HIE ISOLDE HW commissioning in 2016

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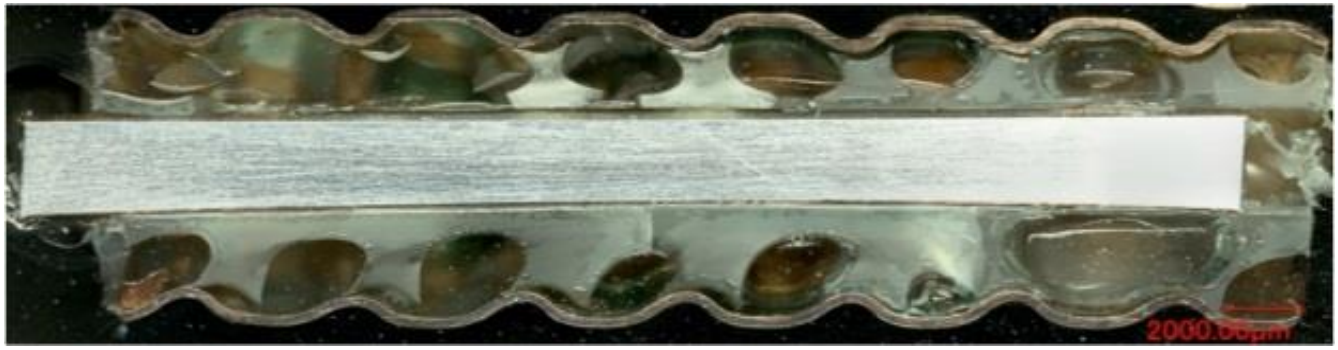
on behalf of the HIE ISOLDE Project

ISOLDE workshop, 8 December 2016

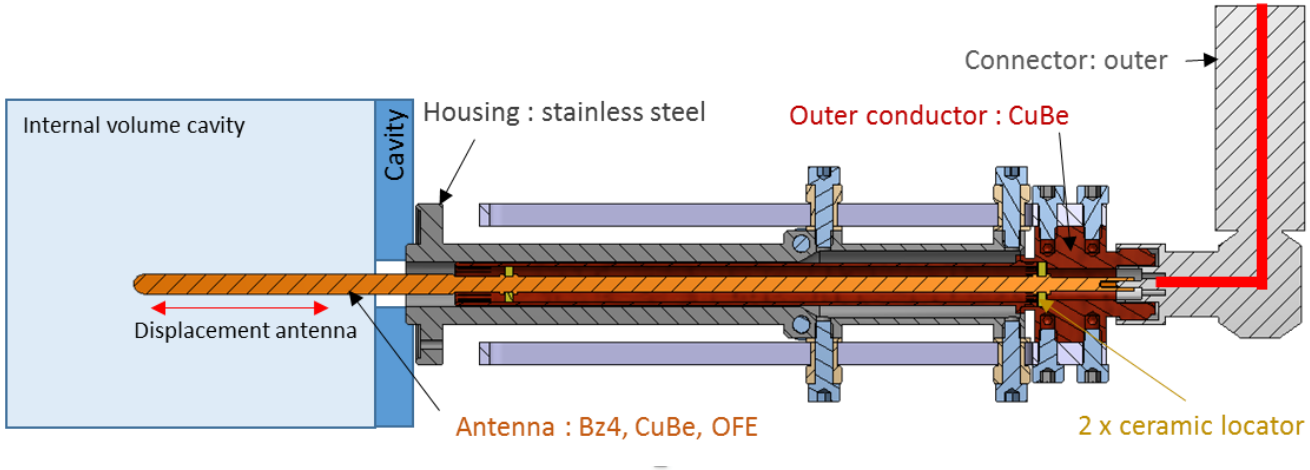
Outline

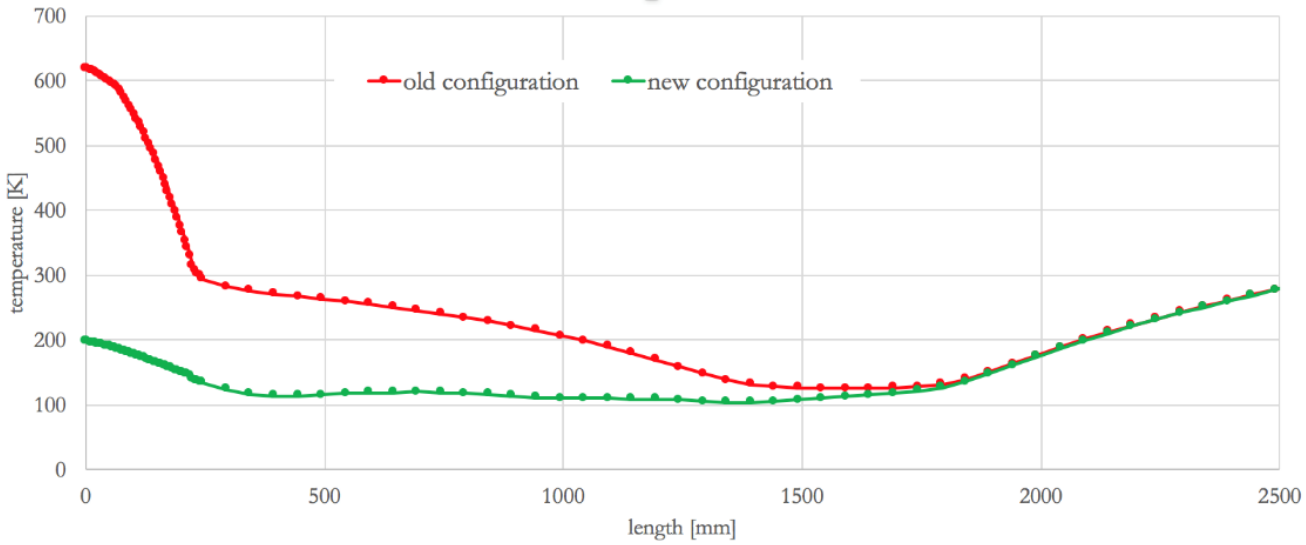
- RF coupler issue and re-design
- 2016 HW commissioning campaign
  - Vacuum
  - Cryogenics
  - SC Cavity performance
  - SC solenoids
- Planning for 2017

RF coupler post mortem (off line stress test, 200 W)



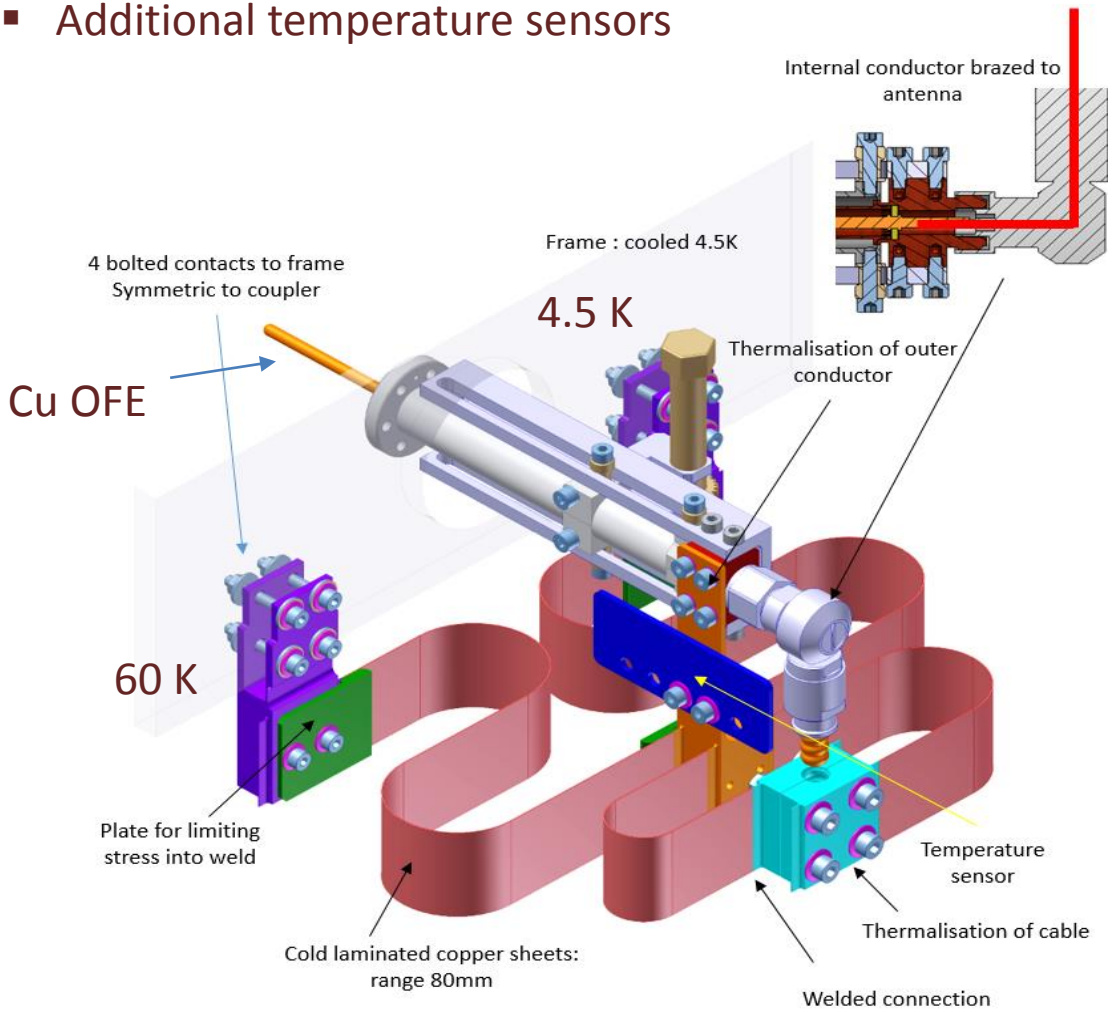
RF and thermal simulations



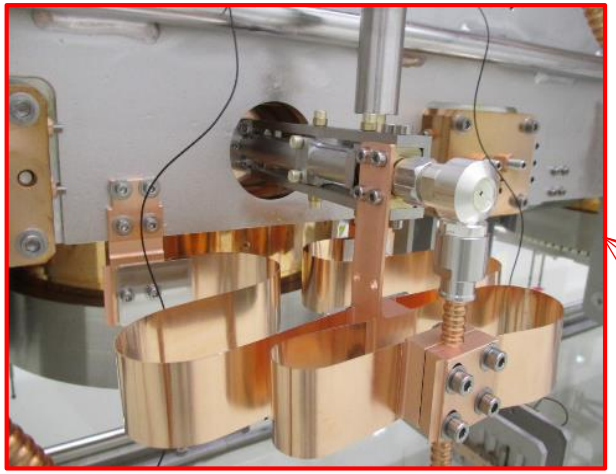


New coupler design

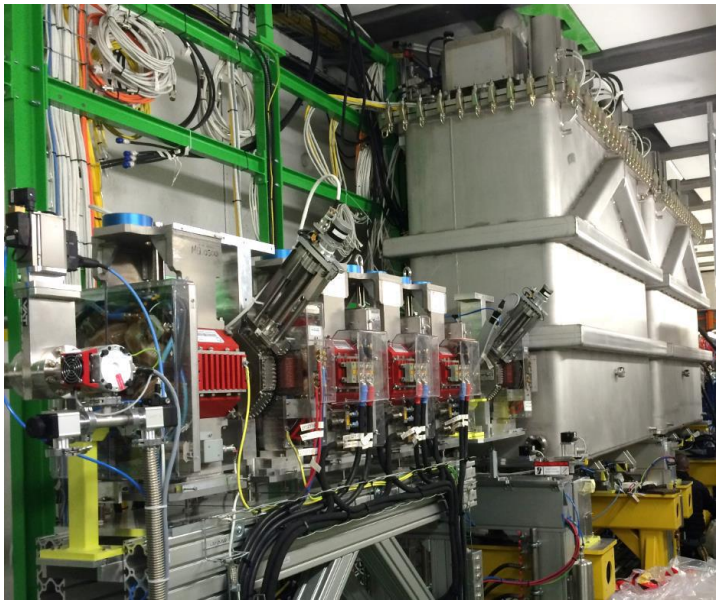
- OFE copper for antenna
- Antenna brazed to RF cable inner conductor
- Reworked thermalization of the RF cable and coupler
- Additional temperature sensors

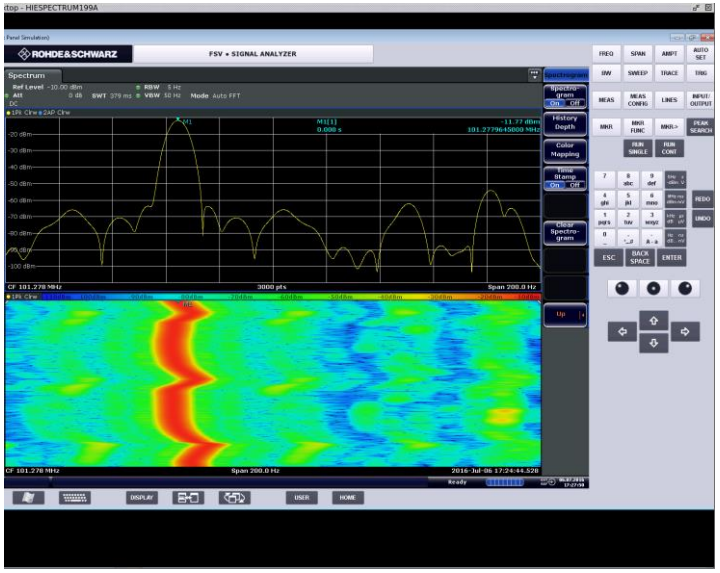


Assembly of new couplers in CM2



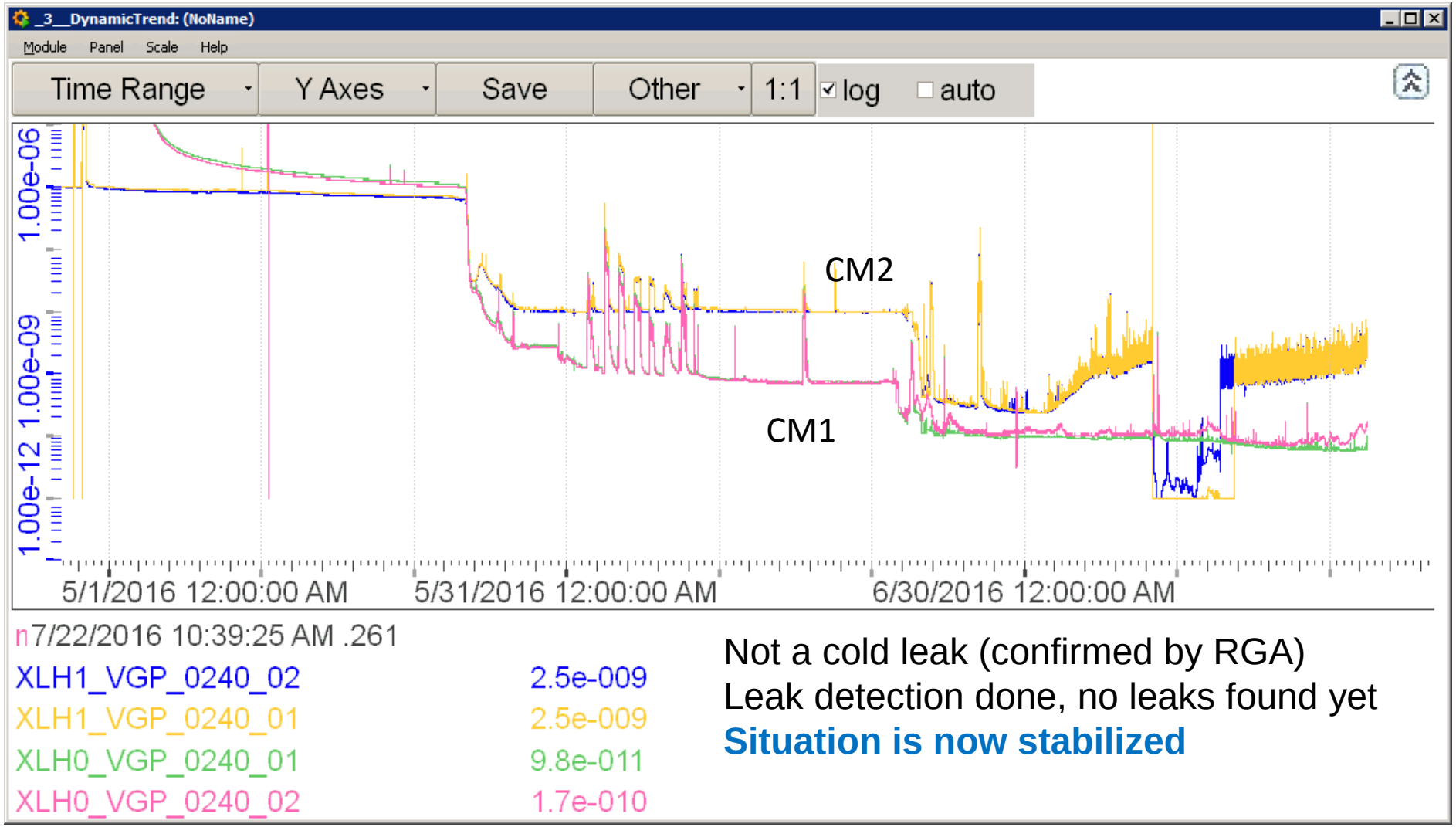
Hardware commissioning highlights





- Main **NEW ISSUES** identified:
  - Cool down much longer than expected
  - Difficulties to manage cryo transients
  - Field emission in two CM1 cavities
  - Suspect vacuum leak in CM2
  - Short circuit on CM1 solenoid circuit
  - SRF cavity detuning from cryo-plant
  - ~ 100 W static heat load un-accounted for
- On the good side
  - The new RF couplers worked well
  - Solenoid short to ground circumvented
  - Positive vacuum evolution in CM2
  - SRF settings for physics below onset of FE
- Re commissioning work after the physics run:
  - ✓ He processing of the two “sick” cavities
  - ✓ Cryogenic heat load measurements
  - Leak detection of CM2 (at warm)

Vacuum evolution in CM1 and CM2



Not a cold leak (confirmed by RGA)

Leak detection done, no leaks found yet

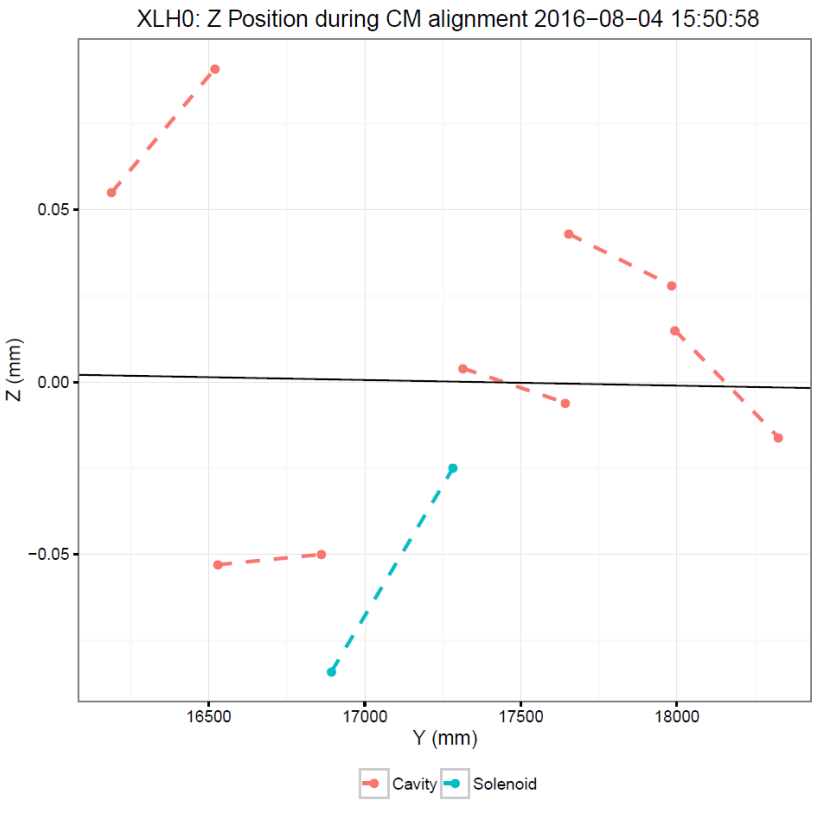
Situation is now stabilized

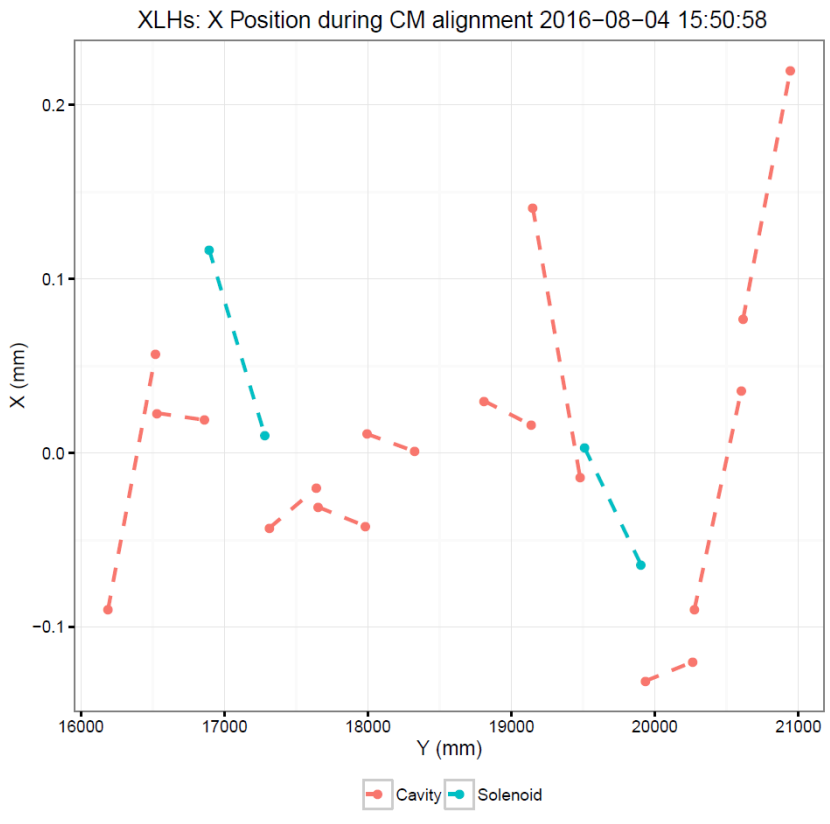
CM1 solenoid commissioning history

- Discovered **short circuit to ground** after cool down
- Inductance measurement between each lead and ground→ fault is outside the magnet
- Earth circuit removed on the converter side
- 1 A successfully controlled in the magnet
- Decision to install additional path to ground close to the fault (in case fault disappears)
- TDR measurement confirmed fault is on the cable
- Installed 100 Ω path to “safety ground” (fault current in steady state < 1 mA)
- Nominal current limited to 50 A (OK for beam transmission)
- **Released for OP at 50 A (22.7.2016)**
- NC to be opened to track the issue

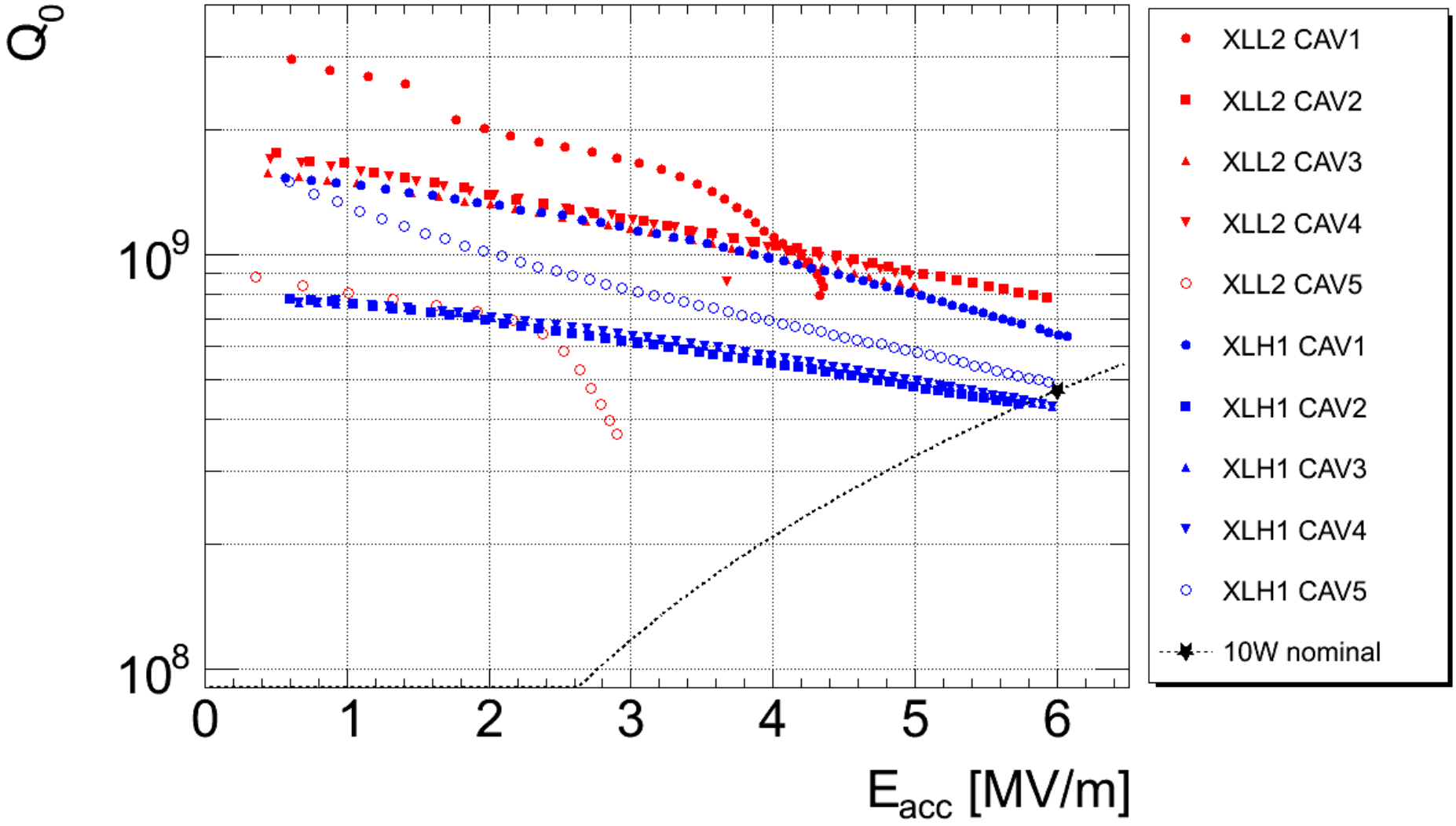
Alignment work

- Smoothing campaign done (w30)
- Alignment at cold of CM1 and CM2 done (w31):
  - V adjustments (0.4 mm/0.9 mm) with internal dof
  - H adjustments (-0.6mm/1 mm) by moving CM on jacks



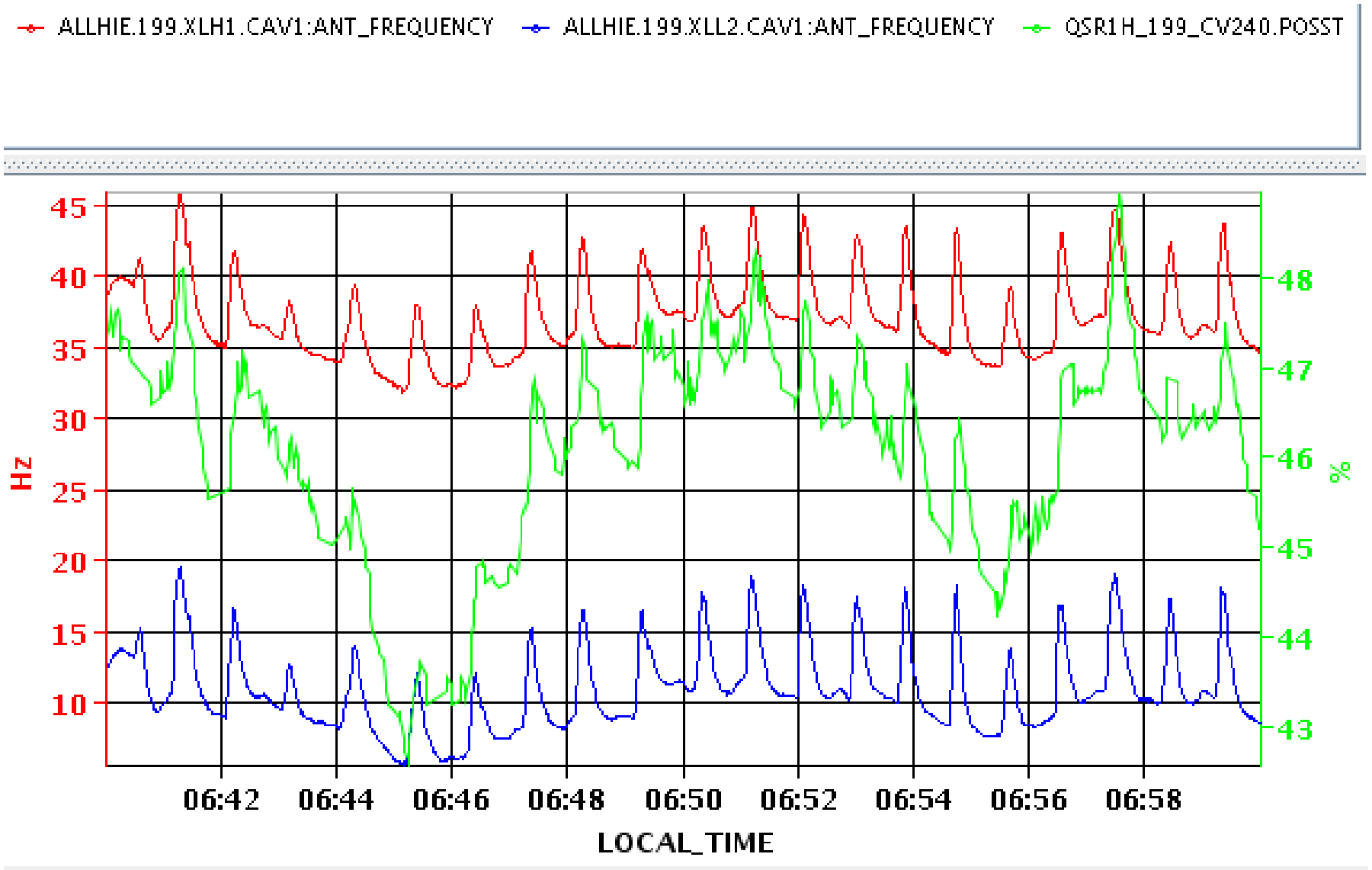


SRF cavity performance (July 2016)

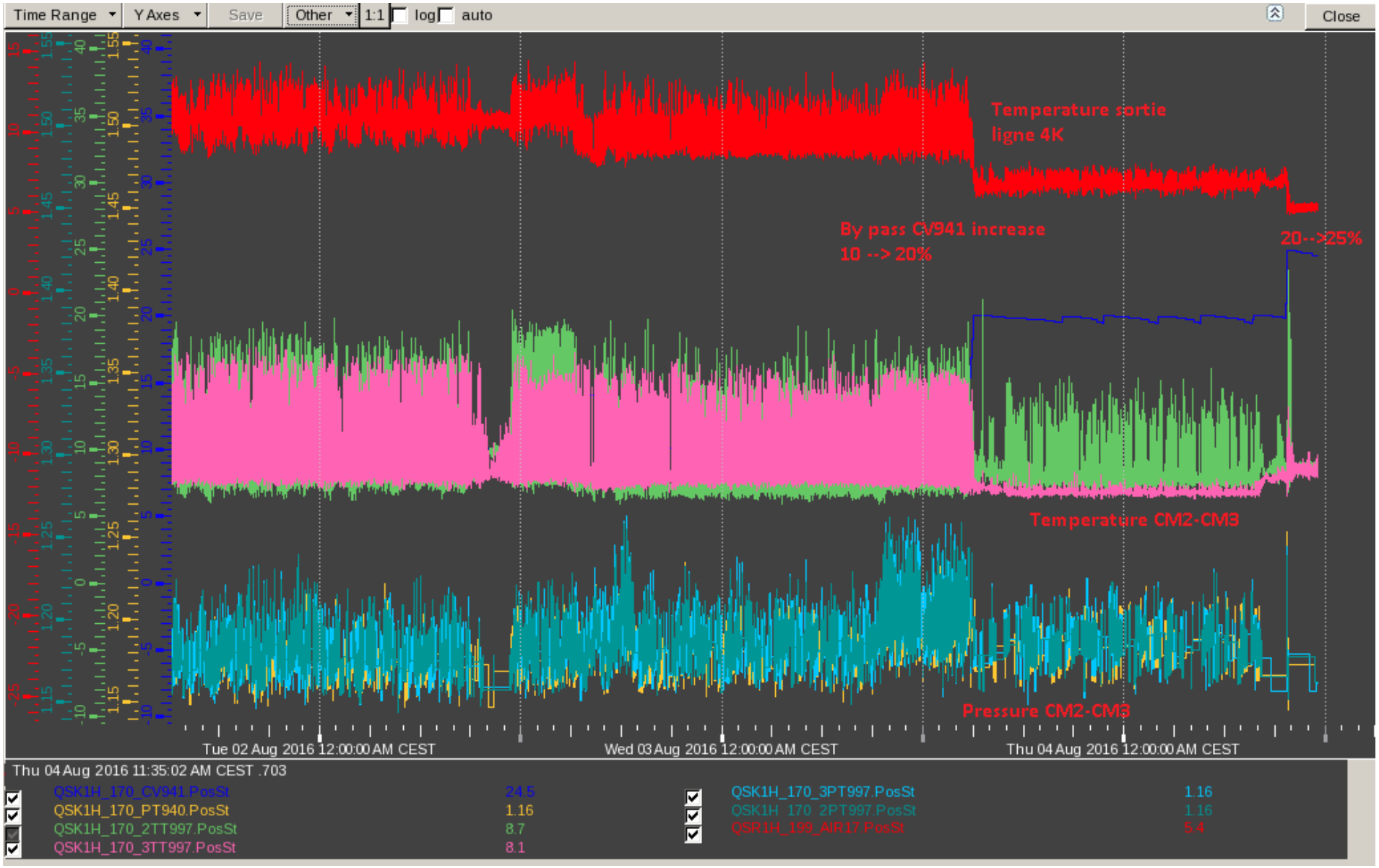


Frequency perturbations

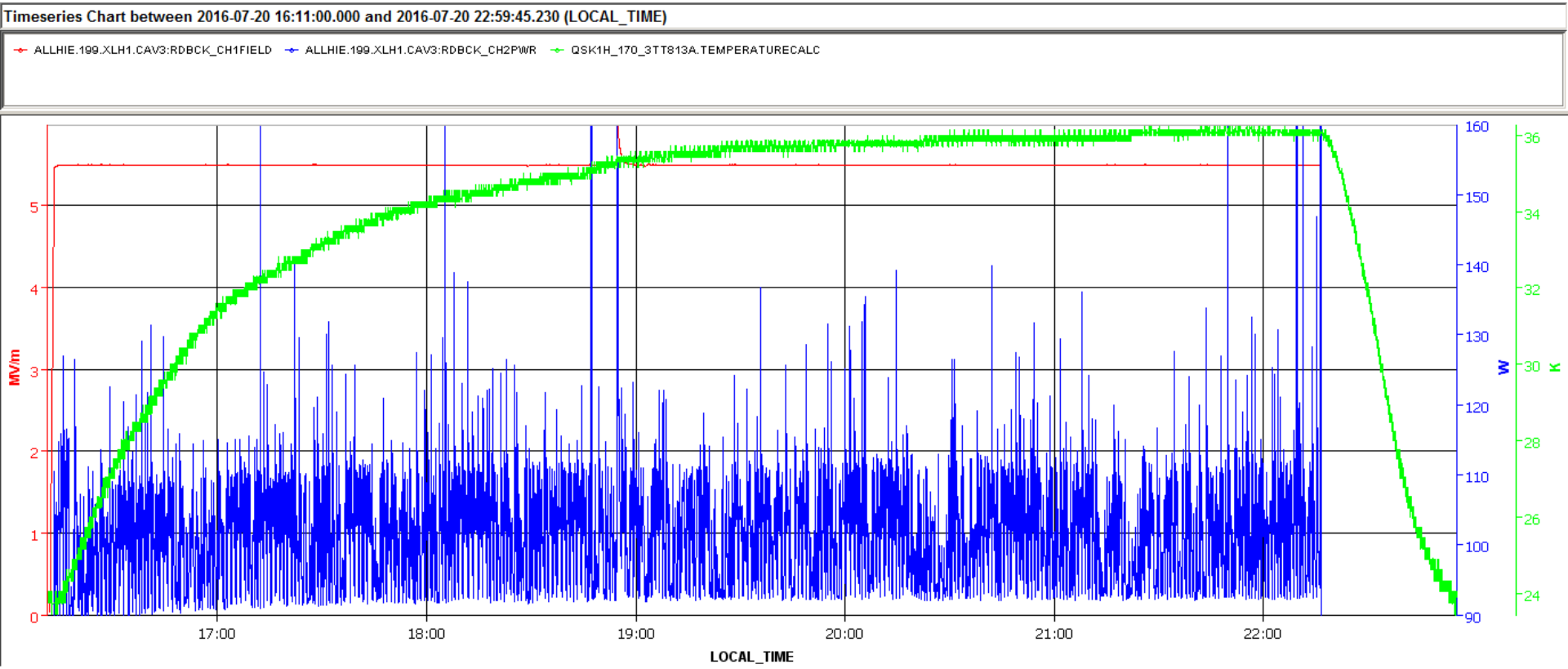
Cause of SRF cavities detuning



Improvements in the cryogenics process



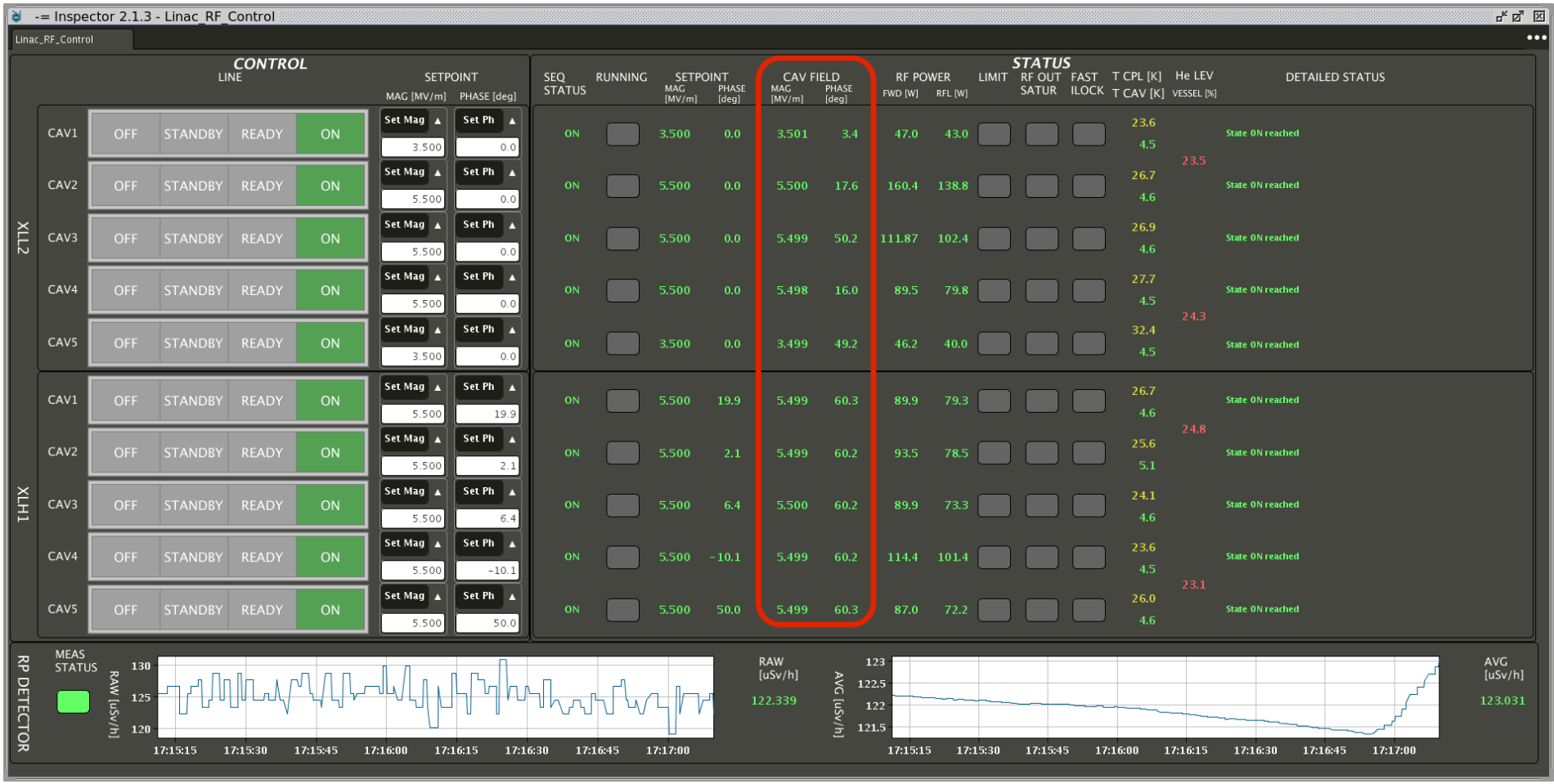
LLRF: first cavity locked at 5.5 MV/m



RMS forward power is stable ☺

Coupler block temperature reaches 36 K after 6 hours ☺

All cavities locked at nominal field for 2016 run as seen from the user interface for OP



Field Settings

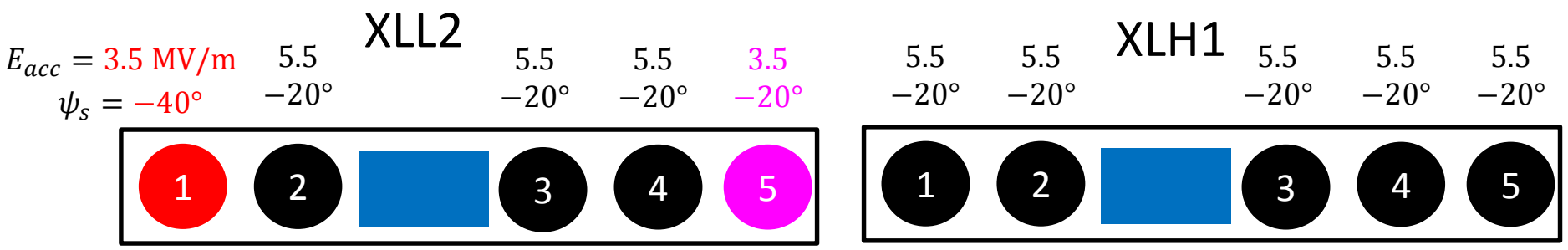
Conditioning XLL2.1 and XLL2.5 by He processing could be ***risky***

- The other good cavities could be spoiled as well

→ ***Postpone conditioning of*** XLL2.1 and XLL2.5 after the physics run

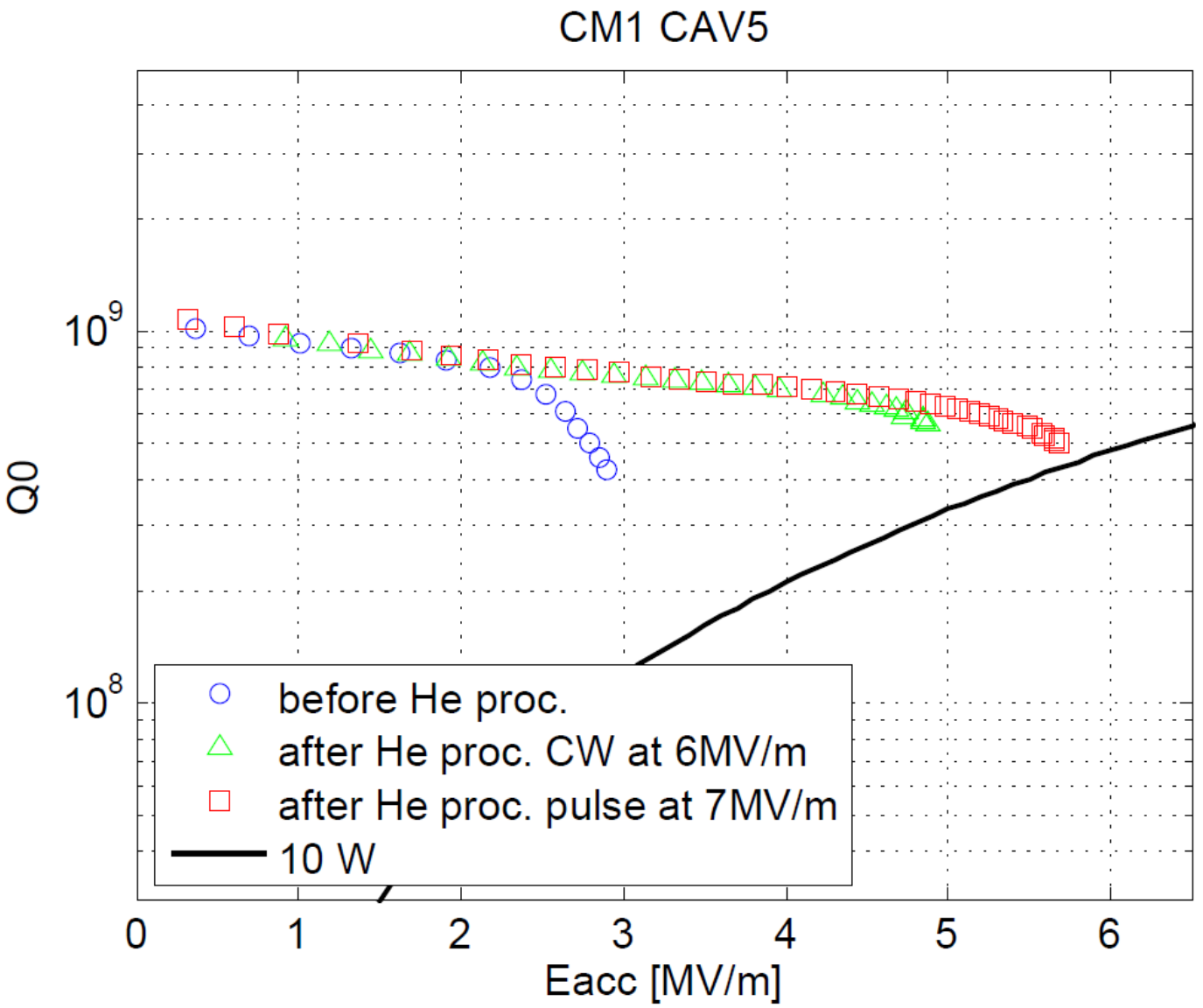
<u>for 2016 physics run</u>

- Keep the field of XLL2.1 and XLL2.5 at ***3.5 MV/m*** and compensate the total accelerating voltage by other cavities
- Bunching efficiency can be also compensated by increase the synchronous phase in XLL2.1 from ***-20 to -40 deg.***
- Total power consumption is well below 10W x 10 cavities



Same energy gain as all $E_{acc} = 5.0$ MV/m and $\psi_s = -20°$

He processing in situ (November 2016)



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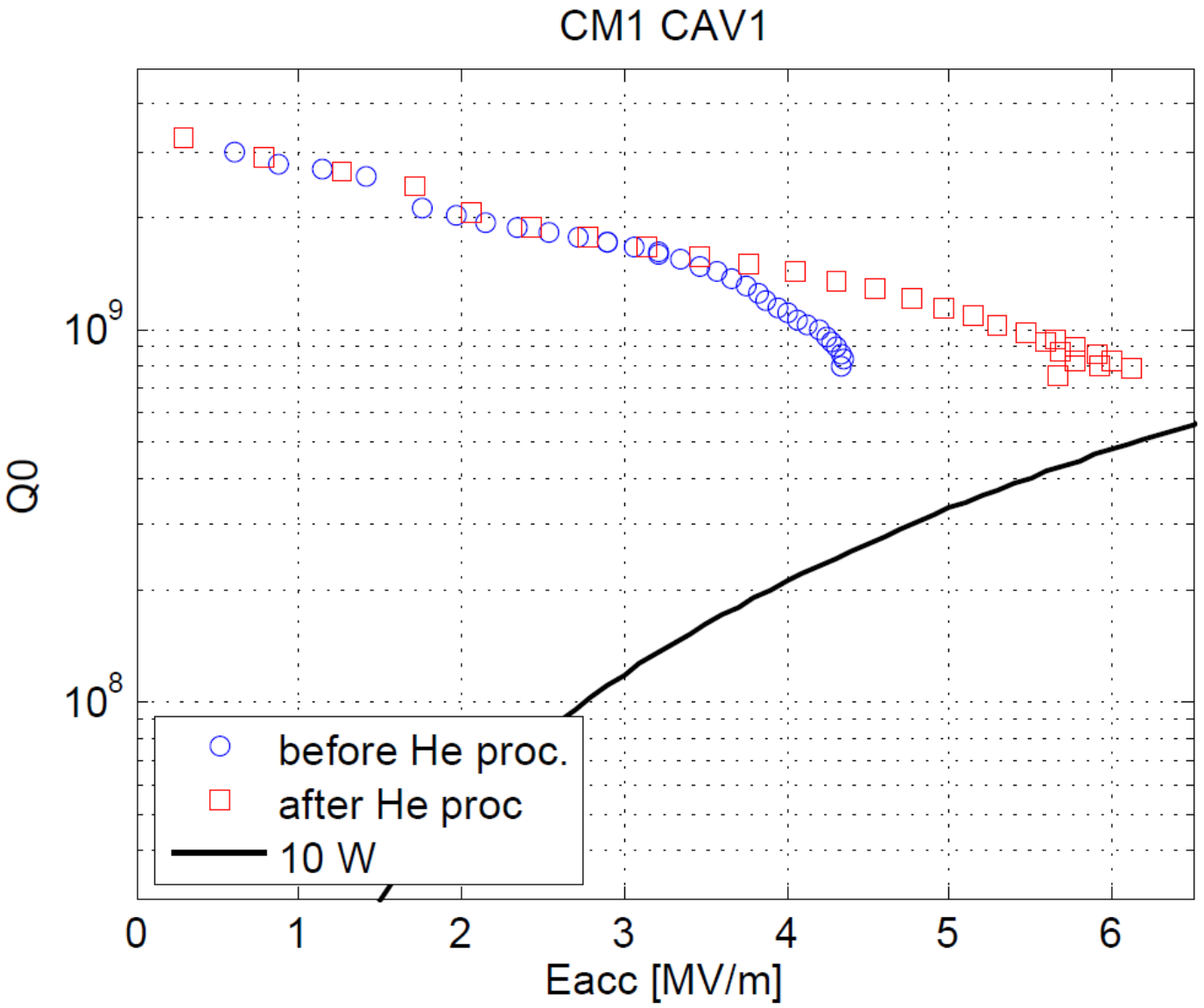
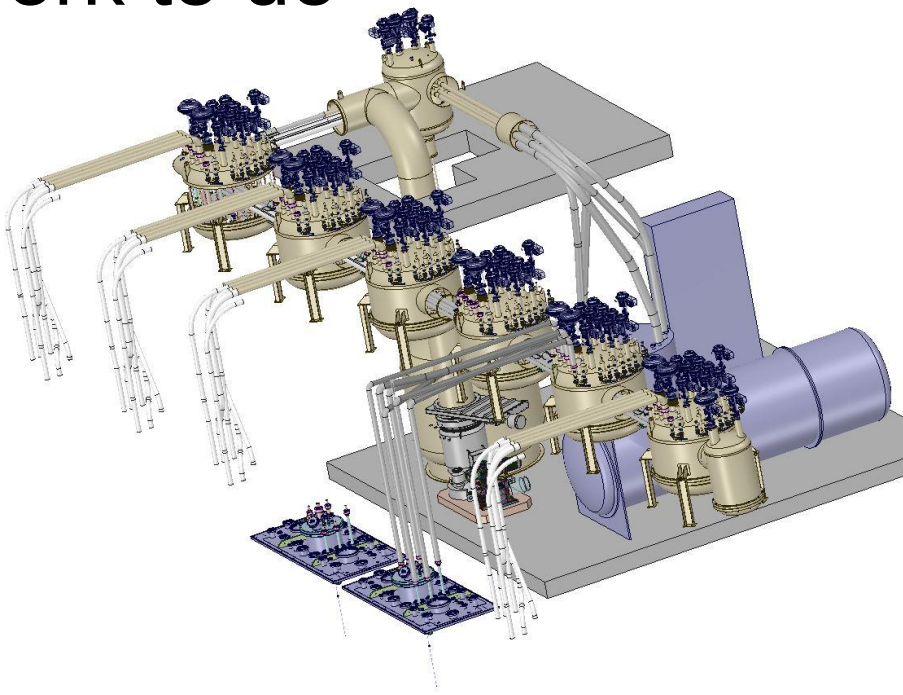
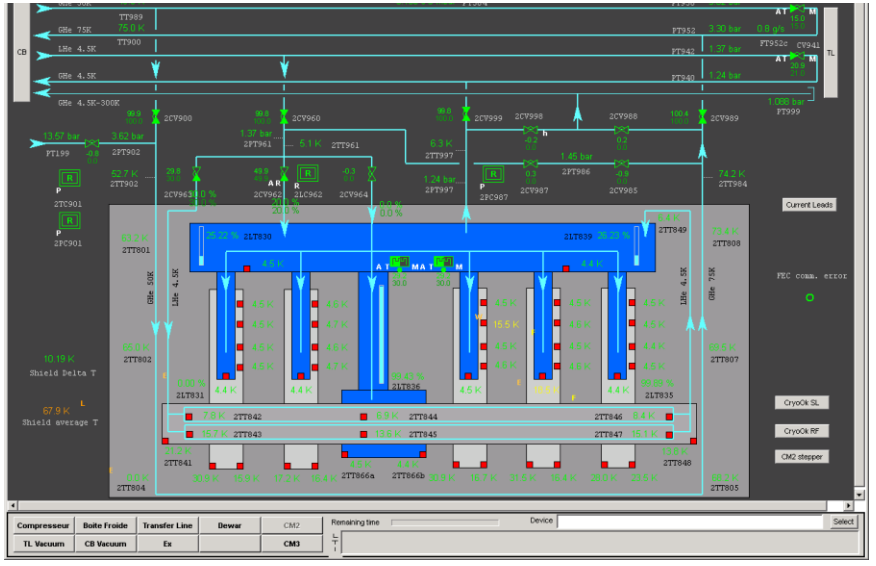


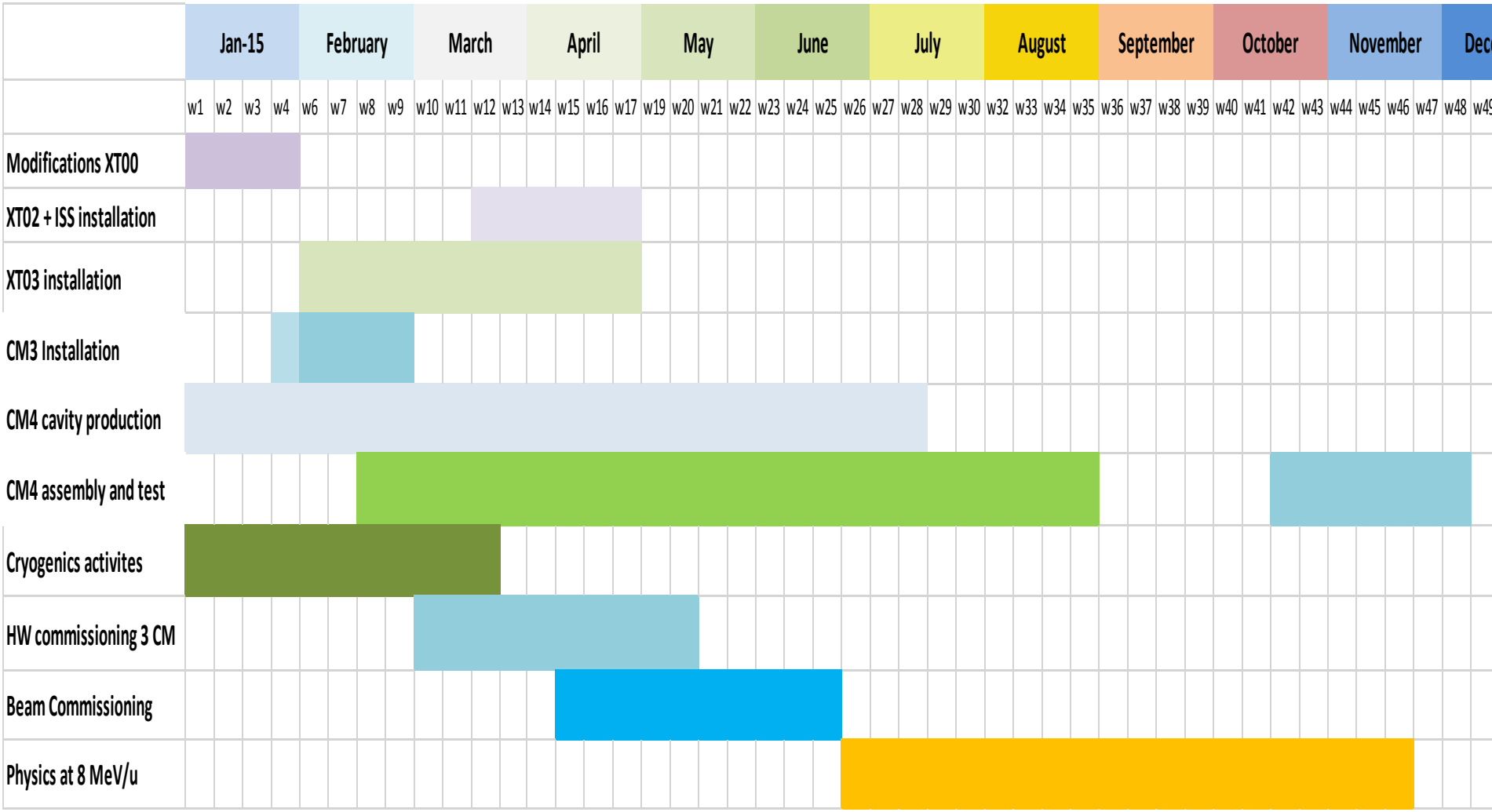
Cryogenics: issues and work to do

- **Heat load and oscillations** on the Cryogenic Distribution System → **Ongoing tests**: boil-off, power tests, cooling of jumper boxes thermal shields
- **Compressor flow capacity** (addressed at next re-start)
- Minor hardware and controls issues (CV positioners, program corrections, naming, ranges, faceplates) → Addressed during EYETS
- Automatic operation of cool-down, warm-up and recovery after power cut: manual operation for these modes till LS2 ☹





Simplified 2017 planning



Summary

- HW campaign split before and after physics run
- New RF couplers worked well
- He processing of SC cavities in situ demonstrated
- Outstanding issues:
  - Vacuum in CM2 to be verified after warm up
  - Cryogenics performance, ongoing
- Transport of CM3 to ISOLDE at end of January
- 2017 commissioning campaign starting in March 2017