



Testing of Liquid-Sn Divertor Prototype: IPP Contribution

A. Manhard, H. Greuner, A. Herrmann, K. Krieger, V. Rohde, R. Neu,
M. Balden, Th. Schwarz-Selinger



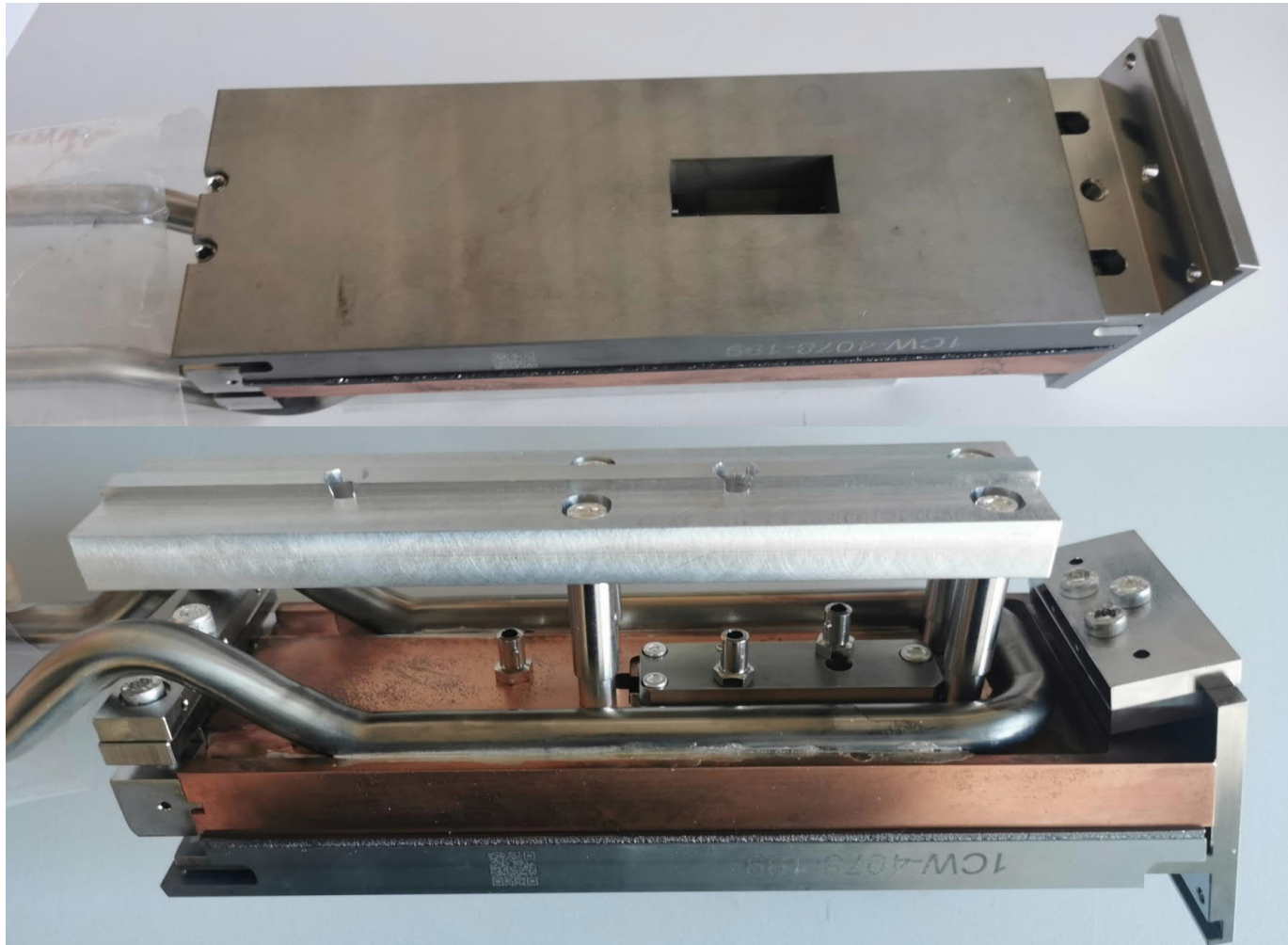
This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European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

- Goal: Test liquid-Sn divertor component prototype in high-power tokamak
 - Divertor manipulator of ASDEX Upgrade
- Necessary preparatory groundwork
 - Establish boundary conditions for successful testing of liquid-Sn component in ASDEX Upgrade **In progress...**
 - Design suitable prototype sample **Done!**
 - ↳ In collaboration with TU/e and DIFFER
 - High heat flux testing of component in GLADIS testbed (IPP) **Awaiting sample...**
 - Design suitable ASDEX Upgrade discharge **To be done...**
- Actual ASDEX Upgrade tests will be part of IPP internal experiment programme
 - One day in summer 2022, in last days before extended maintenance opening of ASDEX Upgrade **Approved!**
 - No EUROfusion budget allocated for this

Sample & holder design decisions

- 3-D printed CPS sample manufactured by DIFFER ✓
- IPP: Divertor target plate and holder modified according to requirements ✓
 - Slot in TZM target plate to accept CPS sample & Langmuir probes
 - Additional TZM witness plate mounted on 2nd position of divertor manipulator
 - ↳ TZM allows easy detection of Sn!
 - Holder/substructure modified to accept
 - ↳ Electric heater for pre-heating of CPS to melting point of Sn
 - ↳ Thermocouple connectors
 - ↳ Langmuir probe connectors

Sample holder for AUG Divertor manipulator: fabricated



GLADIS tests prior to ASDEX Upgrade experiments

- 1) Dry tests of CPS & holders at reduced power to test functionality & fail-safe conditions
 - 2) If 1) successful: infiltrate CPS with Sn, repeat tests up to full planned load
 - Start at low load ($\sim 0.5 \text{ MW/m}^2$), stepwise increase up to $\sim 10 \text{ MW/m}^2$
 - 3) Depending on outcome of 2): Discuss testing of alternative CPS concepts
 - E.g., W felt concept by ENEA; relies on Sn filling to provide thermal contact of CPS to heat sink!
 - ↳ Cannot be tested in “dry” condition due to expected overheating of W felt!
- Successful GLADIS testing remains essential for final go-ahead in AUG!

- Cloud repository was set up at IPP for efficient sharing of data between IPP and DIFFER
- Dry 3-D printed CPS sample is being shipped from DIFFER to IPP
 - Parcel currently delayed in mail service...
- Wetting of CPS after first round of tests
 - Checking possibility to wet CPS at IPP
 - ↳ Probably technically not feasible with parameters established by DIFFER and industrial partner
 - Alternative: Send CPS back to DIFFER for wetting after 1st round of GLADIS tests

- DIFFER TU/e develop and manufacture liquid Sn divertor prototypes
 - IPP provides interface information for GLADIS and ASDEX Upgrade
 - IPP has manufactured/adapted divertor manipulator sample holder (TZM tile + substructure)
- IPP: HHF testing of liquid Sn prototypes
 - 1st campaign: dry testing of CPS component optimized for GLADIS tests with full AUG set-up
 - 2nd campaign: testing of Sn-filled CPS in full AUG set-up
- IPP: Design of ASDEX Upgrade experiments
 - Determine optimal set of diagnostics → available/desired diagnostics established
 - Design discharges for testing liquid Sn components → basic idea stands, details after GLADIS tests
- ASDEX Upgrade experiments: internal programme in collaboration with TU/e and DIFFER
 - 1 full experiment day scheduled