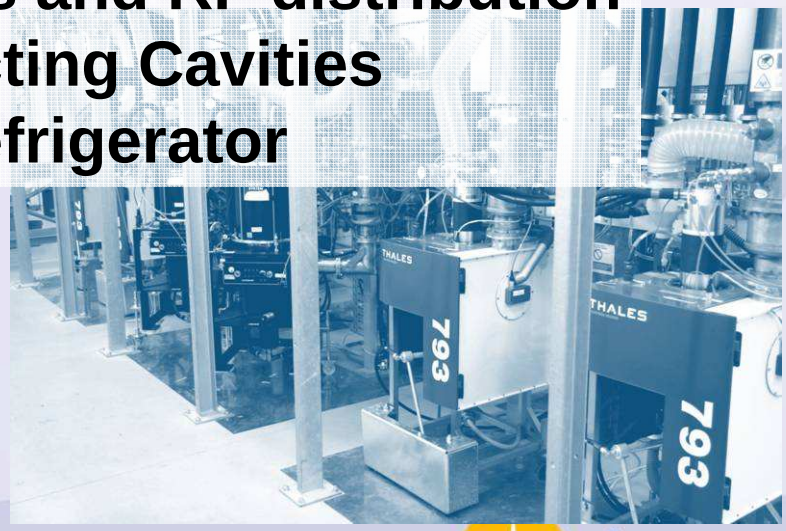
Update of the Storage Ring RF System

Morten Jensen on behalf of the Storage Ring RF Group

diamond

Agenda

- Current Status
- High Power Amplifier
- LLRF, Drive amplifers and RF distribution
- Superconducting Cavities
- Helium Refrigerator



diamond

Current Machine Status

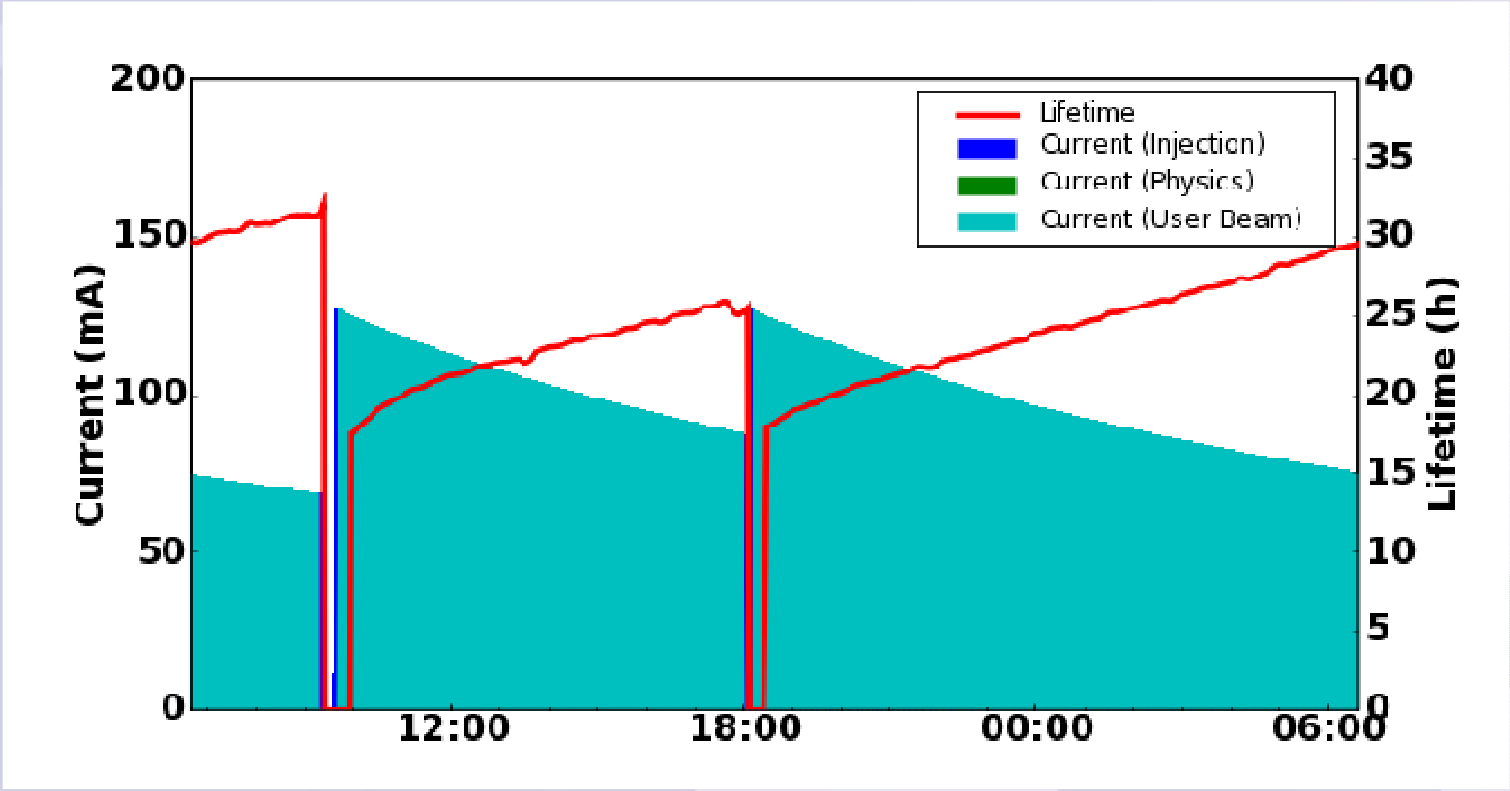
	Target	Achieved	
Energy	3 GeV	3 GeV	
Beam current	300 mA	300 mA	*not yet with IDs operational*
Emittance			
- horizontal	2.7 nm rad	2.7 nm rad	
- vertical	27 pm rad	4-50 pm rad	*coupling can be varied 0.15-2%*
Lifetime	> 10 h	12 h at 300 mA	*still improving*
Min. ID gap	7 mm	7 mm	*all 6 in-vac IDs operational*

diamond

“User Mode” Operation

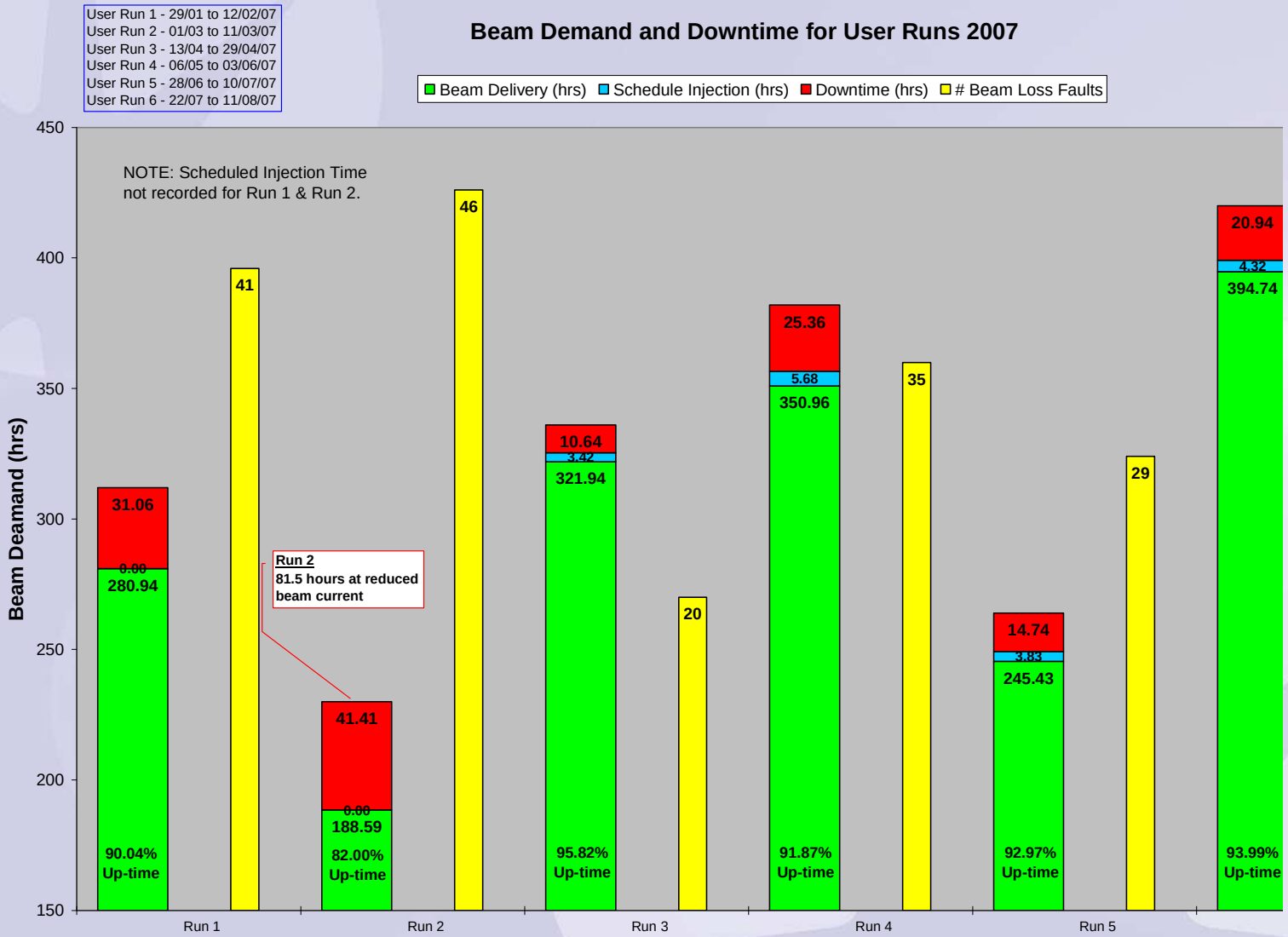
3000 h of User Operation in 2007, 4000h in 2008, 5000 h in 2009

current operation: 125 mA maximum, 2 injections/day



diamond

“User Mode” Operation started 29th Jan 2007



First 6 runs: 1944 hours of User Mode with 92% up-time

[NB] injection counted as down-time

High Power Amplifier

Reliable operation with few amplifier trips

Loose HV connector
Bus bar incorrectly installed

Coaxial connector misaligned

Remainder of faults are either unexplained or trips to do with the IOTs

Separate enclosure around IOTs, racks and combiner being constructed to eliminate dust and for improved temperature stability.

diamond

High Power Amplifier

Systems 1 and 2 handed over and in regular use for operations
System 3 undergoing final measurements and tests
New long term test agreed to rest at 10% below nominal duty, ie 270 kW for 120 hrs
Last run at 300 kW ran for 3 days but then tripped!

Three IOT failures:

- #1 TED IOT due to arc detector not working and ceramic cracked (split cost of replacement)
- #2 TED IOT Loss of output, reason unknown (split cost of replacement
- #3 e2v IOT very early failure, reason unknown, free replacement

diamond

High Power Amplifier

System 1 and System 3 installed with TED IOTs
System 2 installed with e2v IOTS

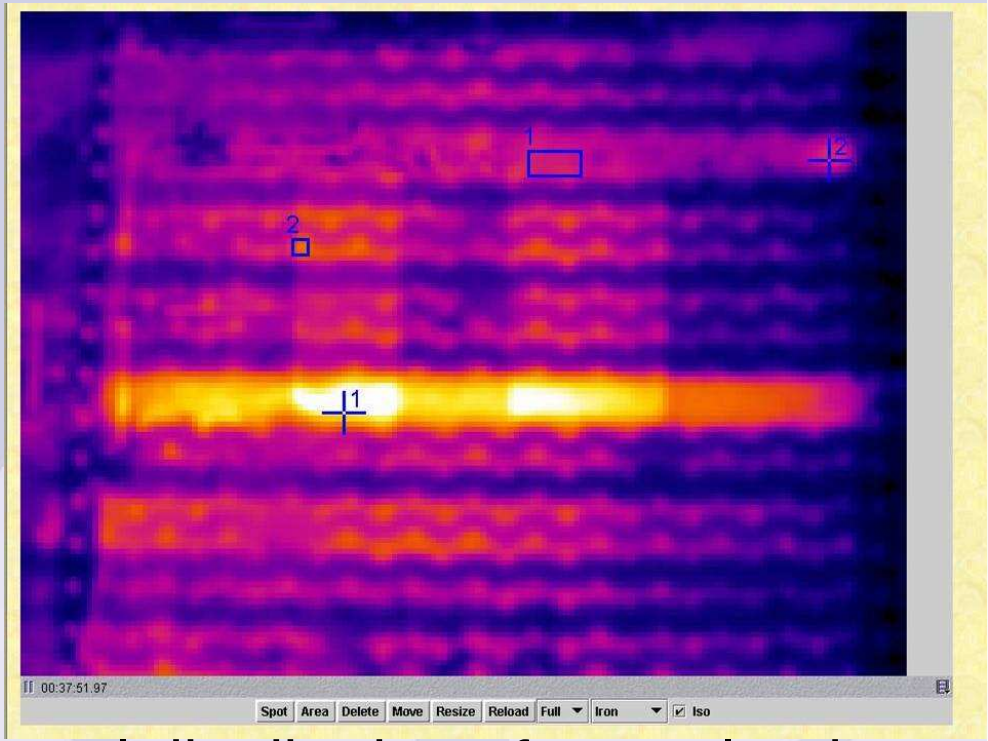
e2v IOTs achieved 300 kW in a couple of days but also trips at 300 kW.

diamond

High Power Amplifier

300 kW loads still trip and loose tiles.
One load returned to AFT for repair.

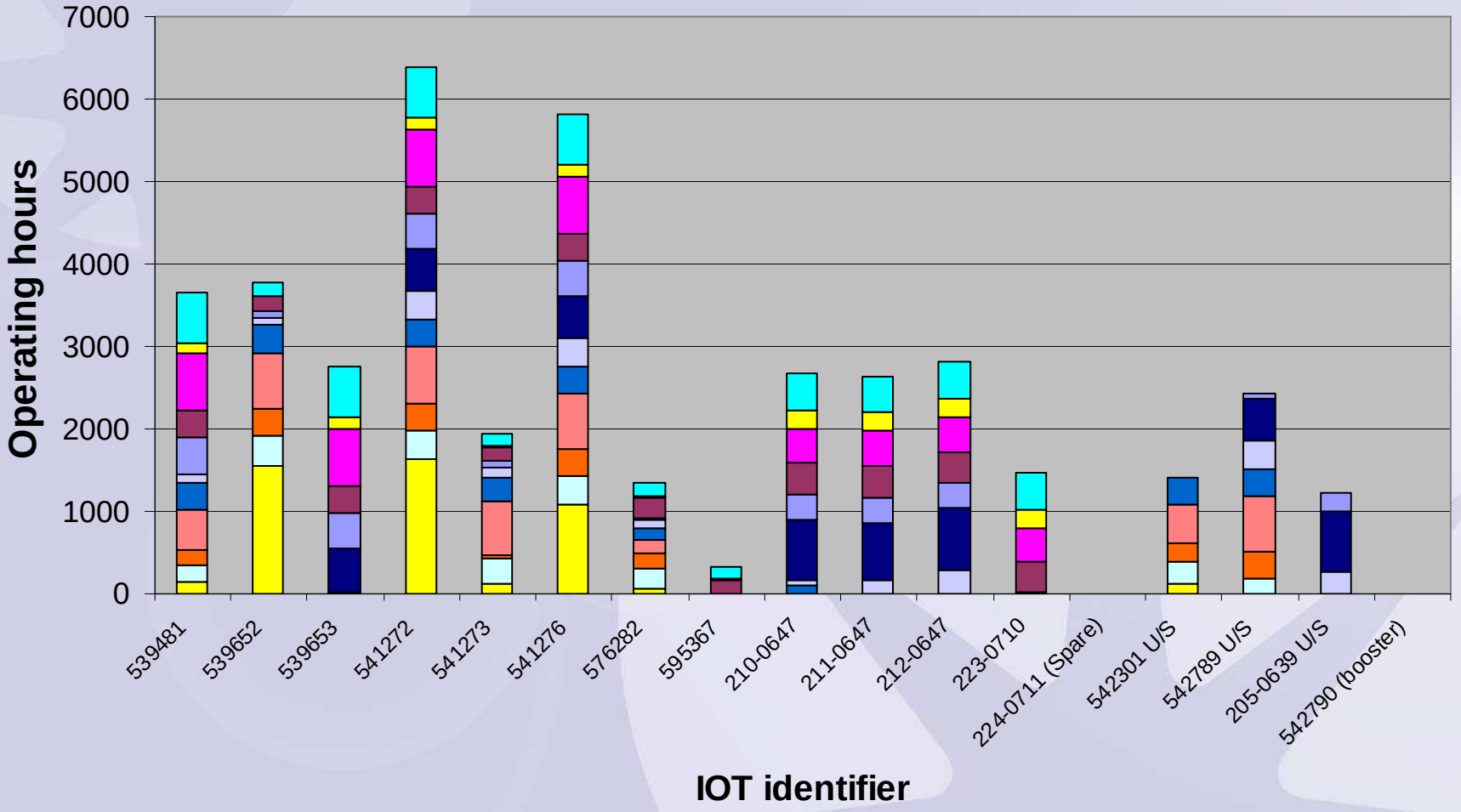
Two sections to be replaced for lower loss and further section added



Thermal distribution of water load indicates blocked channel

diamond

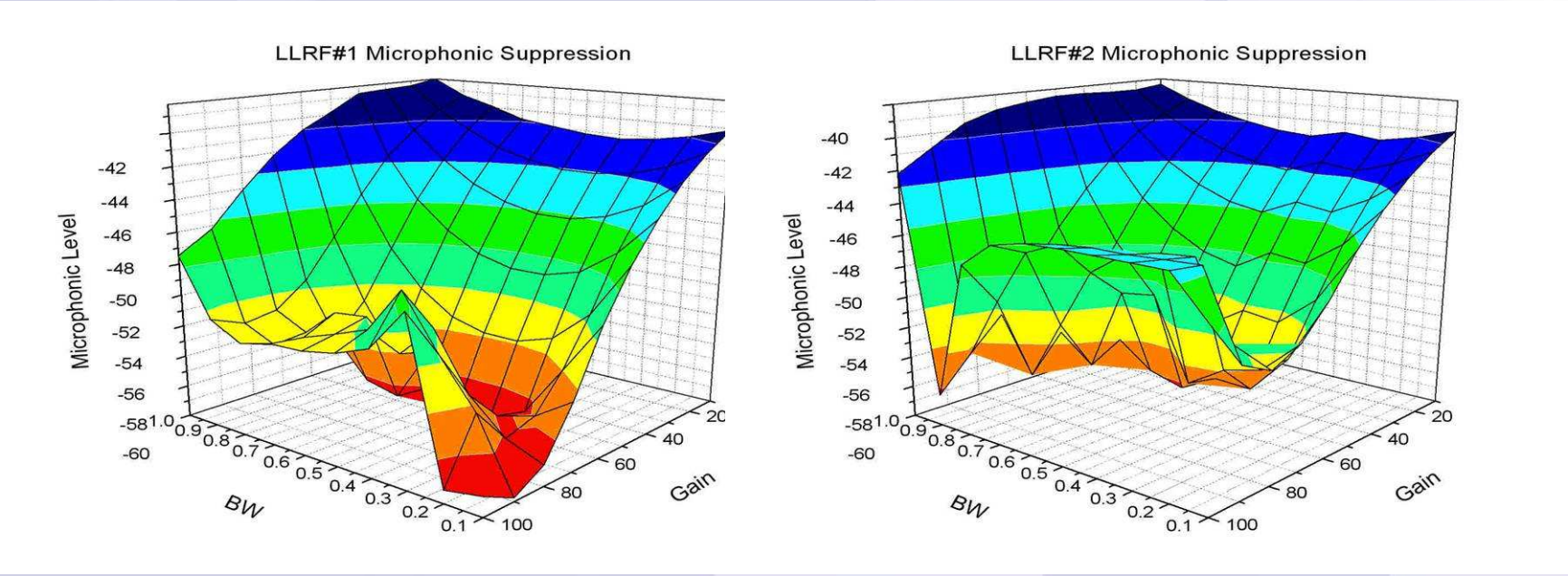
High Power Amplifier



diamond

Drive amplifiers, LLRF and RF Distribution

- 2nd LLRF commissioned enabling 2 cavity operation
- LLRF systems still being characterised
  - Systems behave differently
  - Recent info on oscillation with high current operation for LLRF 2
- Good reliability, only faults being stepper motor cards

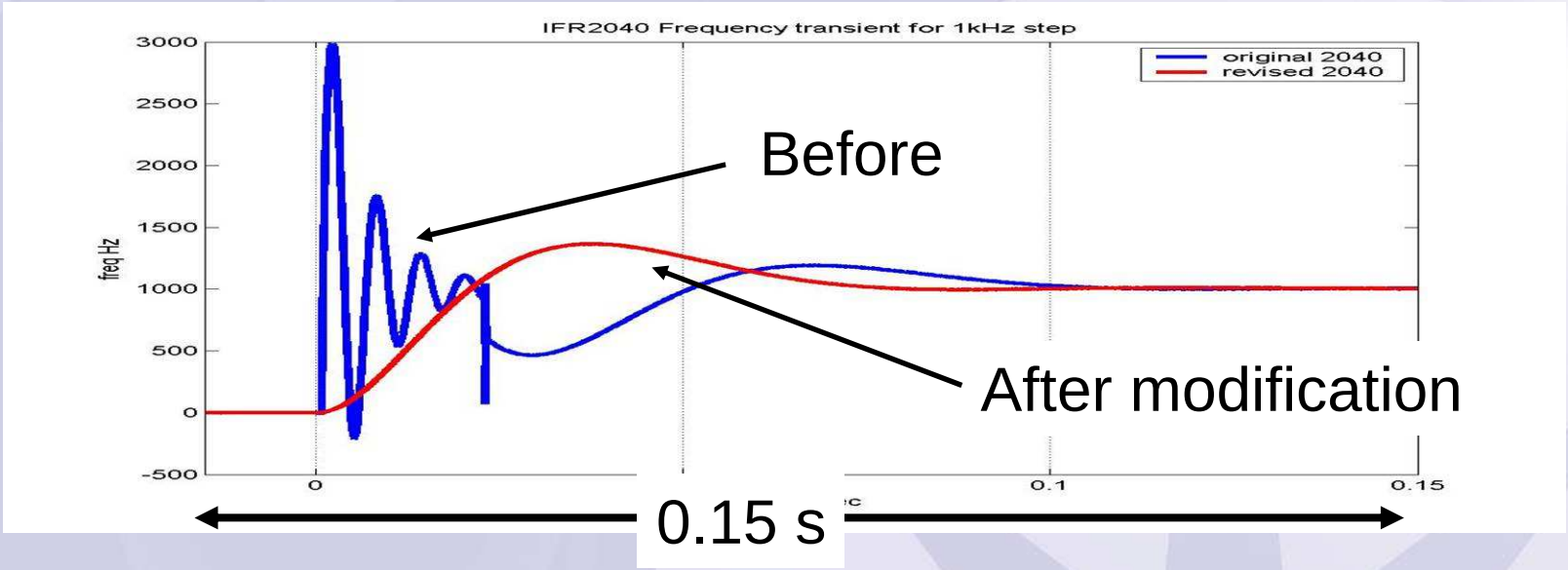


Measured suppression of 2 kHz microphonics (applied via cavity simulator)

diamond

Drive amplifiers, LLRF and RF Distribution

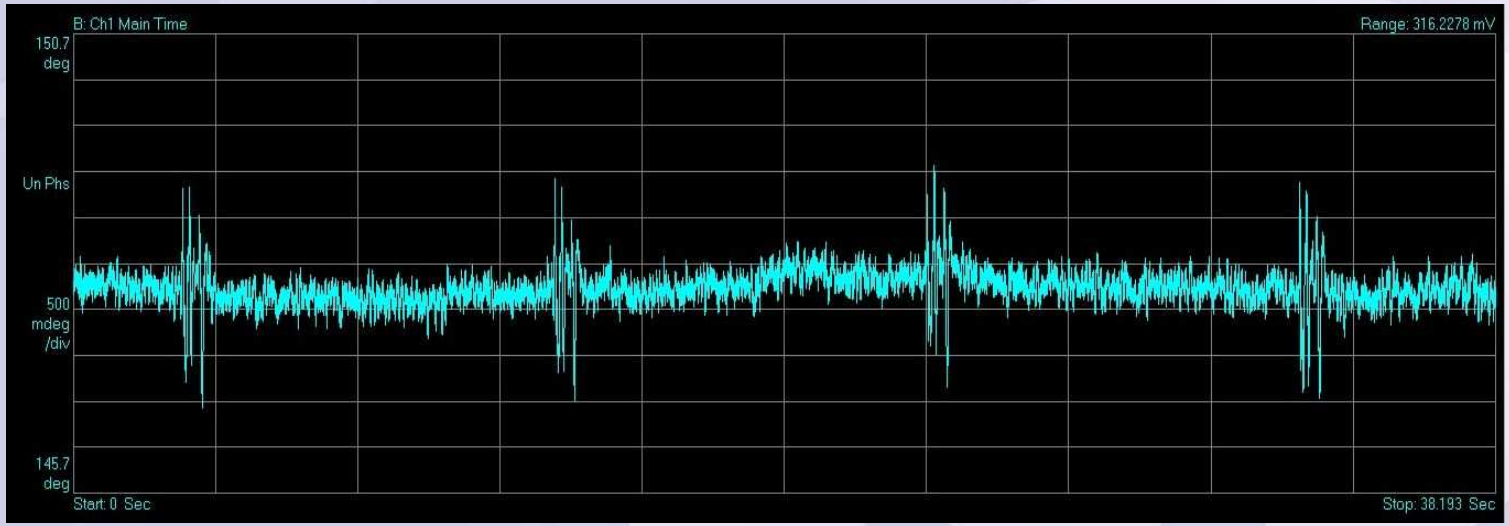
- IFR 2040 signal generator
  - Transient on change of frequency not observed in MO selection tests



Frequency transient before and after MO firmware upgrade

Drive amplifiers, LLRF and RF Distribution

–Phase transient of ± 1.3°when EPICS reads (queries) MO settings



Transient on cavity phase with EPICS MO read every 10 s

Drive amplifiers, LLRF and RF Distribution

- Drive amplifiers being optimised for 500 MHz gives higher gain, more power, less heat
- Reliable operation
  - A few failures at start of operational life, due to production issues
  - Two failures of output stage transistors

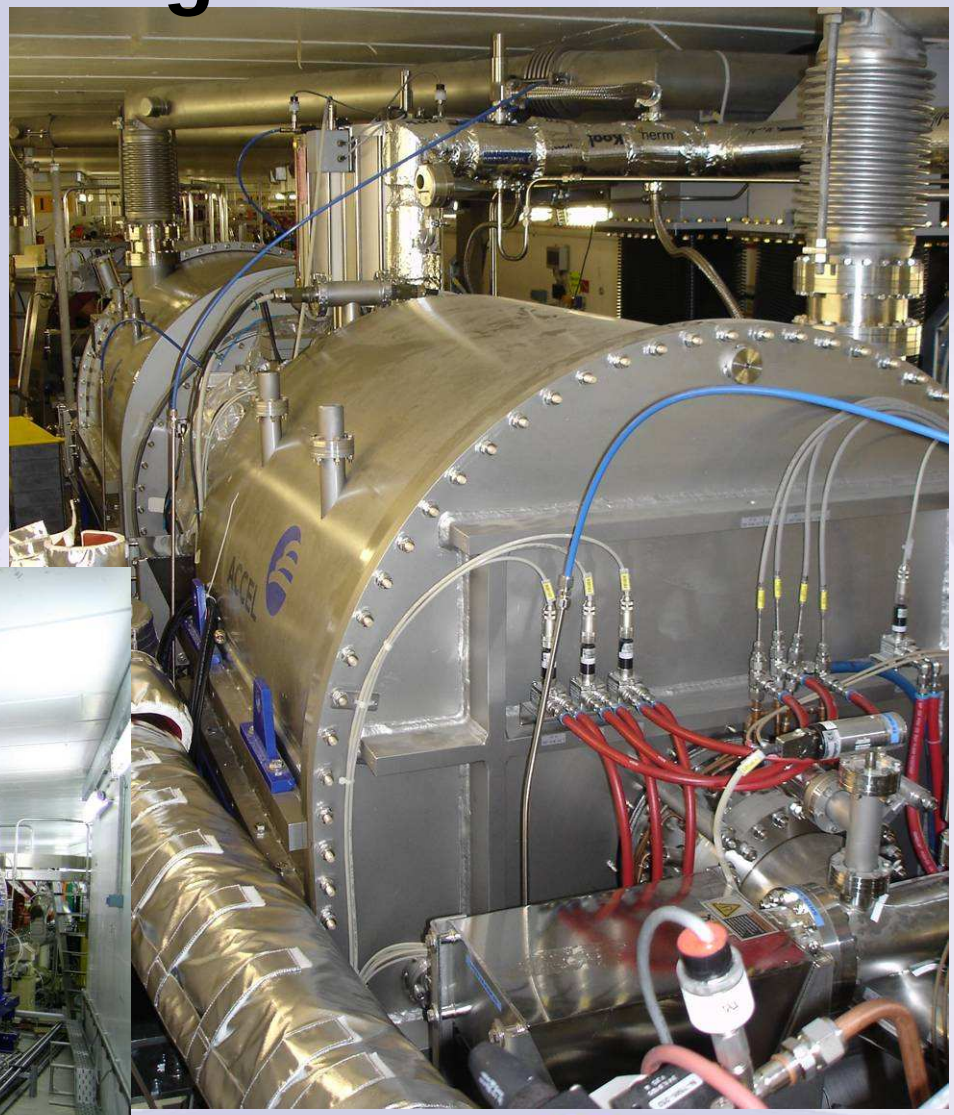
Ongoing

- Improve tuner control
  - PID optimisation
  - replace stepper motor controller
- Cryogenic load leveller
- New secondary water cooling system being designed will improve gain, output power and thermal stability

Superconducting Cavities

Cavity 3 Removed and returned to ACCEL for repair – Turn around 12 months

Cavity 1 and 2 currently installed



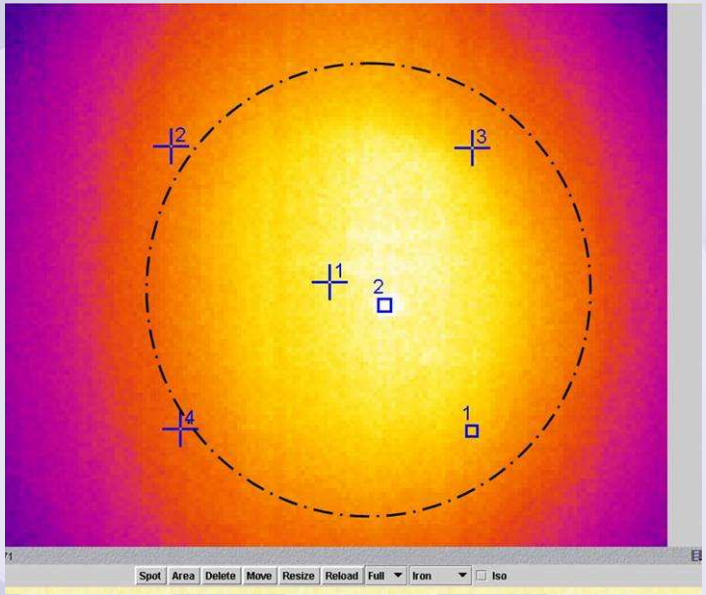
Superconducting Cavities

Cavity 1 and 2 currently installed

Conditioning has been slow

Cavity 1 normally very reliable
Cavity 2 is improving but control room not very patient!

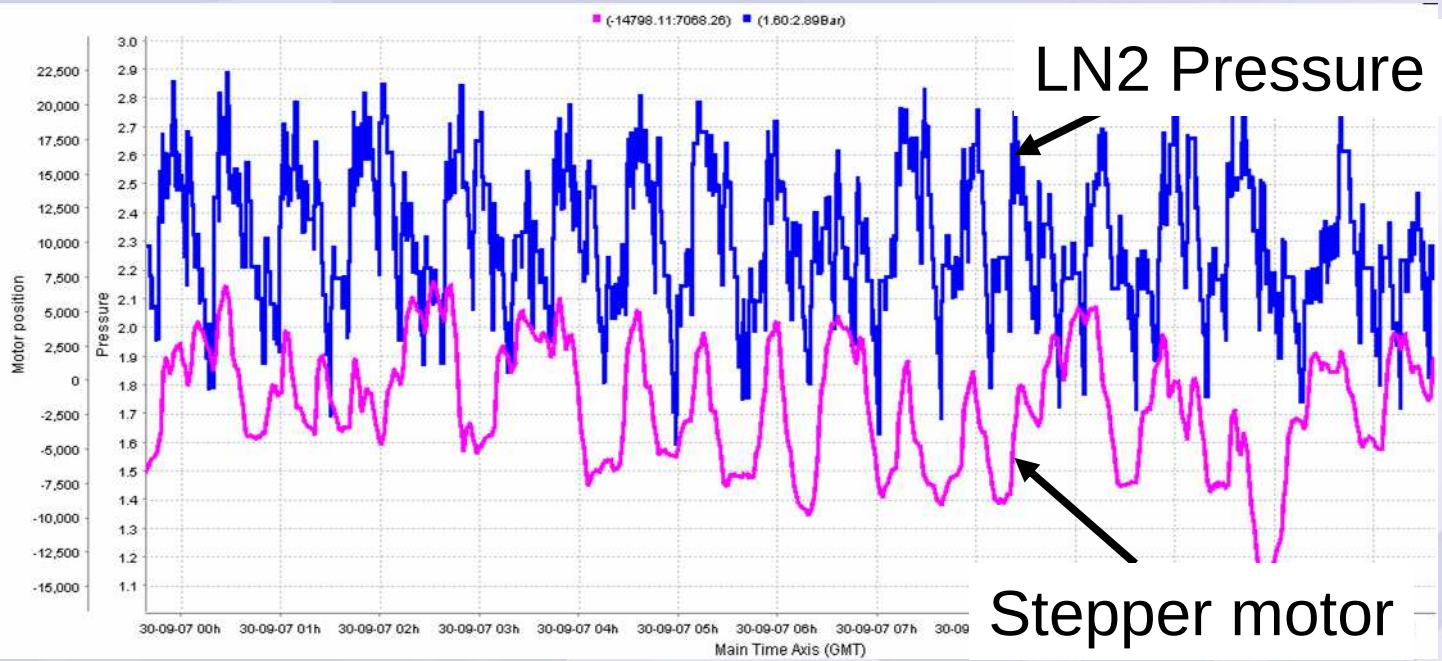
Cavity 1 max current = 200 mA
Cavity 2 max current = 165 mA



Thermal distribution with cavity detuned (73 kW, no beam)

Superconducting Cavities

Two flow meters replaced due to water contamination
Alternative type being sourced

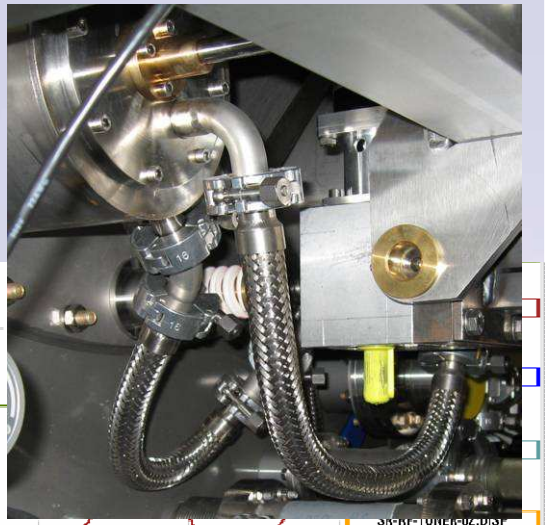


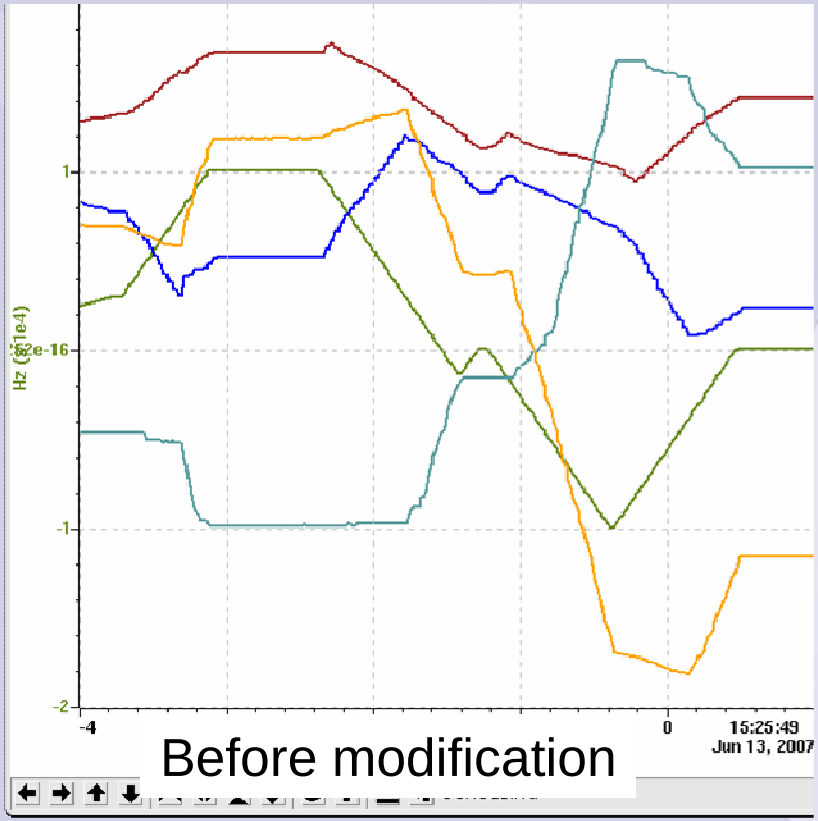
1 bar LN2 supply pressure variation leads to significant tuner motion

diamond

Superconducting Cavities

Significant phase jumps observed on cavity phase
Tuner found to be sticking, long backlash and jerky motion
Tuner was re-fastened and compensation bellows and spring isolated





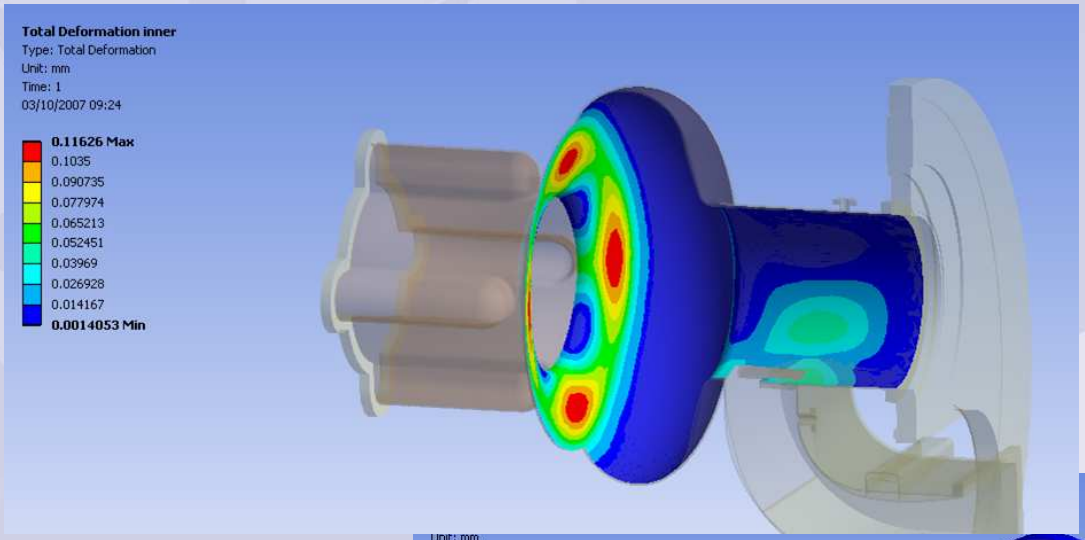
Before modification

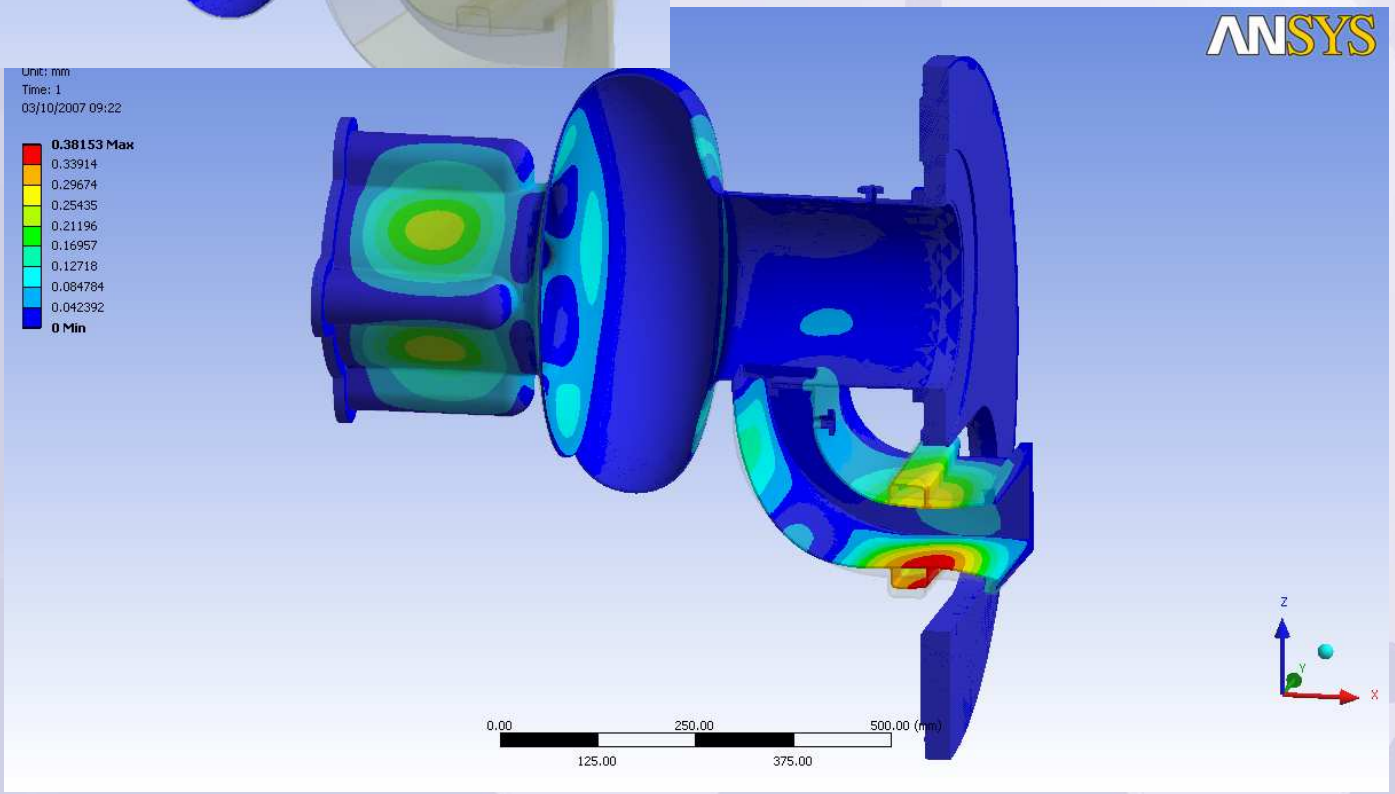
After modification

Cavity tuner operation has improved with mechanical changes:
generally ± 5° tuner control rather than ± 15° repo rted last year

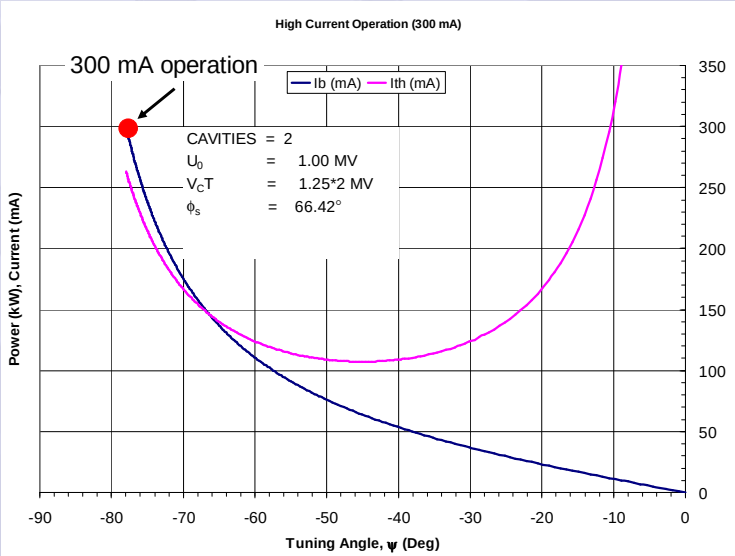
diamond

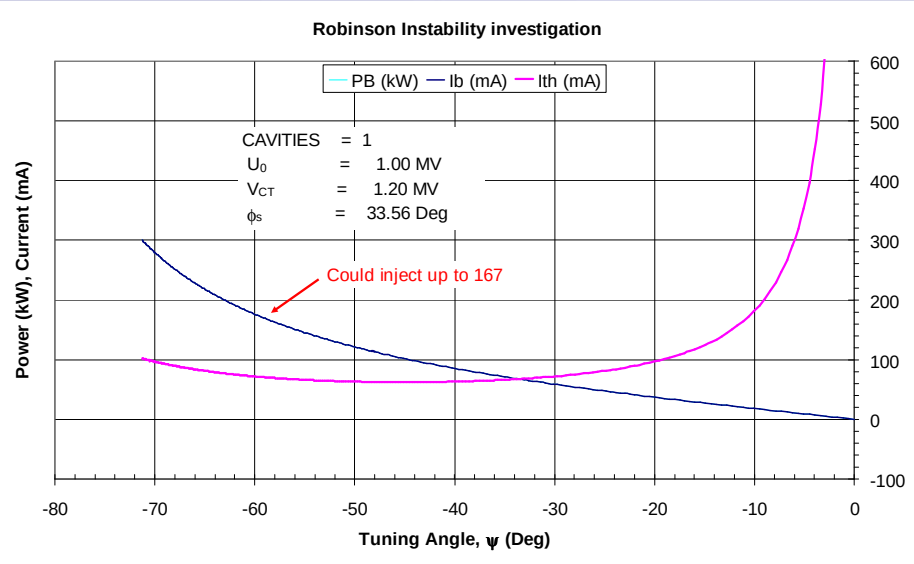
Superconducting Cavities

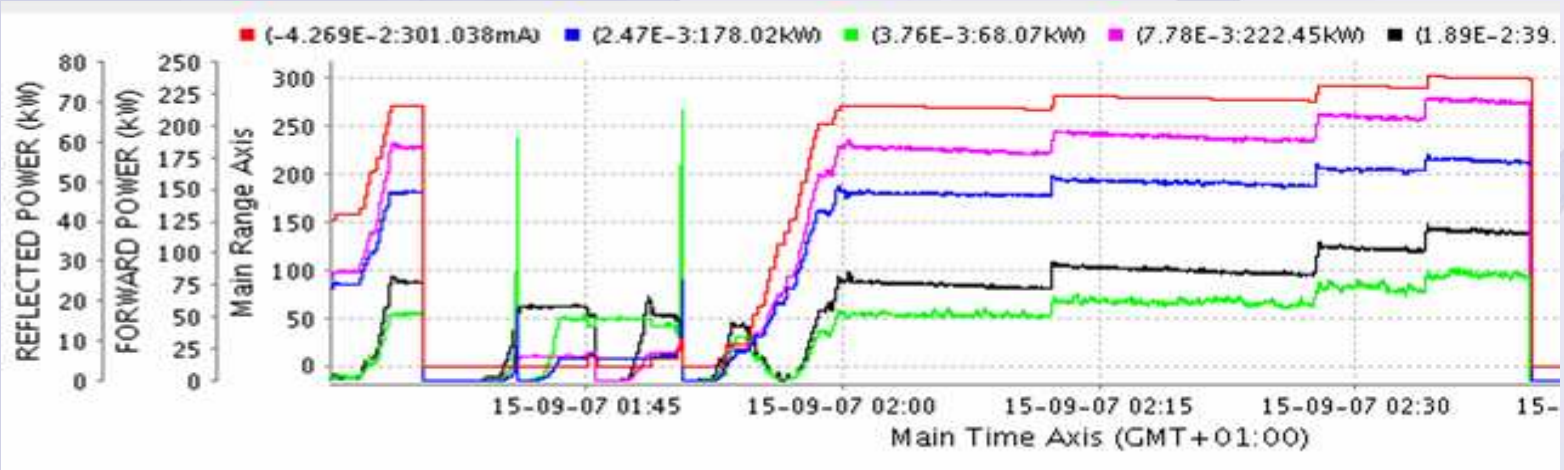




Superconducting Cavities



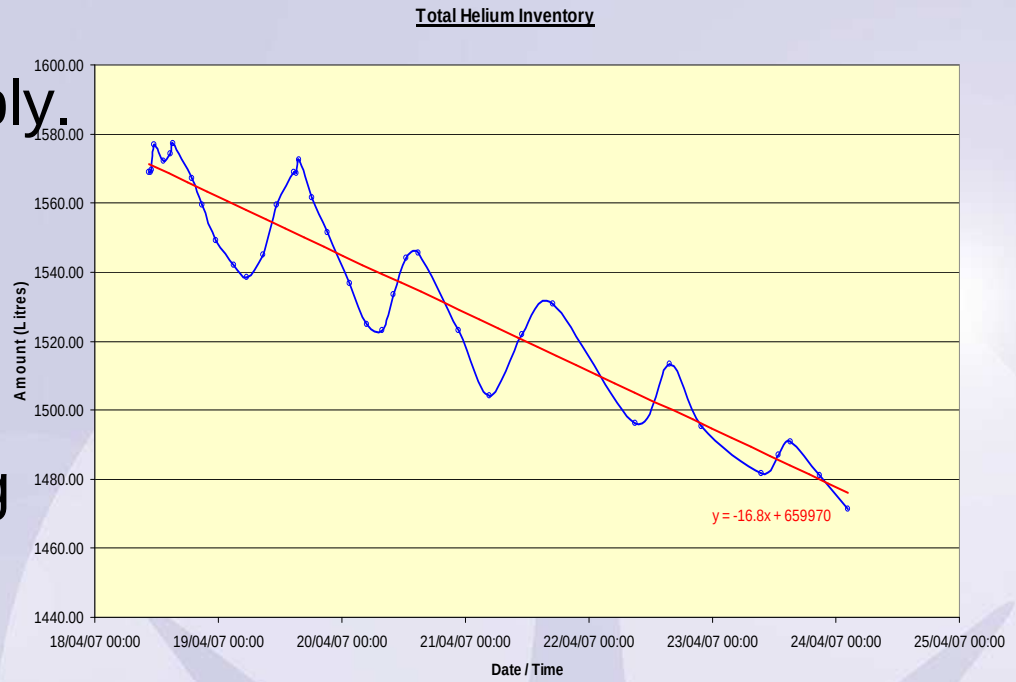




diamond

RF Group – Helium Refrigerator

- Has operated very reliably.
- Problems this year:
  - Leak on pyrolyser
  - System leak following maintenance



Pressure in buffer tanks
Oscillation due to outside temperature
Downward trend due to leak

Neither caused any downtime to operations

diamond

Thank you for your attention on behalf of the Storage Ring Radiofrequency Group