JAGIELLONIAN UNIVERSITY IN KRAKOW

SOLARIS NATIONAL SYNCHROTRON RADIATION CENTRE

Status of the SOLARIS RF system

21st ESLS RF Meeting

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08.11.2018

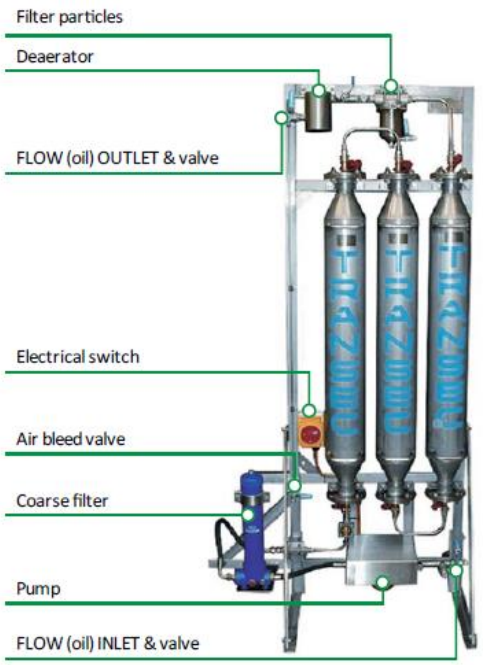
Outline

1. **Linac - Maintenance**
2. **Linac - Issues**
3. **SR RF - Projects**
4. **SR RF - Maintenance**
5. **SR RF - Issues**
6. **SR RF - LLRF**
7. **SR RF – Spare parts and future**

Linac
Oil dehydration

Periodic inspections of the water content in insulative oil required.

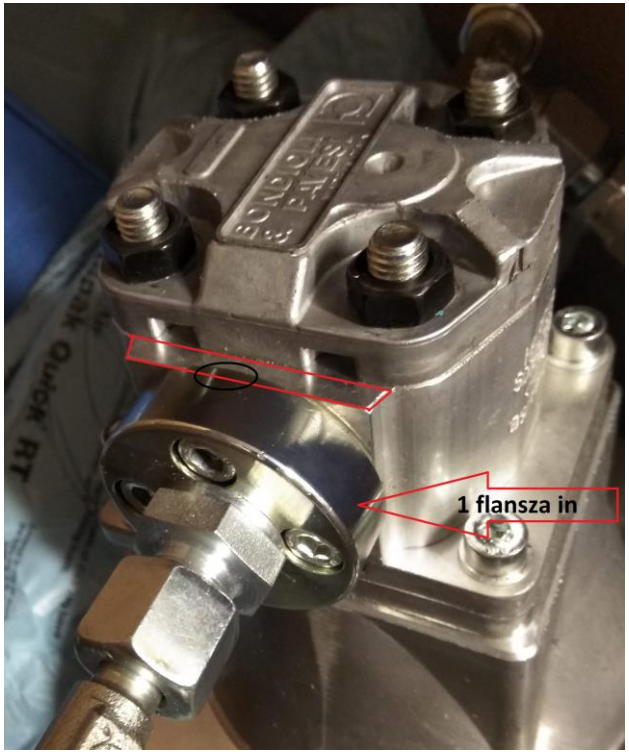
- Previous filtrafion operations proved succesful, although there was still some space for improvements.
- Some amounts of oil were lost during transfering between various containers as filtering devices are suited for lager, industrial size transformers.
- New device of much smaller size has been found, it can do the filtering without shutting down of modulators.
- Some plumbing modifications needed to adapt modulator's cooling system to the new device.



Linac Issues

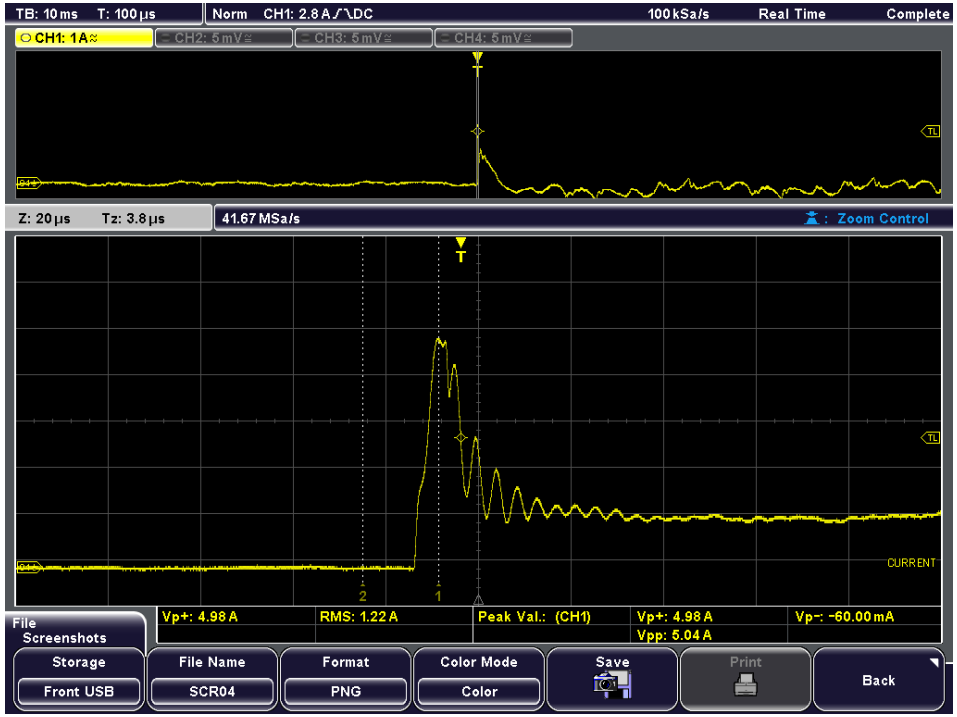
Oil pumps leak a small amount of oil

- Spare o-rings and gaskets ordered. Spare pump was disassembled and inspected for any weak points. Replacement of parts scheduled next shutdown



Increased leakage current in some HVPS in modulators.

- Might be a sign of HVPS wearing down, issue requires further investigation



Storage Ring RF Layout

6 1/8” EIA rigid coax line and 60dB directional couplers

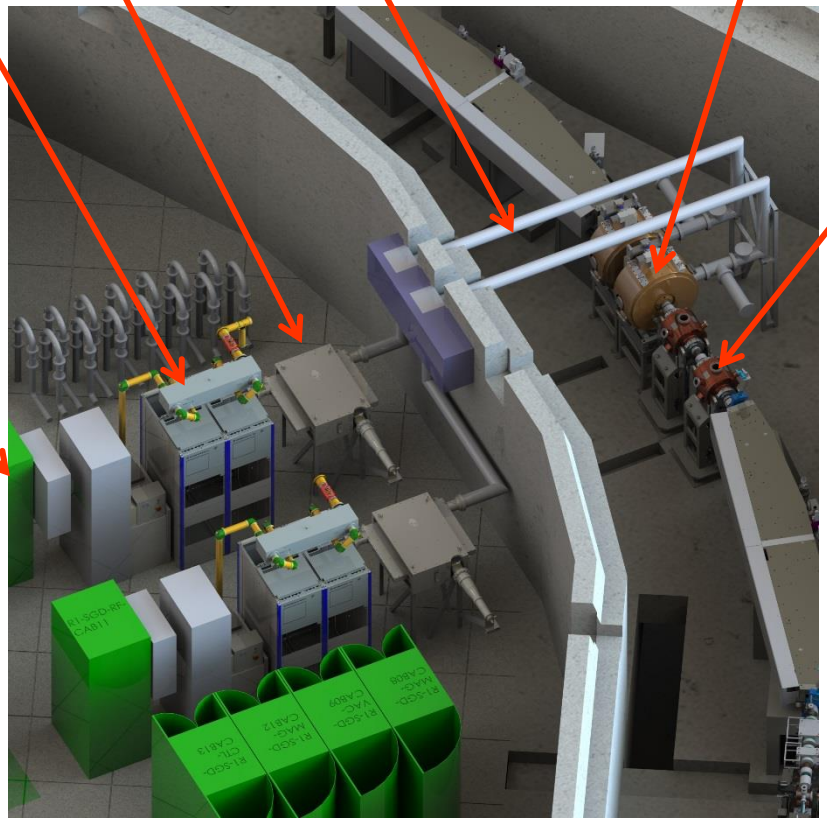
120 kW CW Isolator

60 kW CW, 100MHz RF Transmitter THR9

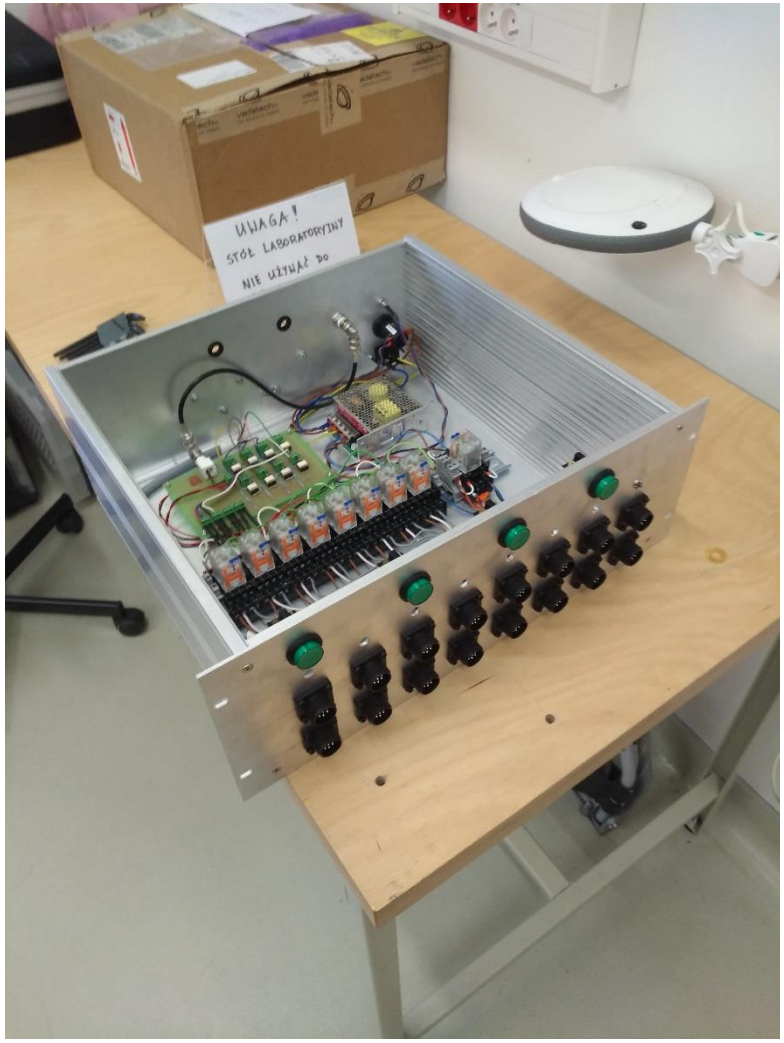
Digital LLRF for Storage Ring

100MHz Main active cavity

300MHz Landau passive cavity with tuning plunger

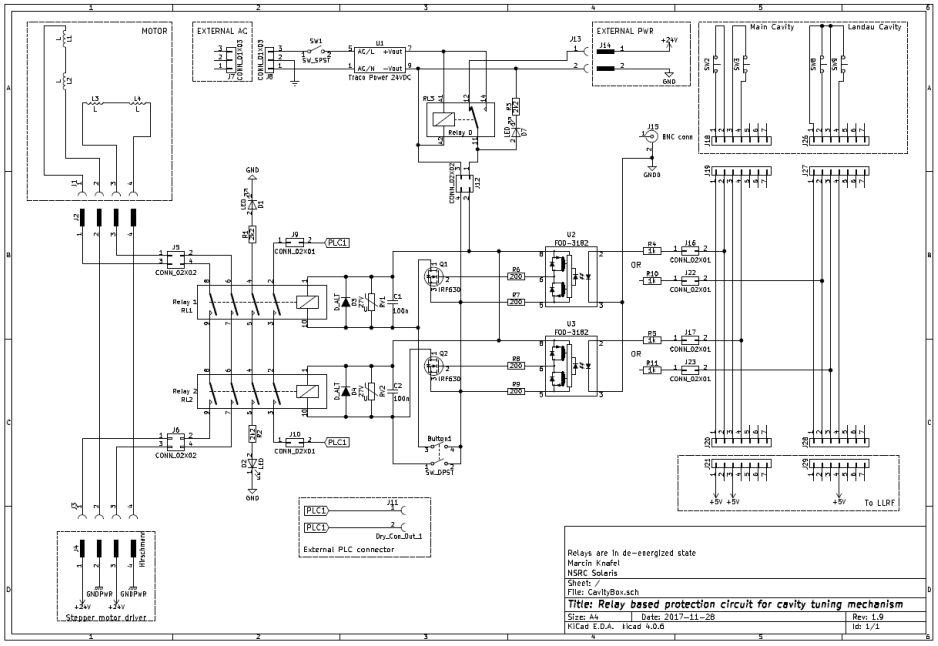


Storage Ring RF Projects



Project „CavityBox”

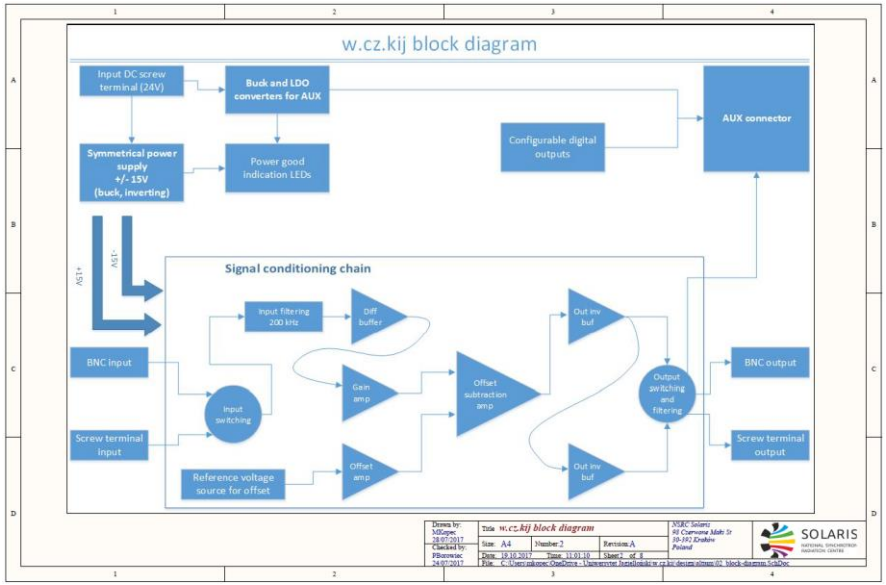
- Simple relay based circuit to protect cavity stepper motors from tuning the cavities beyond their physical limitations
- Designed to switch off the power from the motors as soon as a limit switch is reached
- Requires physical interaction in order to reset an interlock (feature, not a bug!)

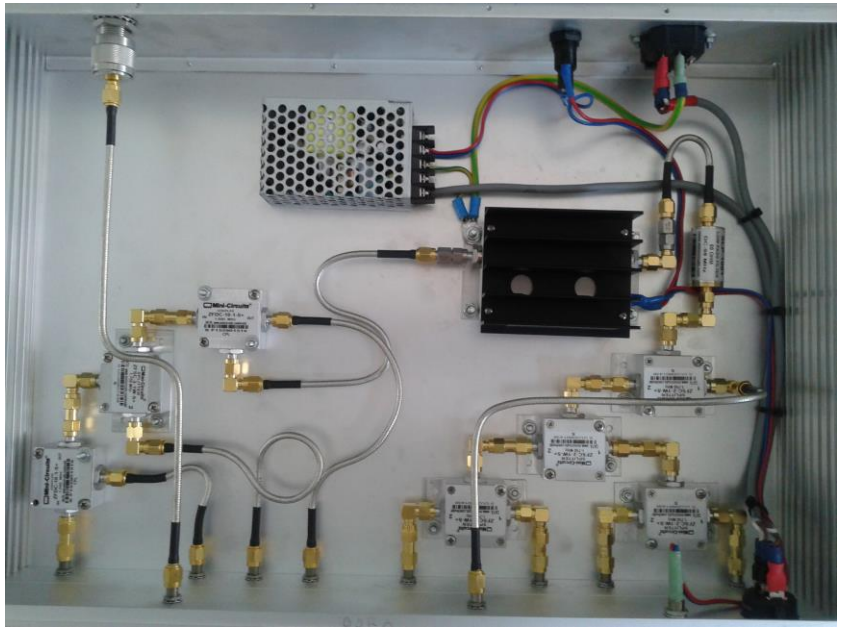


Storage Ring RF Projects

Master oscillator signal splitter

- Increasing demand for MO signal from various devices
- Cannot split signal using splitters due to increasing drop in signal power
- New device built and tested to satisfy the needs



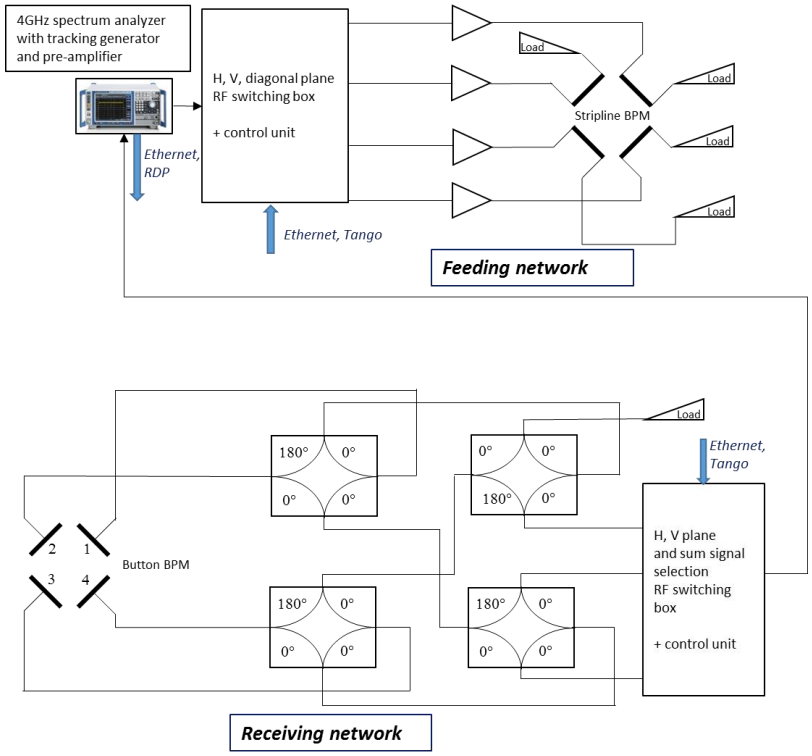


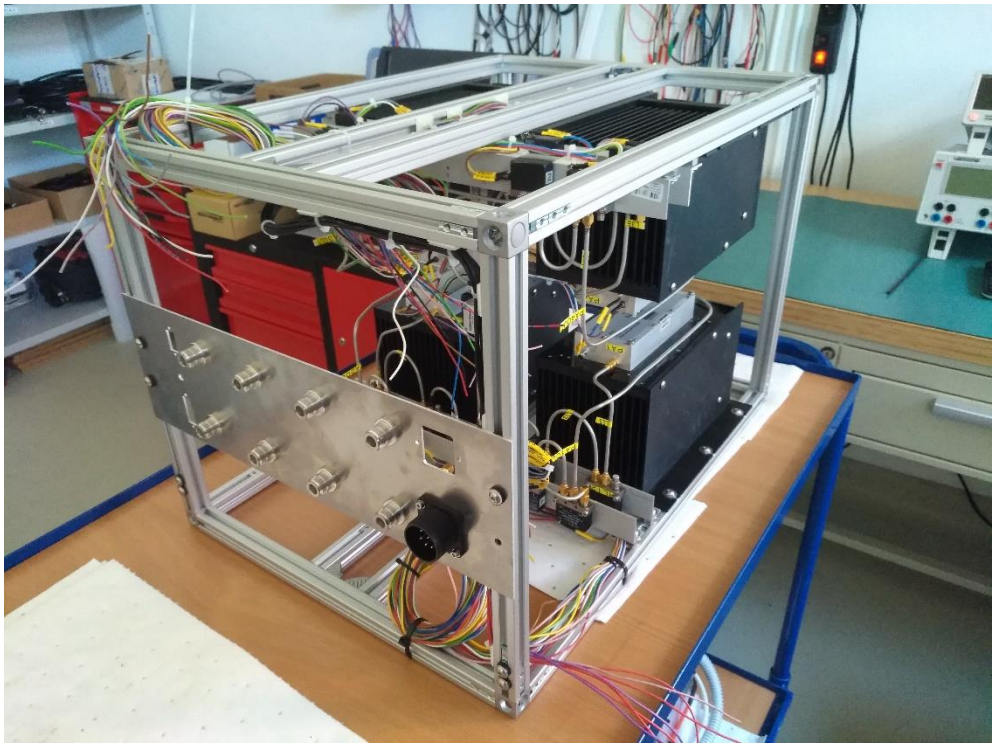
Beam Current monitor

- Need to incorparate information about beam current level in LLRF
- A proper device was built to measure readings from DCCT and to output a voltage signal proportional to beam current

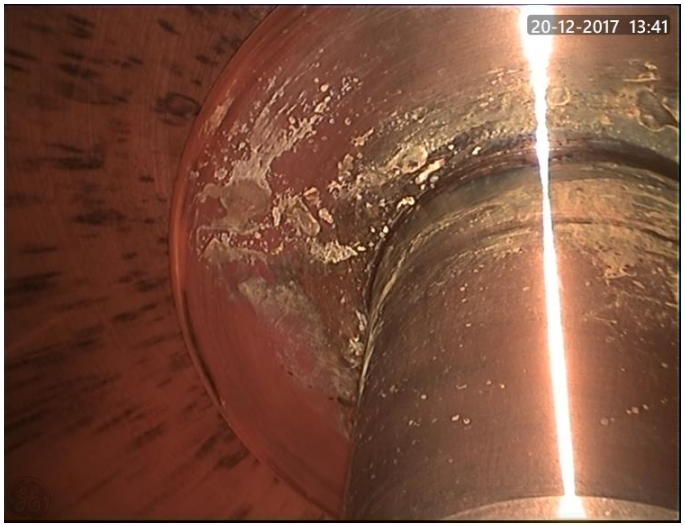
Tune measurement device

- Built according to MAXLAB specification
- Stripline feeding network in measurement stage
- Work in progres





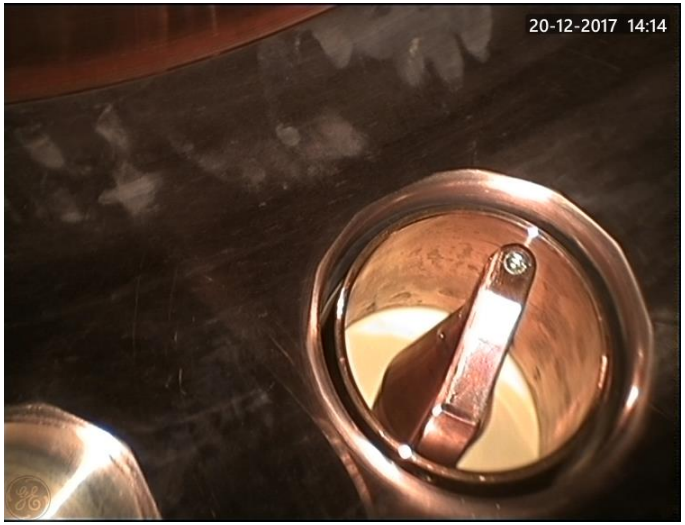
Storage Ring RF Maintenance



100MHz CAV2, mushroom

Cavities endoscopy

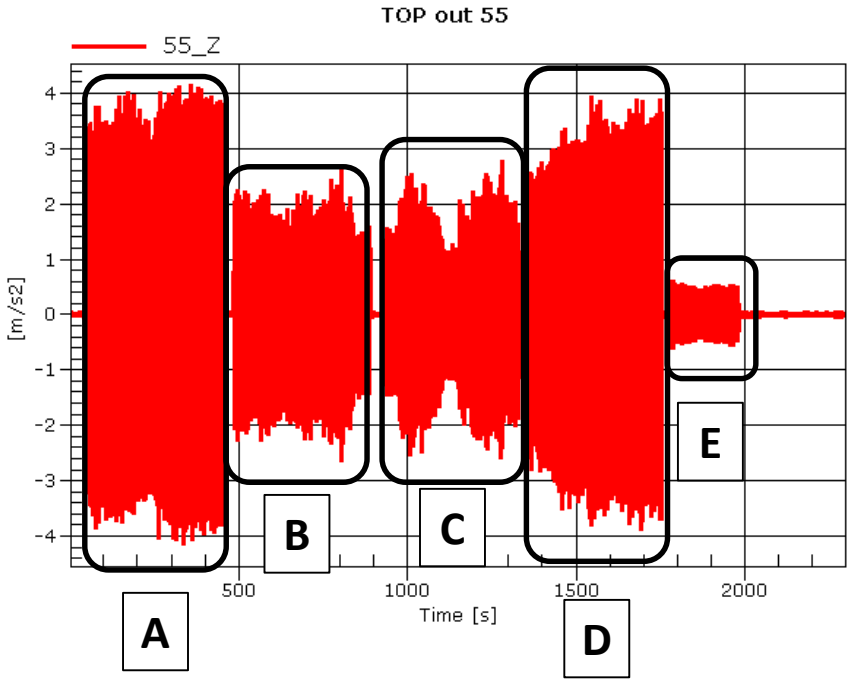
- Since machine installation the cavities were not inspected internally.
- During shutdown this opportunity was used to carry out an endoscopy.
- Results were slightly suprising.
- Most of cavities are clean, although some surfaces have clearly visible fingertip marks, and other impurities



100MHz CAV1, shell

300MHz LAN2, bottom pickup

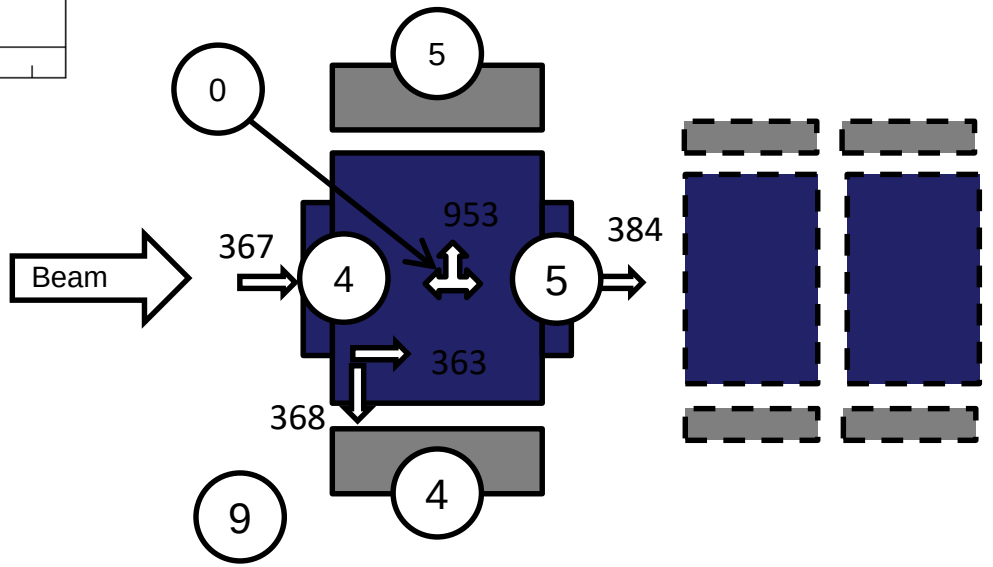
Storage Ring RF Maintenance



A	Tuning the cavity up (freq up)
B	Returning to resonant frequency
C	Tuning the cavity down (freq down)
D	Returning to resonant frequency
E	Influence of the second cavity

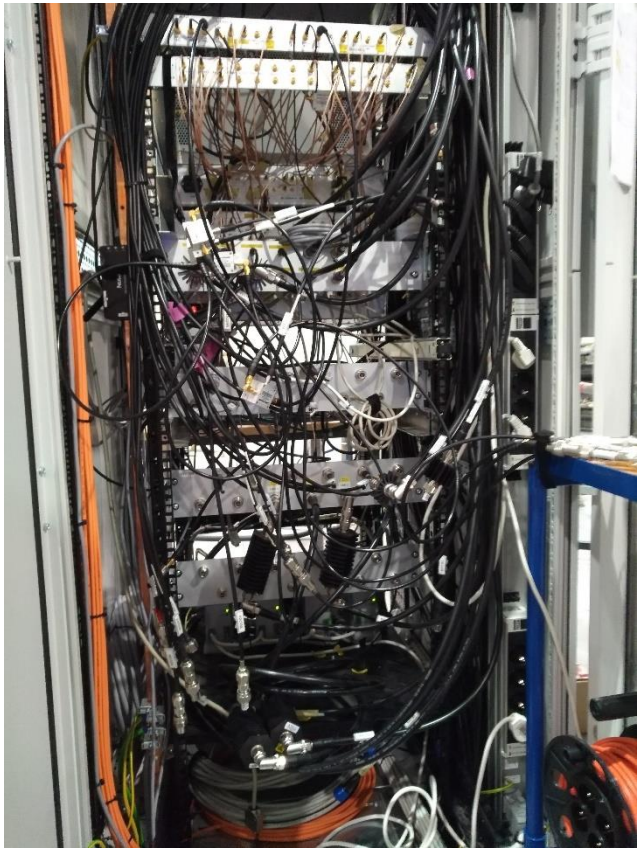
Vibration measurements

- Mechanical vibrations were measured to see the impact of stepper motors while tuning the cavities
- Measured acceleration values are rather high
- Optimisation of temperature stabilisation algorithms for SHGs could help minimise the need to tune the cavities mechanically
- No data on the effect of vibrations on beam stability – STUDY REQUIRED



Placement of sensors, top view

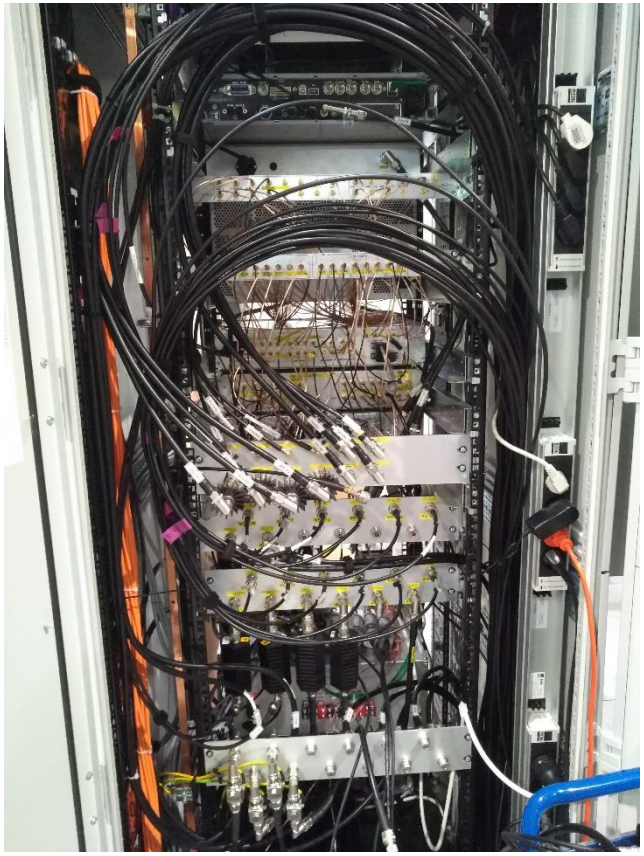
Storage Ring RF Maintenance



Before

CAB 10 rearrangement

- Many loose cables and attenuators
- Slightly chaotic design
- Rearrangement of cables was performed along with update of documentation
- New patch-panels added
- Much easier maintenance and measurements now



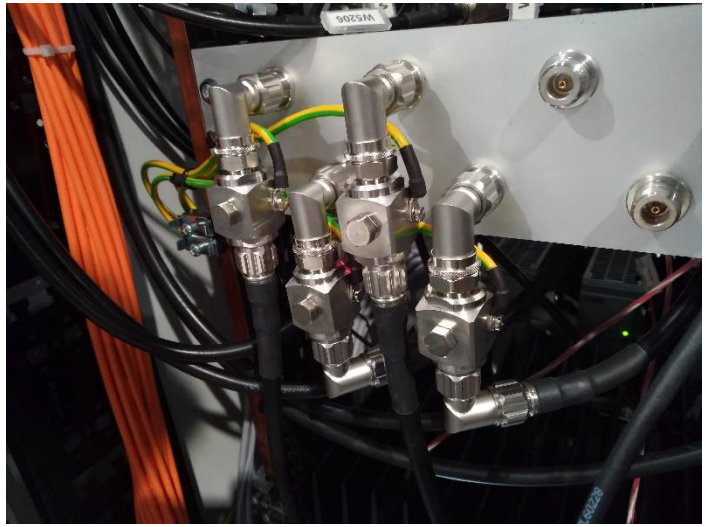
After

Storage Ring RF Issues

Landau upper pick-up overheating

- Lots of HOM modes generated in the cavity
- No grids on pick-up ports – strong coupling
- Dominating frequencies around 1,5 and 1,9 GHz
- Frequent overheating of attenuators and loads
- Gas discharge tubes installed, to contain the problem
- Cable insulation melted, GDTs overheating, damaged RF N-type connector socket
- Bottom pickups do not cause any problems

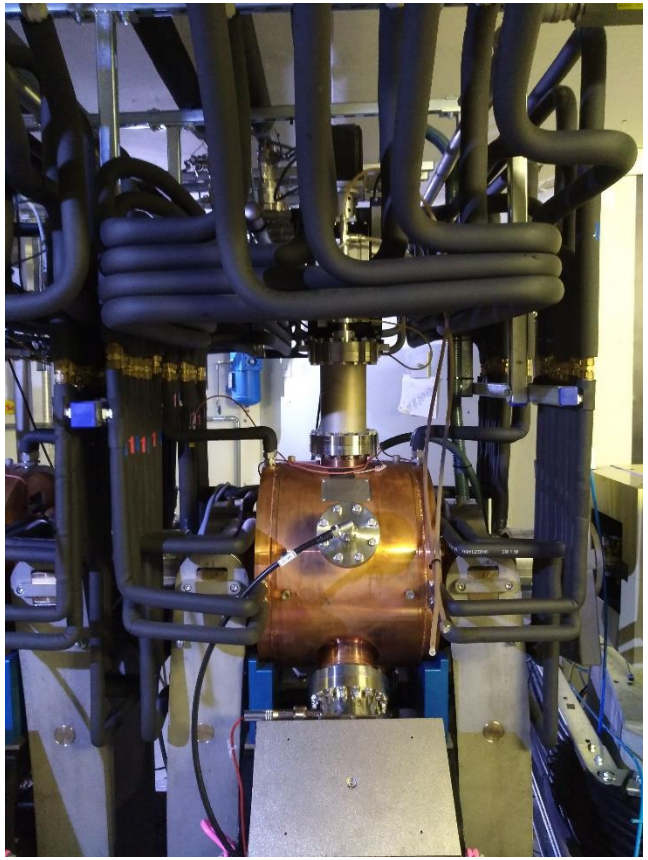
Should we remove upper pick-ups in landau cavities?

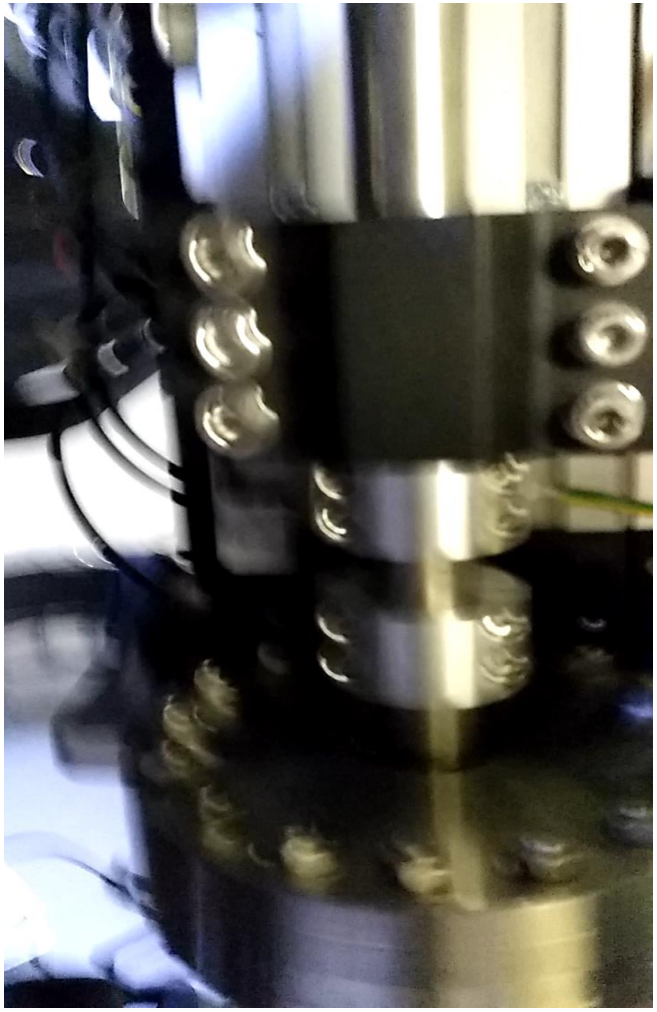


Storage Ring RF Issues

Landau plunger mechanism produces metallic sounds during movement

- Sounds are generated by moving bellow
- The bellow is probably too large
- Issue was investigated but no damage to plunger mechanism was discovered





Storage Ring RF LLRF

Two weeks visit of LLRF designer at Solaris for knowledge transfer:

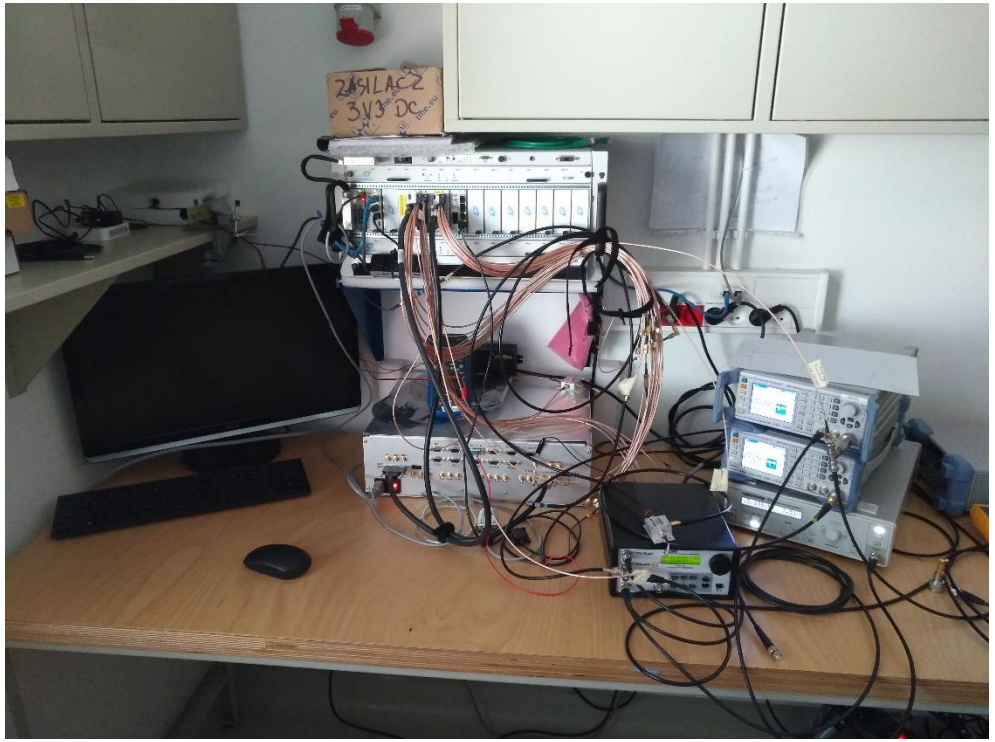
- Advanced training
- Fine LLRF tuning
- LLRF debugging and support for control group for software tasks
- LLRF FPGA code upgrades

LLRF upgrades by SOLARIS:

- Beam current monitoring in LLRF – introduced
- Increased Landau Tuning speed – introduced
- Landau field stabilisation & turn off below field & Beam current treshold – implemented
- Completely independent development platform
- Different FPGA in test system (100MHz ADGs) old one (250MHz), we can compile code for both

Complete test stand and development platform for LLRF

- FDL implementation
- Ability to test new configurations
- Different FPGA in the test setup, although fully functional with the rest of the hardware



Storage Ring RF
Spare parts recently ordered

Main cavity:

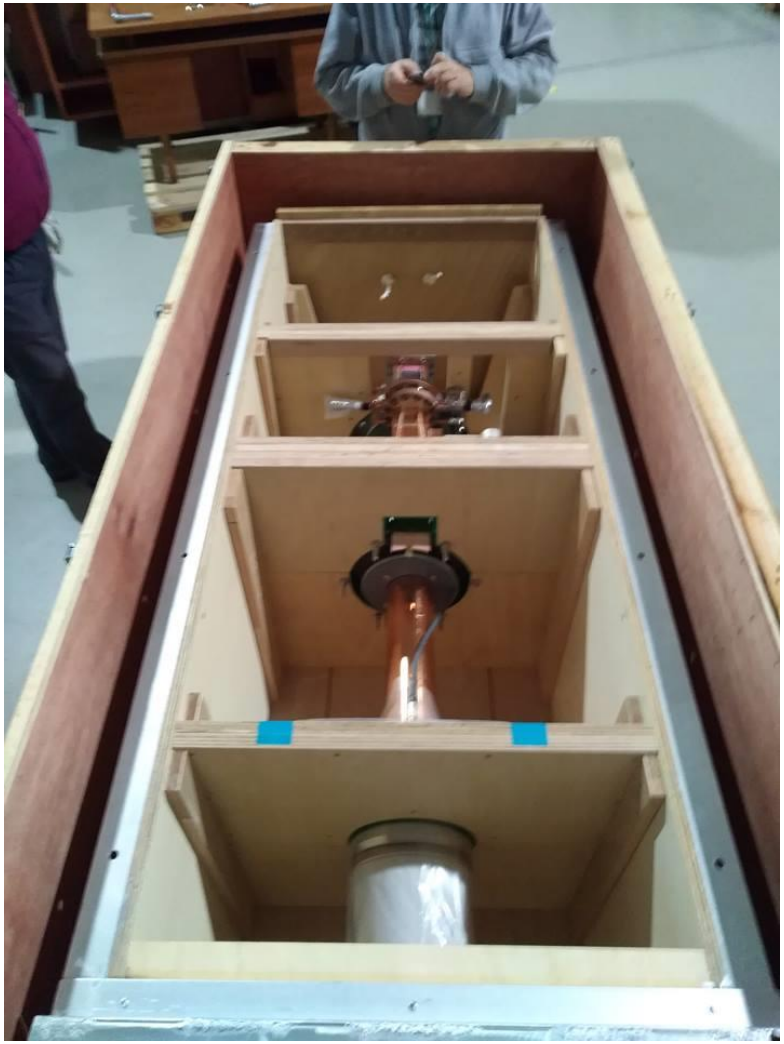
- Power coupler – delivered
- Arc detector for circulator

LLRF:

- Complete test stand – delivered

Linac:

- Waveguides with NEG pumping ports - delivered
- Klystron K1 (toshiba), - delivered
- Klystron K0 (thales) - 2019



Future activities

Main cavity:

- Modulators – oil dehydration
- Development of fully analog interlock systems for reflected power in cavities and klystrons

LLRF:

- FPGA and high level software development

Other:

- Final configuration of tune measurements
- Regular maintenance of RF equipment
- New Staff members required

Thank you for your attention