F02
Liquid metal limiter

FTU Experimental Campaign 2019-C1-B

Debriefing
Thu 27/06/2019 (Early)

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IFP

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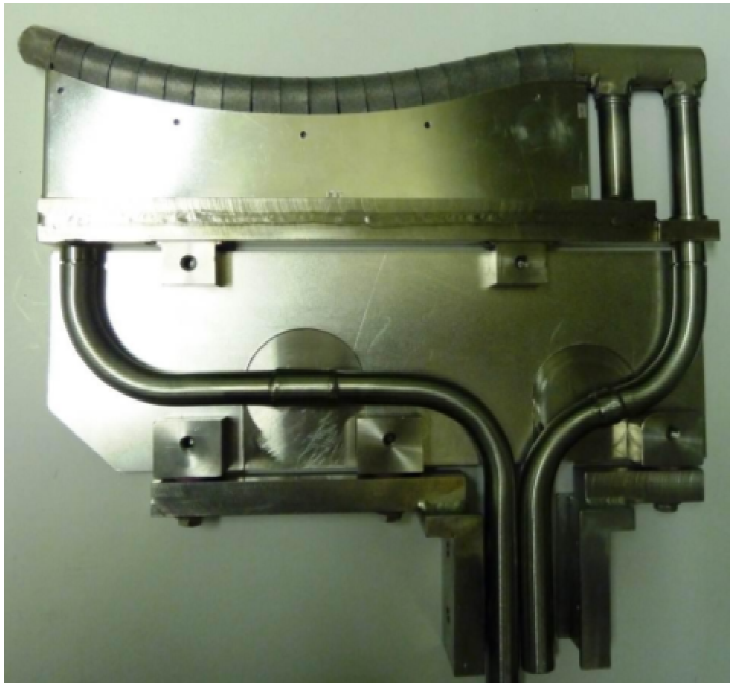
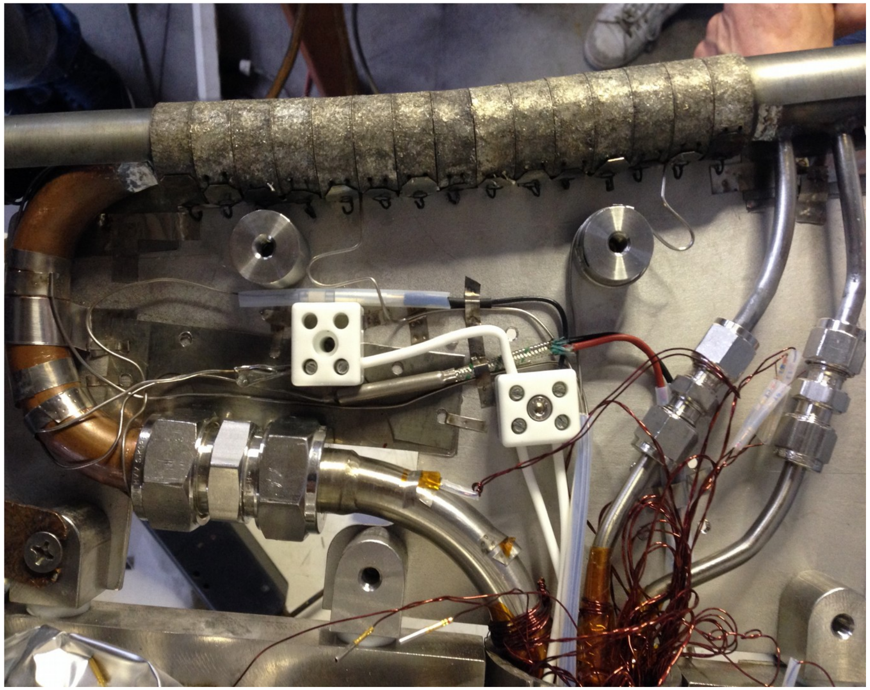
Ricerca Formazione Innovazione

Background

FTU is the only European medium-size tokamak in which are performed experiments with liquid metals.
Since 2005 several liquid metal systems have been installed in FTU:

- Liquid Lithium Limiter – LLL
- Cooled Lithium Limiter – CLL
- Tin Liquid Limiter - TLL





Goals & Strategy

Goals

- Investigation of the liquid tin limiter in presence of high heat loads for longer discharges and improved diagnostic capabilities.

- More quantitative determination of plasma contamination, tin transport mechanisms and scrape-off layer characterization.

Strategy

- The power on the limiter will be progressively increased in standard ohmic discharges by moving the TLL position

- A systematic scan of the scrape-off layer and dedicated analyses of plasma contamination and tin transport mechanisms will be performed

- Visible, UV and soft-X diagnostics will be fundamental during these activities

Requirements

Machine

Toroidal magnetic field BT (T):	5.3
Plasma current Ip (MA):	0.5 – 0.7
Electron density ne (10^{20} m^{-3})	0.5 – 1.2

Special requiremetns: Liquid Tin Limiter, ECRH, SOXMOS

Diagnostics

Electron density and temperature profiles, D_{α}, Mirnov coils, Langmuir probes, bolometry, Visible and VUV spectroscopy, Soft-X, visible camera, fast IR-camera, bremsstrahlung

Modeling

JETTO

Pulse Plan

Strategy:

- impurity penetration
- keep the ST using ECRH
- push contamination even further
- try keep the ST using two Gy

A) 5.3 T / 500 kA , $n_e = 0.6\ 10^{20} m^{-3}$, Limiter -> 4cm + ECRH

B) 5.3 T / 500 kA , $n_e = 0.6\ 10^{20} m^{-3}$, Limiter -> 4cm + ECRH (1/2Gy → 0.3s)

C) 5.3 T / 500 kA , $n_e = 0.6\ 10^{20} m^{-3}$, Limiter -> 4cm + ECRH (1/2Gy → 0.3s)

D) 5.3 T / 500 kA , $n_e = 0.6\ 10^{20} m^{-3}$, Limiter -> 4cm + ECRH (2/2Gy → 0.3s)

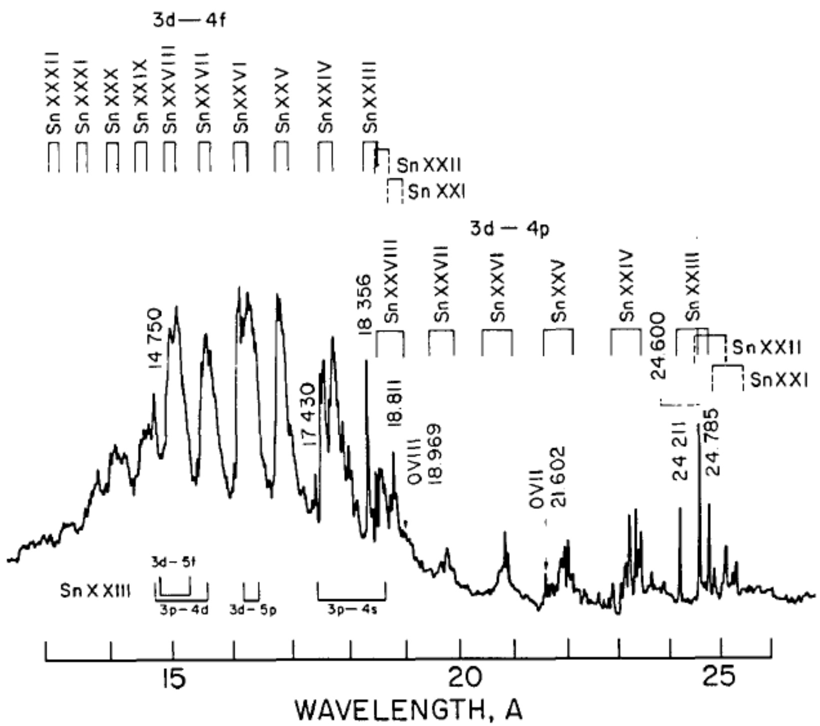
E) Repeat @ 700kA

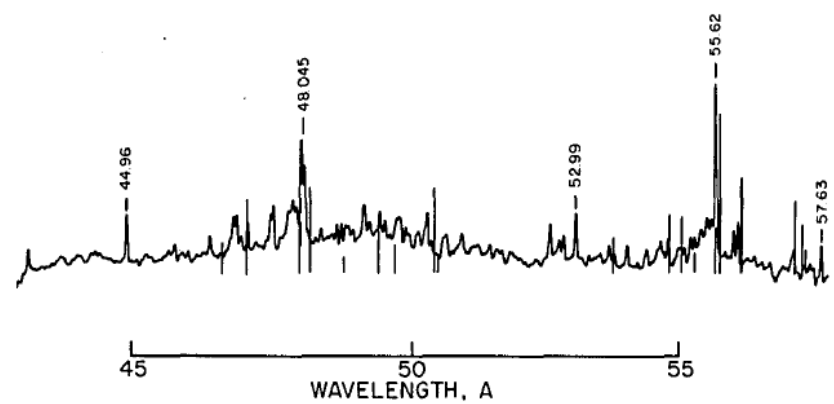
https://ftuwiki.frascati.enea.it

UV spectroscopy - summary

- Schowob spectrometer → 1 CCD
- calibration in lambda has to be performed – SPRED spectrometer also worked in parallel
- Metals (Mo, Fe, Ni) mainly dominate the UV spectra
- Sn has been detected at the end of the discharge with the limiter inserted +3cm and +4cm
- High resolution grating (1200g/mm) has been used to solve lines around 13.5nm
- Many lines has been detected at lower wavelength → identification is on going (207???)
- Increase Te to access higher tin ionization states > Sn28+

UV – spectroscopy

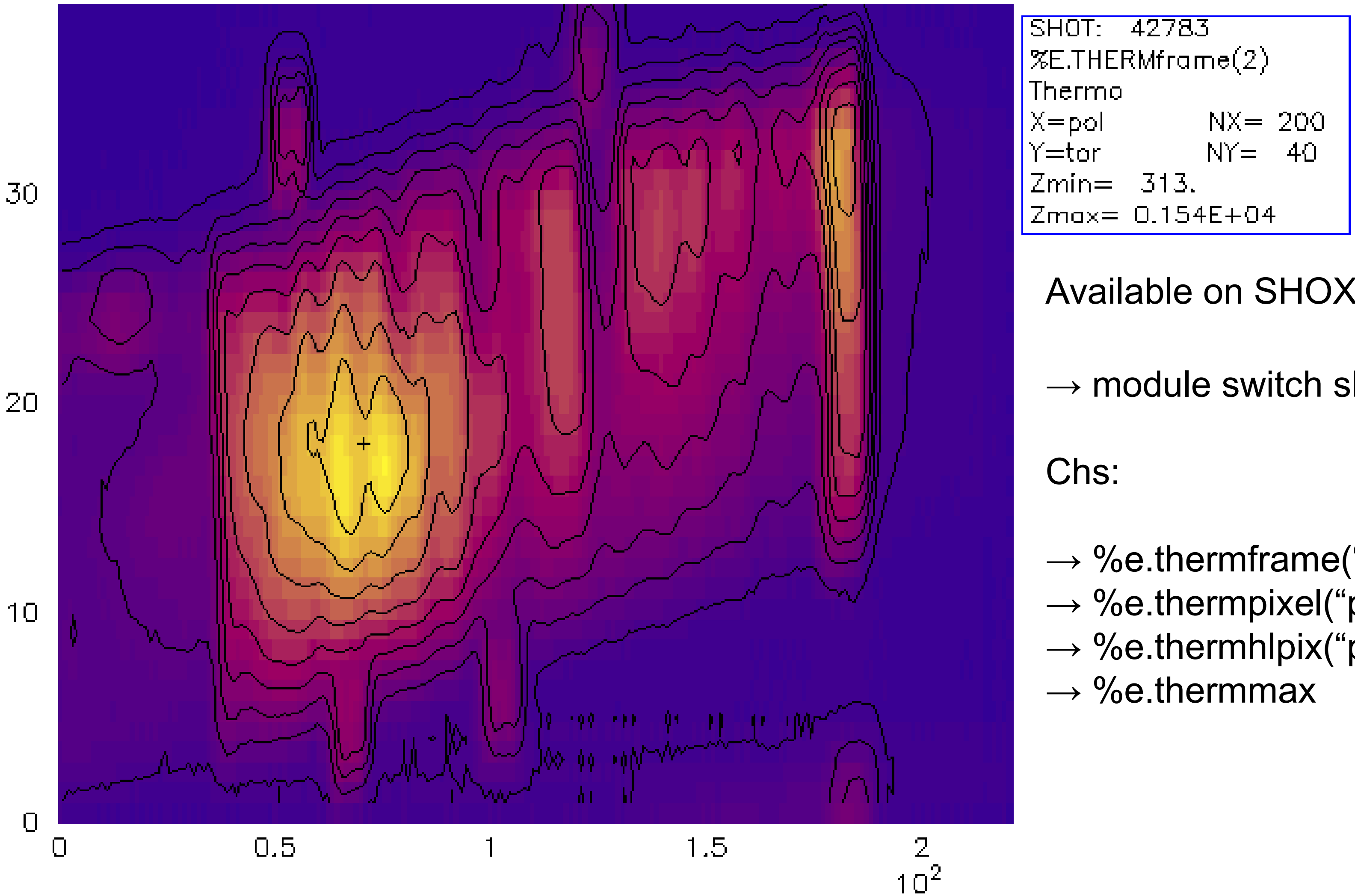




Burkhalter, Feldman, Cowan
J. Opt. Soc. Am.,**64(8)** 1058 (1974)

F. Bombarda

General summary



Available on SHOX:

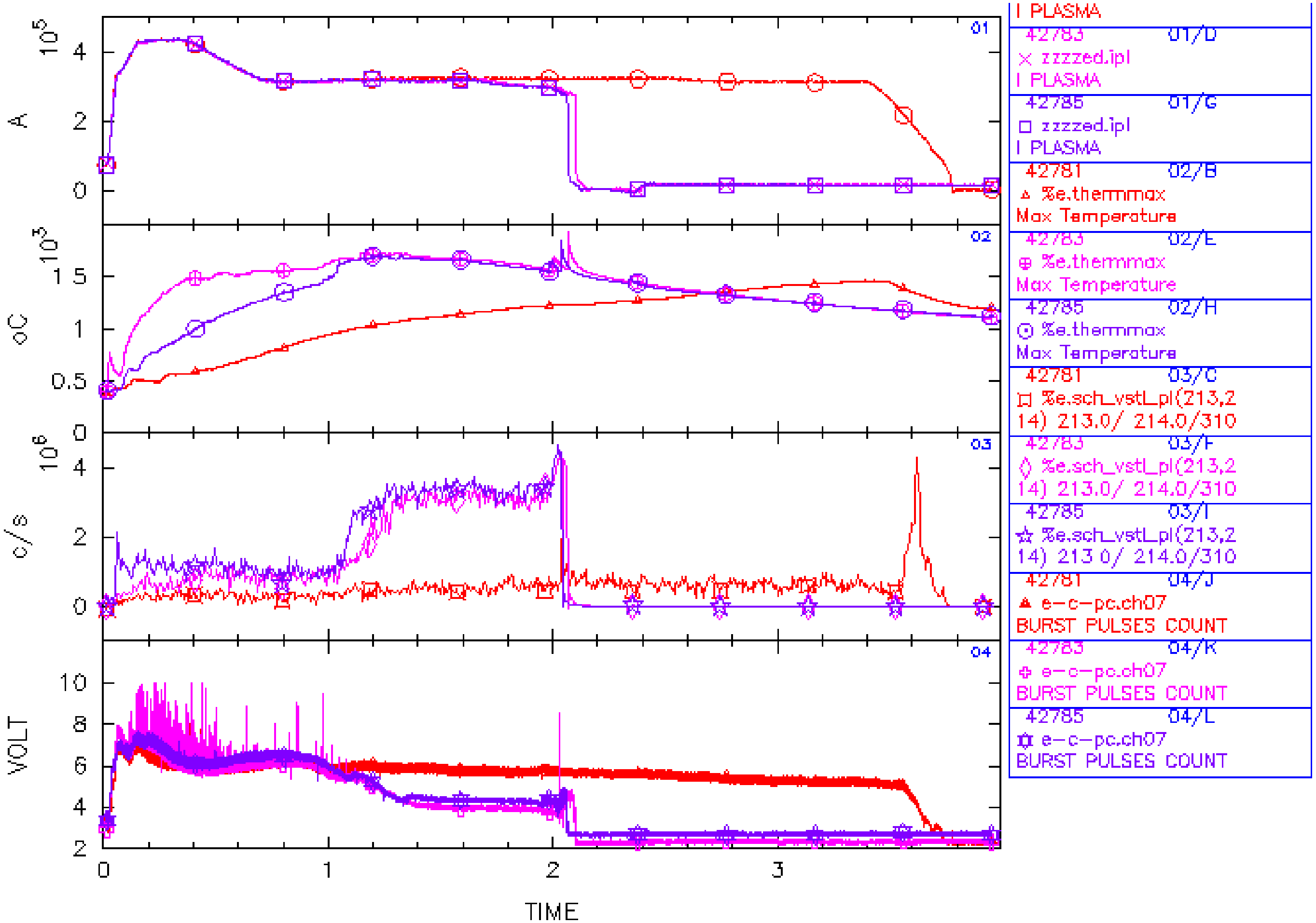
→ module switch shox/gfortran

Chs:

→ %e.thermframe(“time”)
→ %e.thermpixel(“py, px”)
→ %e.thermhlpix(“py, px”)
→ %e.thermmax

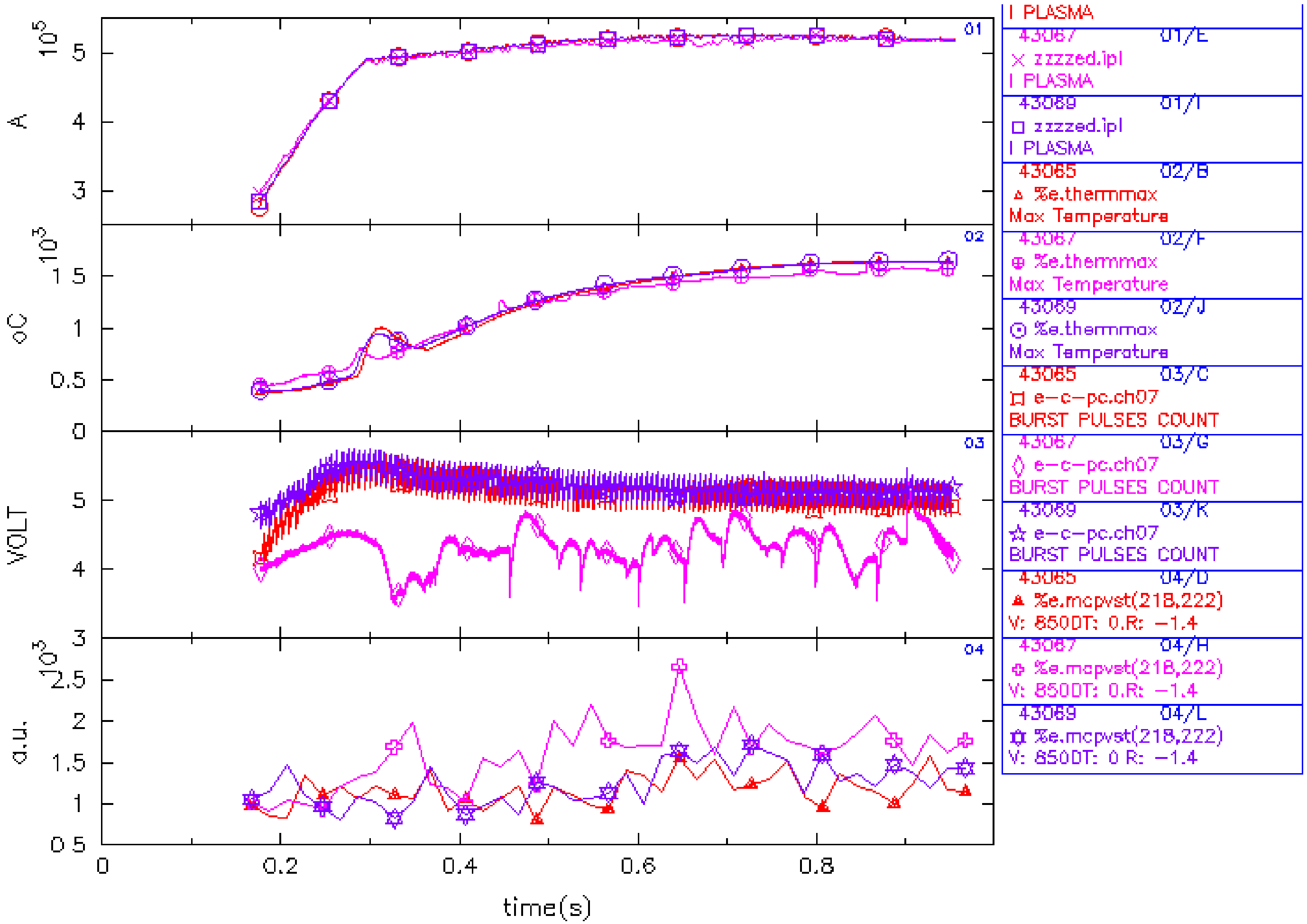
General summary

17/04/2019 → long pulses



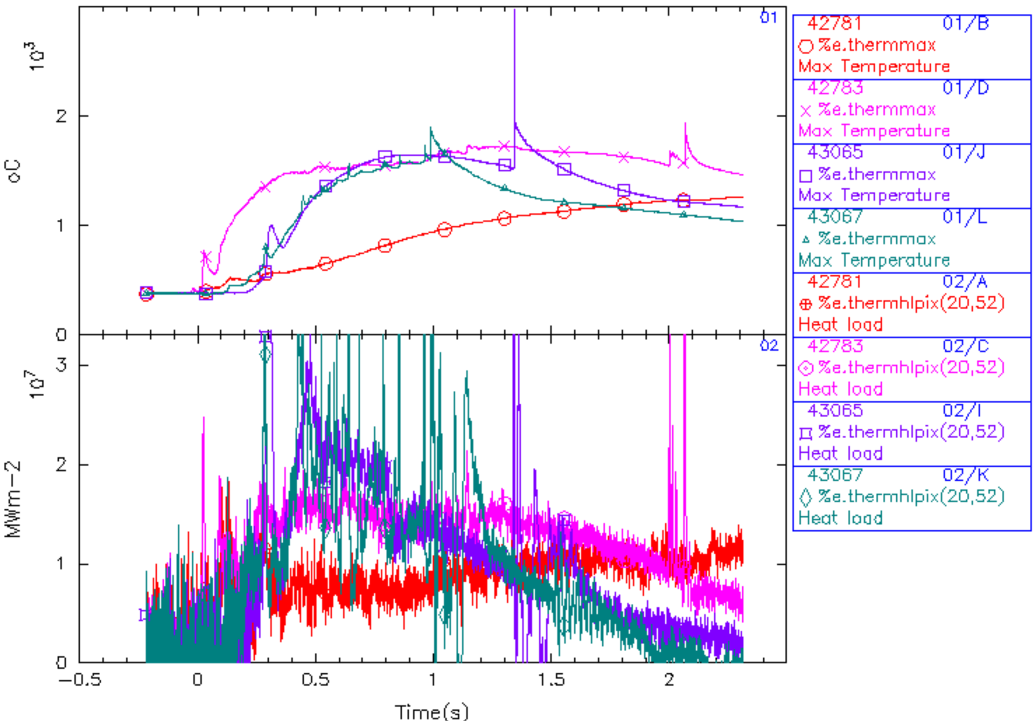
General summary

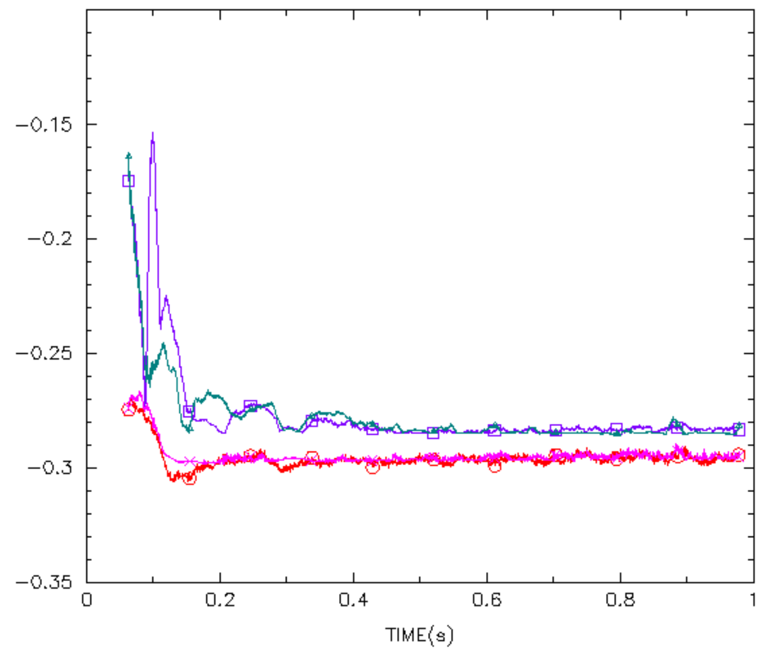
27/06/2019 → looking for the target



General summary

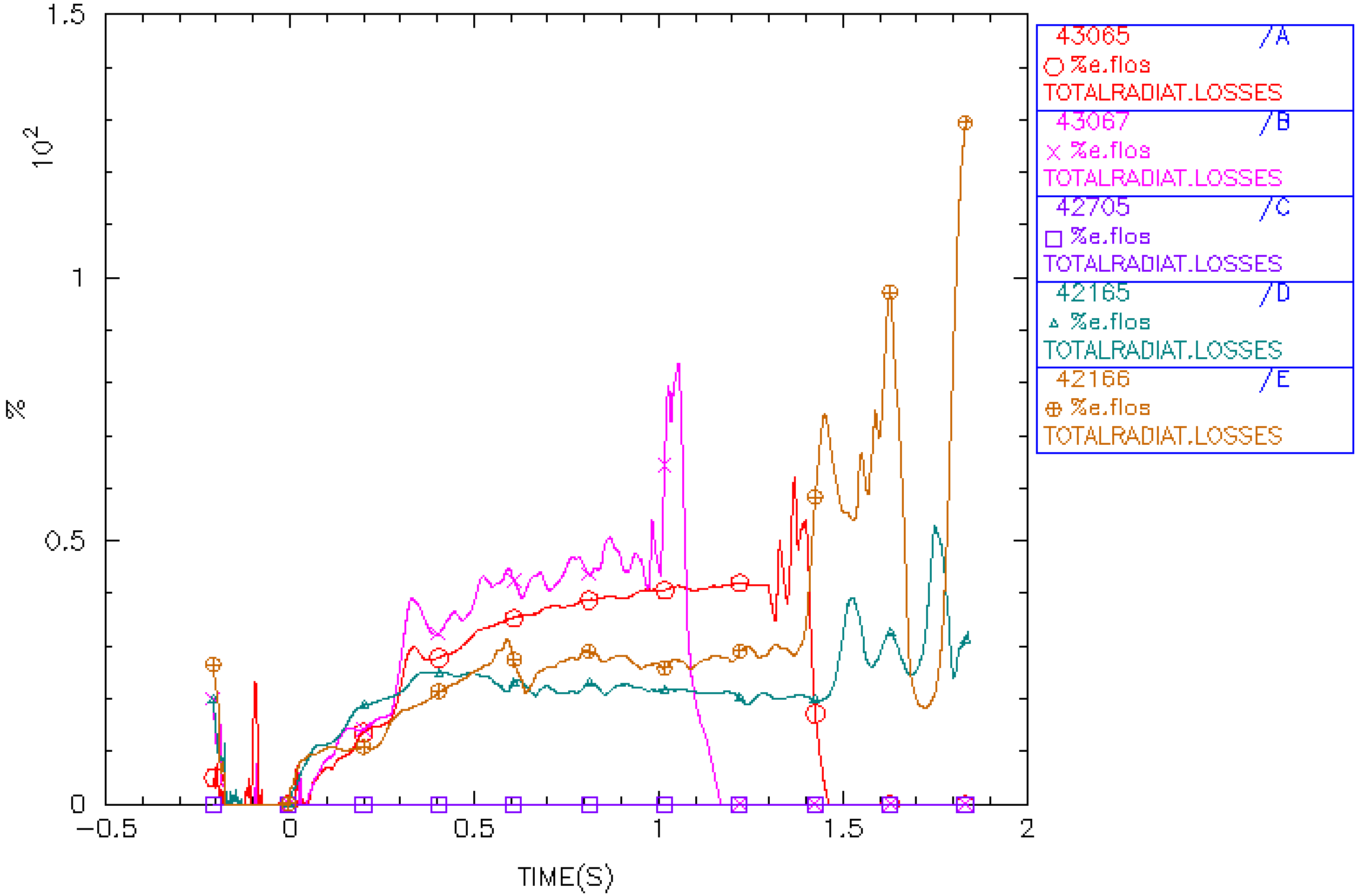
Surface temperature, heat fluxes and plasma radius w/wo fast switching network and H field





General summary

%e.flos shows a different behaviour



Last update

A new camera is now looking to the liquid tin limiter