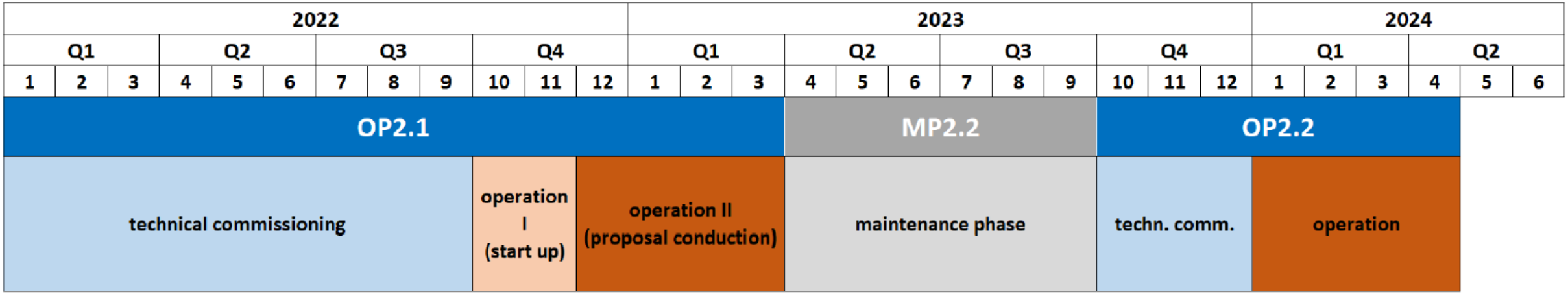
- Some baffle tiles consisting of W heavy alloy (W/CuNi) are exposed during OP2.1
- Should be taken out after OP2.1 or OP2.2
- Analysis with SEM/FIB (and RBS if necessary)
- **Goals**
  - **Qualification of W heavy alloys in baffle region**
  - **Plasma modifications of W heavy alloys**

C-coated TZM screws

- C-layer thickness ~10 µm, pre-characterized
- C-layer thickness measurements by Betascope (C.P. Dhard)
- Supporting RBS measurements for absolute calibration by RBS
- SEM/FIB investigations, if necessary
- **Goals**
  - **Erosion of C on TZM screws**



Samples inside W7-X in OP2.1 and 2.2 (3)



Timeline

- Samples from OP2.1 will become available in summer/autumn 2023
- Samples from OP2.2 will become available autumn/winter 2024

Midplane manipulator: B deposition during Boronizations

- Exposure of samples (fine grain graphite, CFC, stainless steel, Si wafer, …) during boronizations
- Analysis of deposited layer thicknesses by RBS and ERDA (NRA if necessary)
- **Goals**
  - Deposition of H, B during boronizations

Midplane manipulator: Erosion during GDC

- Manufacture of marker samples for erosion measurements during GDC
- Samples: thin layers of a-C:H, Ni (or steel), W, …
- Exposure of samples during GDC with midplane manipulator
- Analysis of material erosion by RBS before and after exposure
- **Goals**

  - Erosion of materials during GDC

Midplane manipulator: Charge-exchange fluxes and energies

- Exposure of catcher plates (graphite, Si, …) with midplane manipulator during plasma discharges
- Analysis of H content using ERDA
- **Goal**
  - Determination of neutral charge-exchange H-fluxes

- Exposure of erosion samples with midplane manipulator during plasma discharges
- Erosion samples with different sputtering thresholds (C, Ni, W, …)
- Manufacture and pre-characterization of samples by RBS
- Post-exposure analysis of samples by RBS
- **Goal**
  - Determination of neutral charge-exchange energy spectra
  → Requires very long exposures: LTS?