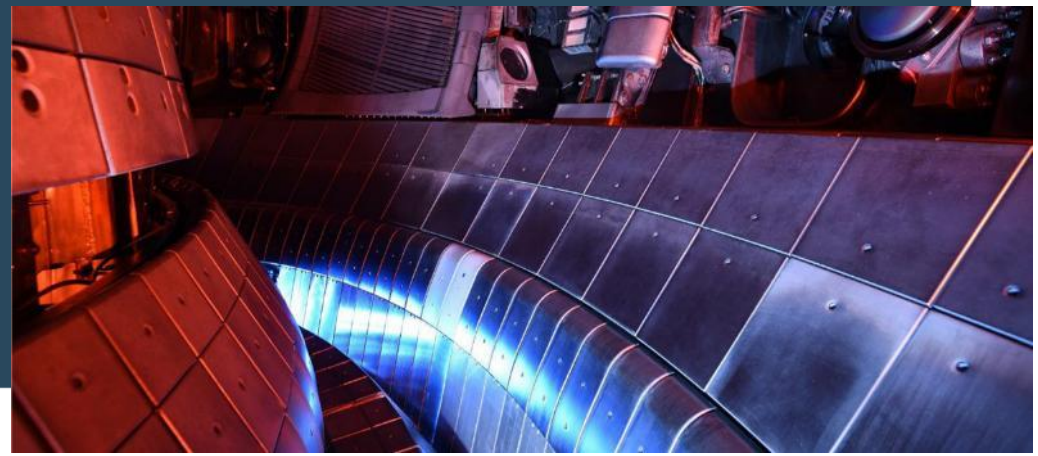
MAX-PLANCK-INSTITUT
FÜR PLASMAPHYSIK

PWIE SP F.1:
Status and progress of boronization studies in AUG

Sehoon An, Volker Rohde, Karl Krieger, Tim-Oliver Hohmann, Martin Balden, Jörg Hobirk, ASDEX Upgrade Team



EUROfusion

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MPG Contribution to SP F.1 in 2026: Tasks and Deliverables

Tasks to be performed (2026)

- **Exposure of witness samples on the LBO manipulator** during AUG glow discharge boronization (GDB) and samples analyzed by ion beam analysis (IBA)
- **Long-term Si samples** by IBA to determine the **campaign-integrated** spatial distribution of boron content and deuterium retention behavior

Deliverable (2026)

- **D002 -** Comprehensive dataset on boron layer thickness, spatial homogeneity, erosion and redeposition behavior in AUG based on QMB, IBA witness samples and long-term silicon samples
- **D003 -** Benchmarking assessment comparing GDB procedures and post-boronization plasma performance between WEST and AUG

Task #1 - Witness Sample Exposure during AUG GDB

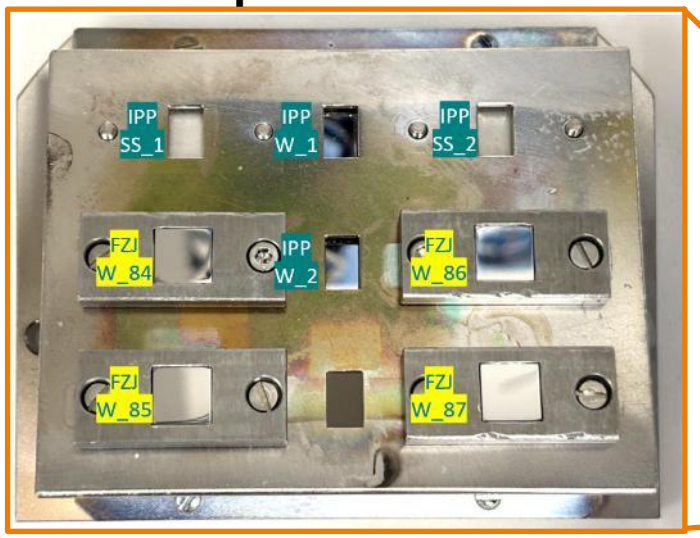
Tasks to be performed (2026)

Exposure of **witness samples on the LBO manipulator** during GDB and samples analyzed by IBA

Activity status:

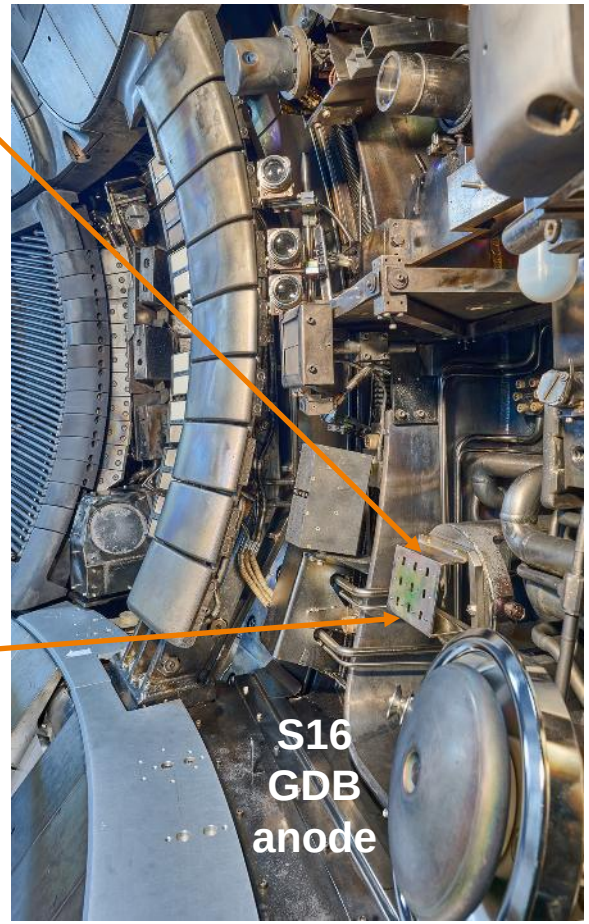
- **[MPG, An]** GDB → done
  Characterization of GDB layers
- **[FZJ, Houben]** GDB → done
  Benchmark with lab-produced B-layers
- **[MPG, Krieger]** GDB + Discharges
  Assessment lifetime of GDB layers by reference discharges → exposure done
  analysis ongoing
- **[MPG, Maragkos]** Discharges
  Measurement of CX neutrals
  ~~planned in July~~ → delayed to Nov / Dec

LBO manipulator



GDB on 15.06.2026:

- **MPG:** 2 × W, 2 × 316L
- **FZJ:** 4 × polished W



Task #2 - Post-campaign investigation on B-layer

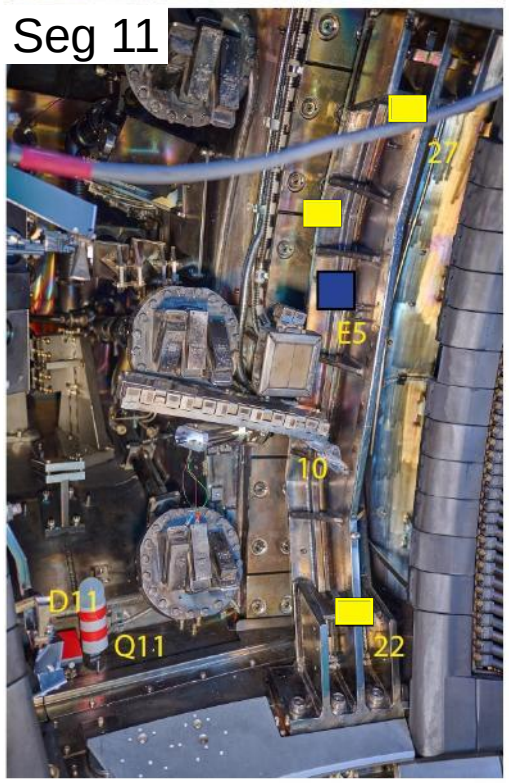
Tasks to be performed (2026)

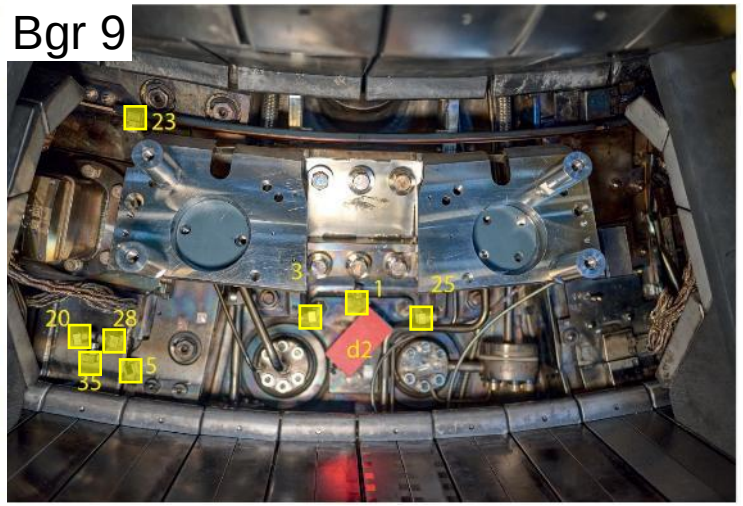
- Exposure of Si-LTS samples during the AUG experimental campaign → **done**
- Sample retrieval and ion beam analysis → **done**

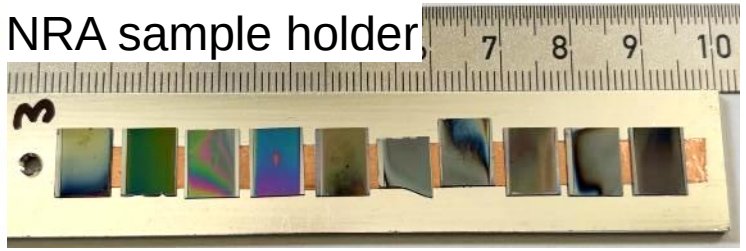
Objectives:

- Investigate campaign-integrated spatial variation of B and D amount
- Assess long-term erosion/redeposition behavior of GDB layers
- Provide reference data for comparison with LBO witness samples and QMB results

NRA measurement on Si Long Term Samples





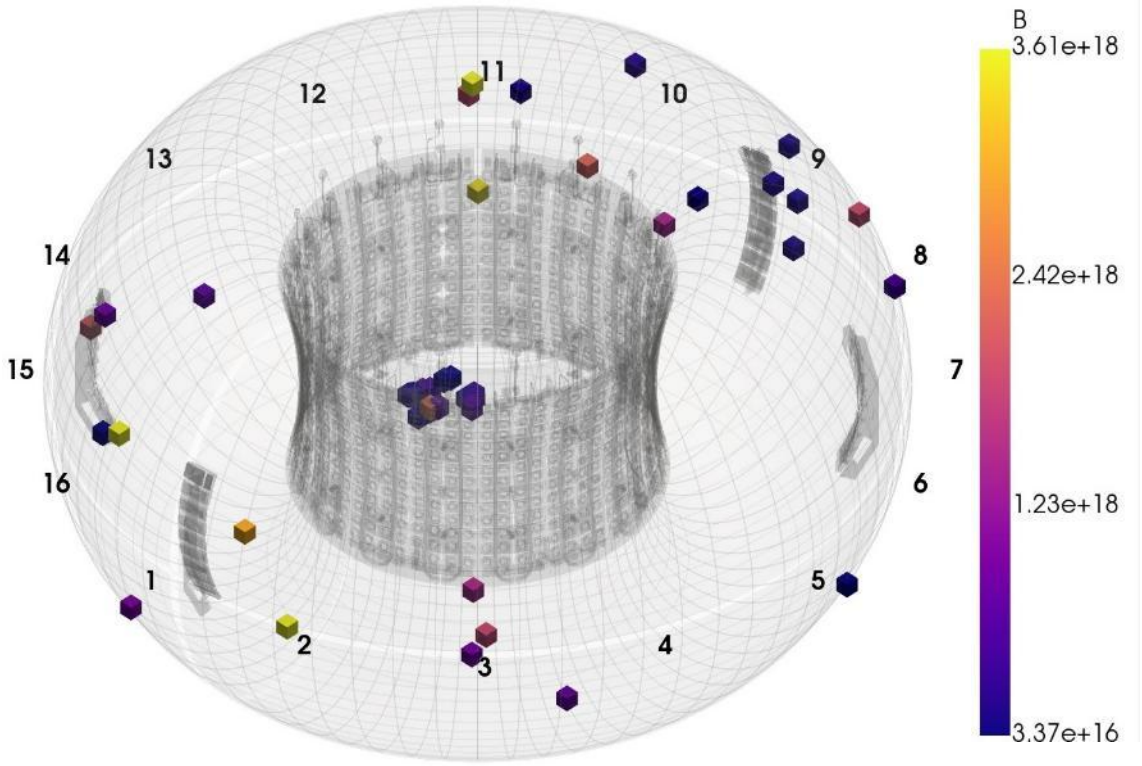


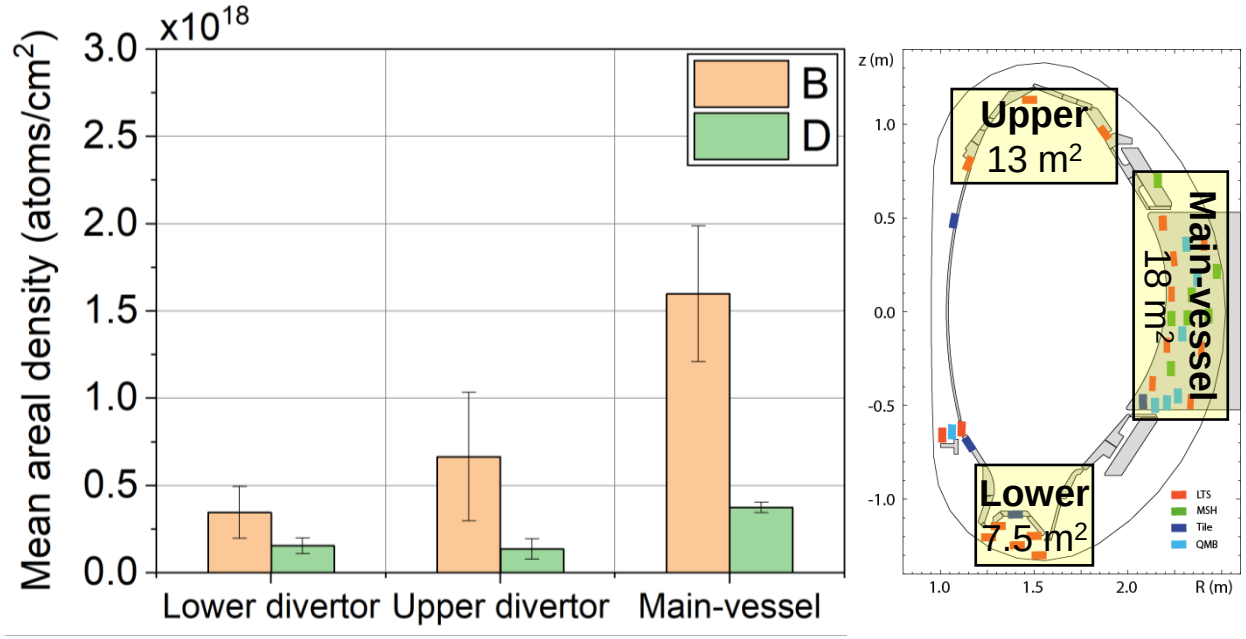
- 52 Si wafers at varied and **recessed** locations
- After campaign (2025), samples measured by NRA

Task #2 - Post-campaign investigation on B-layer

Progress and key results from campaign 2025

3D Spatial Distribution of B on Si-LTS Samples



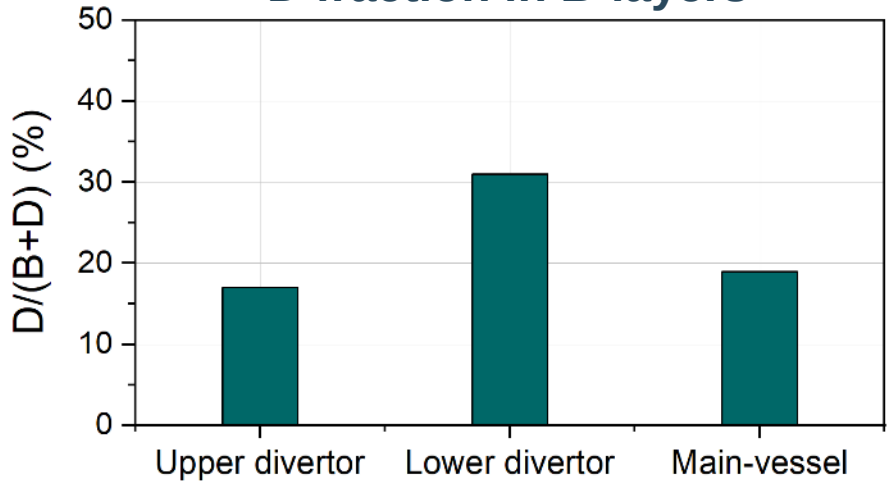


- Higher B and D at main vessel than divertors
- The lower divertor was not directly exposed GDB
  → originated from erosion and redeposition
- **~ 20%** of the injected B remained remote regions

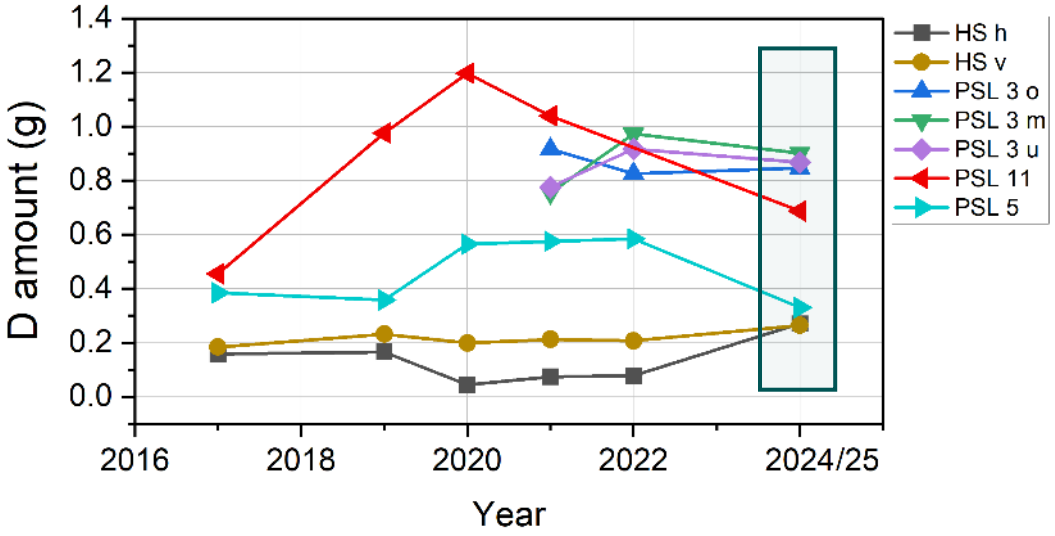
Task #2 - Post-campaign investigation on B-layer

Progress and key results from campaign 2025

D fraction in B-layers



Estimated D-inventory in B-layers



Spatial variation of D retention

- D/(B+D): 17–31% across the investigated wall regions
- Highest D fraction in the lower divertor, approximately twice that of the upper divertor

Hydrogen-isotope retention

- Estimated regional D inventory ranging: 0.01 – 1.2 g
- **Total D input** during the campaign: ~ 400 g
- **Total D inventory** on Si LTS: ~ 0.4 g

~ 0.11% of the total campaign D input at remote area

Progress and status of SP F.1 (2026)

Tasks (2026)

Task #1 – LBO Witness samples

- GDB exposure completed; assessment of B-layer lifetime ongoing.
- CX-neutral measurements postponed to Nov–Dec 2026.

Task #2 – Long term Si Samples

- 52 Si-LTS samples analyzed by NRA.
- Spatial B distribution and D retention characterized.

Deliverables (2026)

D002 — AUG Boronization Dataset

Consolidation of QMB, IBA witness sample and Si-LTS results ongoing.

D003 — WEST–AUG Benchmarking

Comparative assessment of GDB procedures and B-layer properties in AUG and WEST.

→ *Paper accepted S. An et al., NME 102230 (2026)*