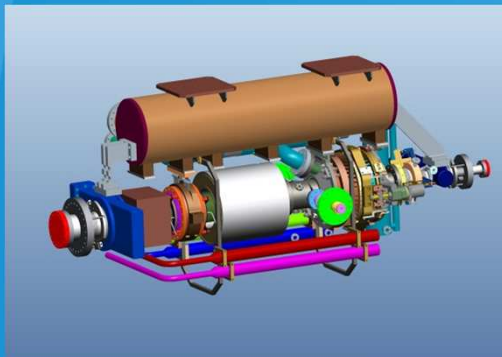


Status of RF at HZB and BESSY II Renovation

Wolfgang Anders,

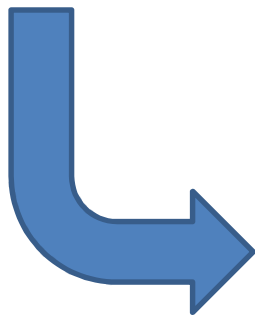
Helmholtz-Zentrum Berlin for materials and energy (HZB)

17th ESLS-RF Meeting 18.-19.9.2013 HZB



- **BESSY II gets refurbished**
 - New control room
 - Top up operation
 - Fast orbit feed back
 - New WLS
 - New cavities
 - New transmitters
 - Future: BESSY-VSR
- **MLS**
 - SSB no service on preamplifier any more → Cryoelectra
- **BERLinPro**
 - Status transmitters
 - Status cavity production
 - Status modules

New control room



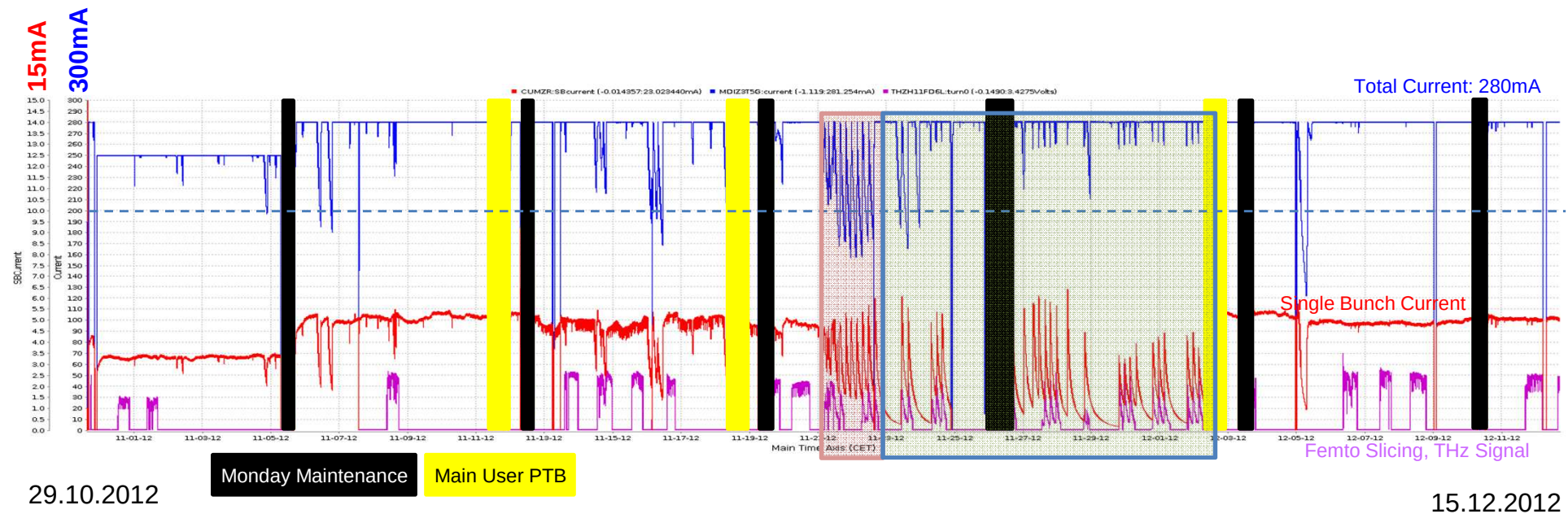
New control room –
beam operation starts
next week



TopUp – start up and first user operation

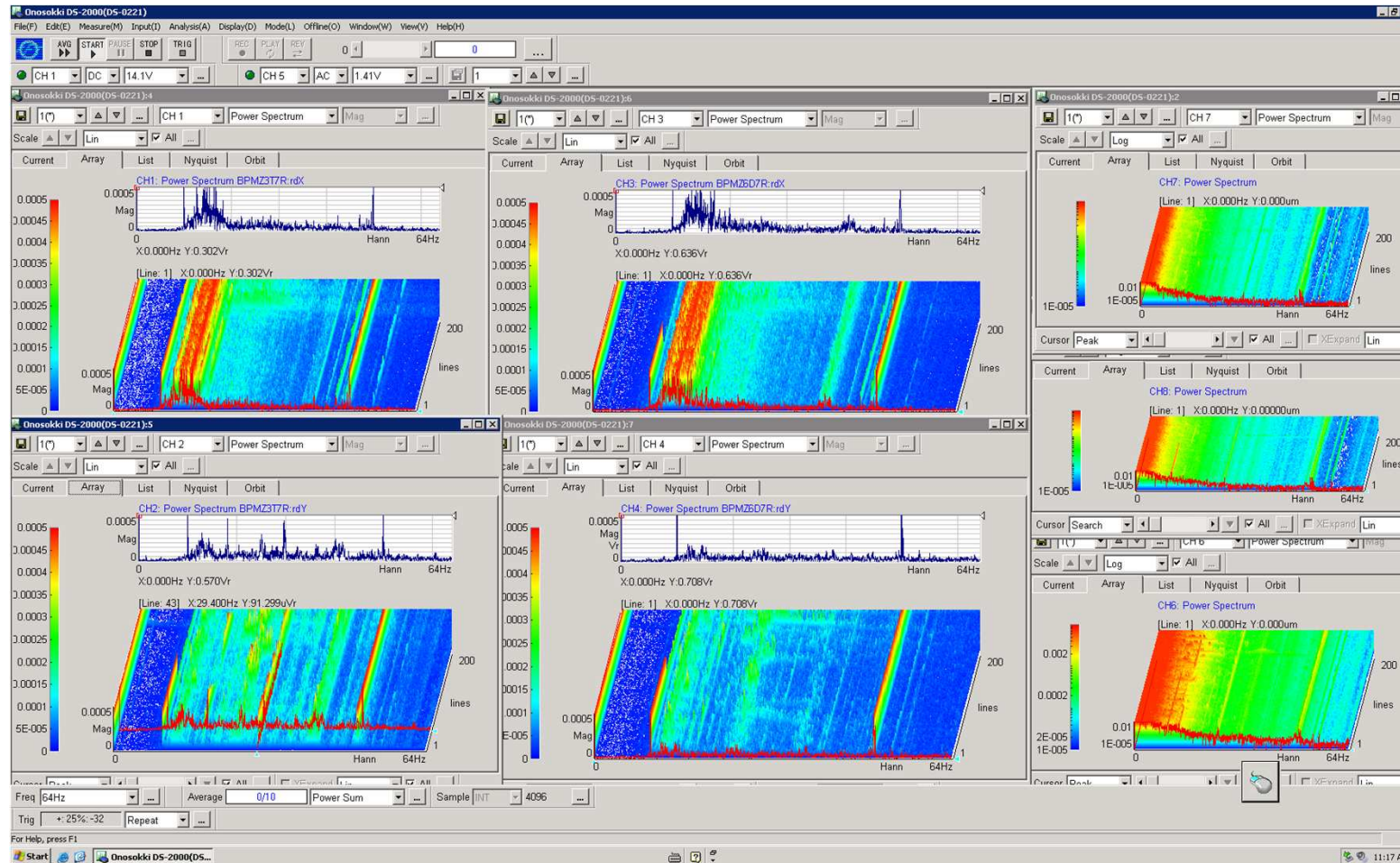
TopUp started 25. October 2012, in user operation since 29.10.2012

Requirement on injection efficiency: 4 h average > 90%



Fast Orbit Feed Back

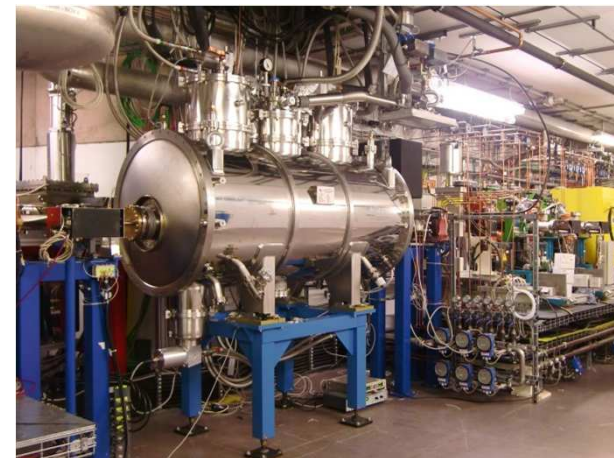
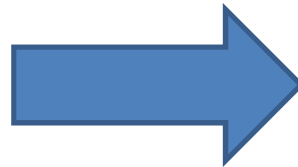
Fast orbit feed back at BESSY II in operation since fall 2012



Beam motion 0-64 Hz scaling in comparison “slow orbit feed back” (1/6 Hz, upper)
and “fast orbit feed back” (50/150 Hz lower)

New Cryostat for 15-pole 7T sc WLS Magnet

- The 15 pole 7 Tesla sc Wave Length Shifter Magnet has a cold vacuum chamber at ~ 40 K.
- Chamber is heating by
 - wake fields (new filling pattern including 4 high current “single bunches”)
 - beam current $\rightarrow$ average current increased by Top Up operation causing cryogenic losses
- $\rightarrow$ new low loss cryostat ordered at Budker Institute and installed this shutdown



Old WLS cryostat (left) and new WLS (right)

Transmitters BESSY II: Klystron → Solid state

Due to the fact, that there were no spare klystrons in production, HZB ordered 4 x 70 kW and 1 x 40 kW 500 MHz solid state transmitters at Cryoelectra.

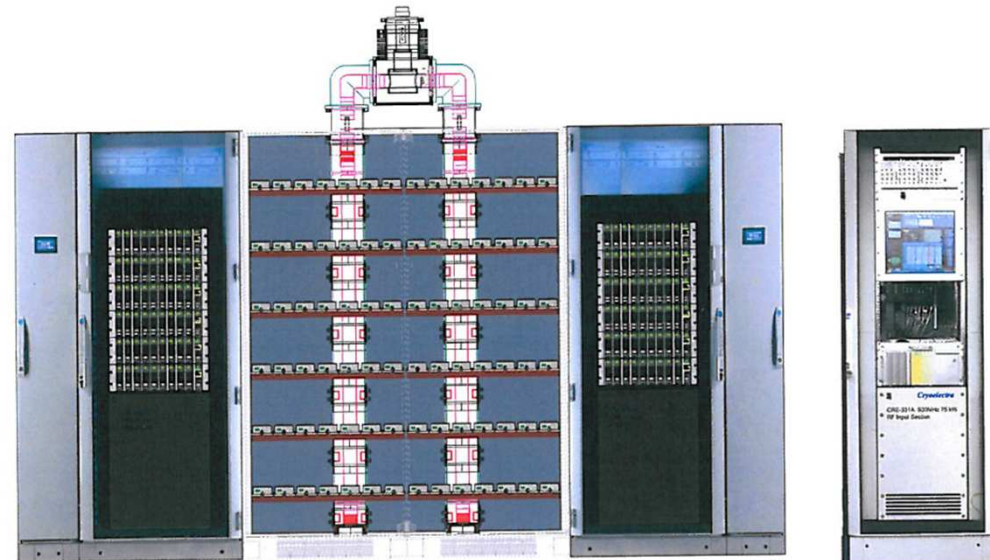
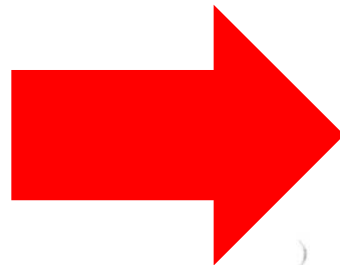
→ More details see talk of Bernhard tomorrow



HV collector power supply gallery

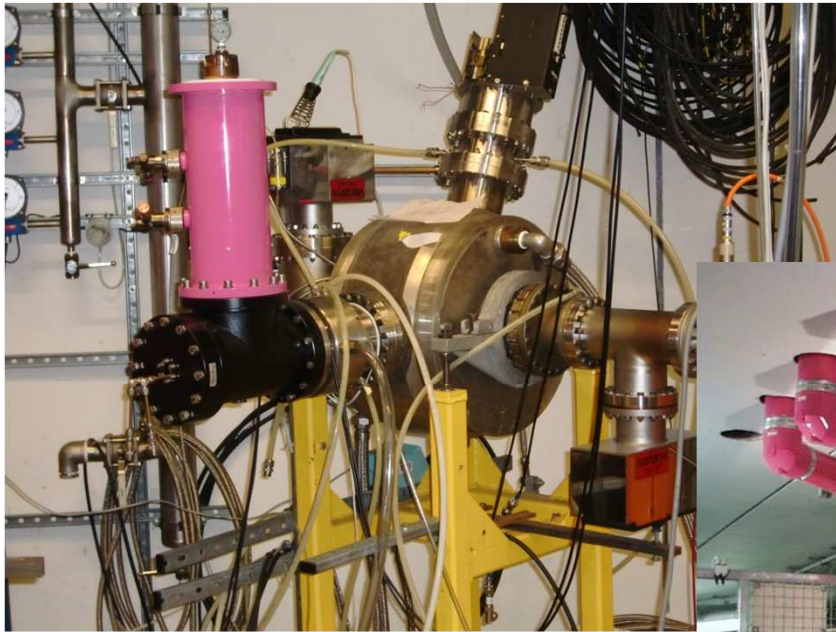


HV frontend with klystron
Wolfgang Anders



Design of new solid state transmitter. Power supply modules are in left and right rack, combiner and RF modules in the middle

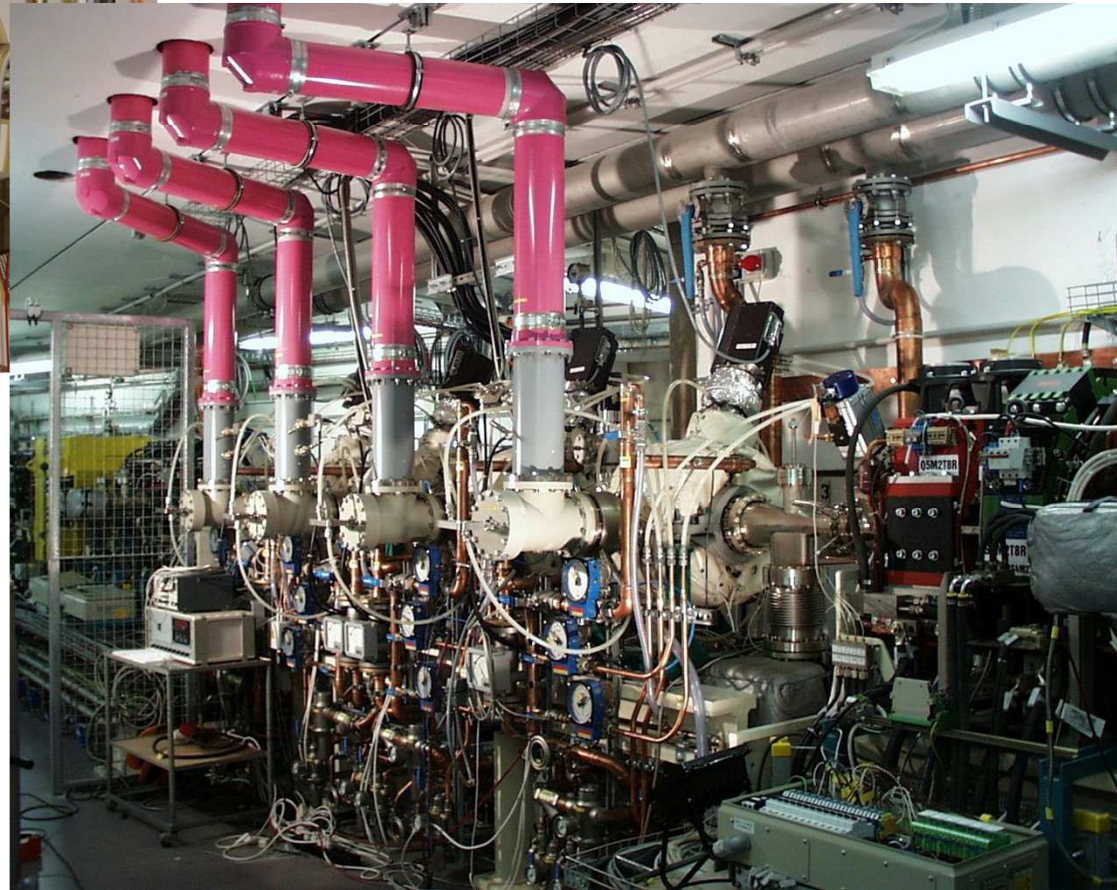
Old DORIS Cavities at BESSY II



DORIS single cell cavity in the test area.

RF straight in the BESSY II storage ring with four DORIS cavities

Four DORIS single cell cavities are installed at the BESSY II storage ring.

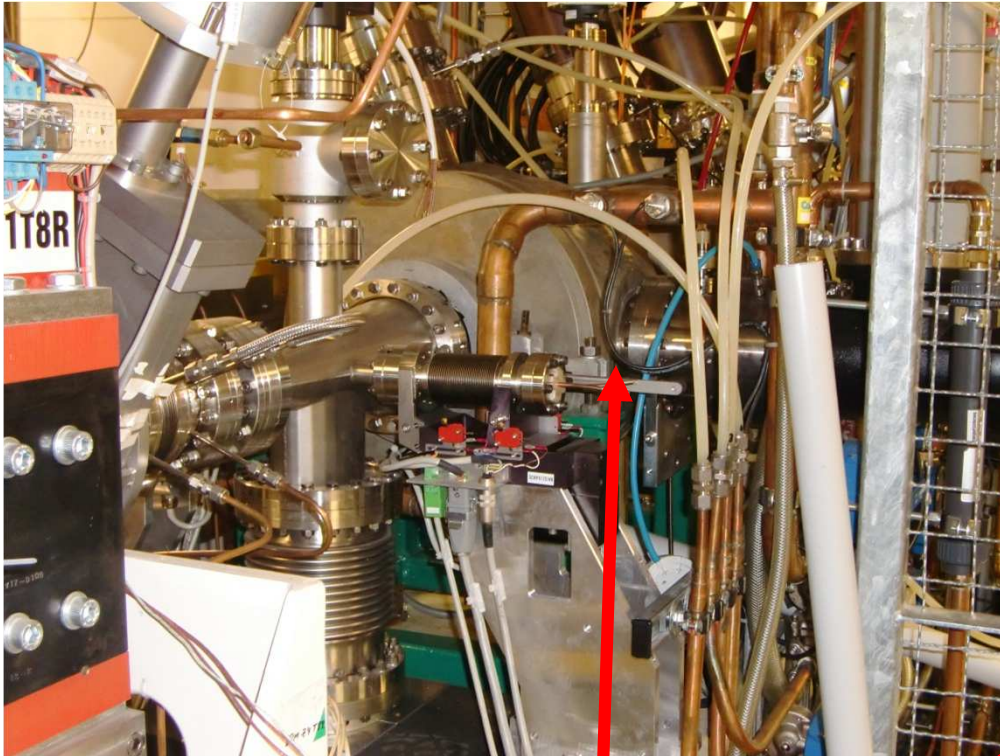


- DORIS cavities are produced in the early 1970's for use at the DORIS storage ring at DESY.
- Later they are replaced at DESY by 5-cell and 7-cell PETRA cavities.
- They have been a good and cheap choice for storage rings like BESSY II

- Shunt impedance ~ 2.9 (5.8) $M\Omega$
- Body power load up to 40 kW
- Max voltage ~ 480 kV
- Simple HOM dampers (see picture next slide)
 - Three $\lambda/4$ fingers for damping lower HOM modes
 - Broadband ferrite with cutoff of 1.3 GHz

- **Degrading of the cavities due to their lifetime**
 - One cavity water leak to vacuum (BESSY I) $\rightarrow$ replaced
 - One cavity deforming water cannels on the inner side of the cavity scratching on the tuner $\rightarrow$ cavity replaced
 - One cavity strange behavior $\rightarrow$ cavity replaced
 - One cavity water leakage near coupler port $\rightarrow$ cavity replaced
- Last spare cavity installed 2010

BESSY II: Water leak at Doris cavity

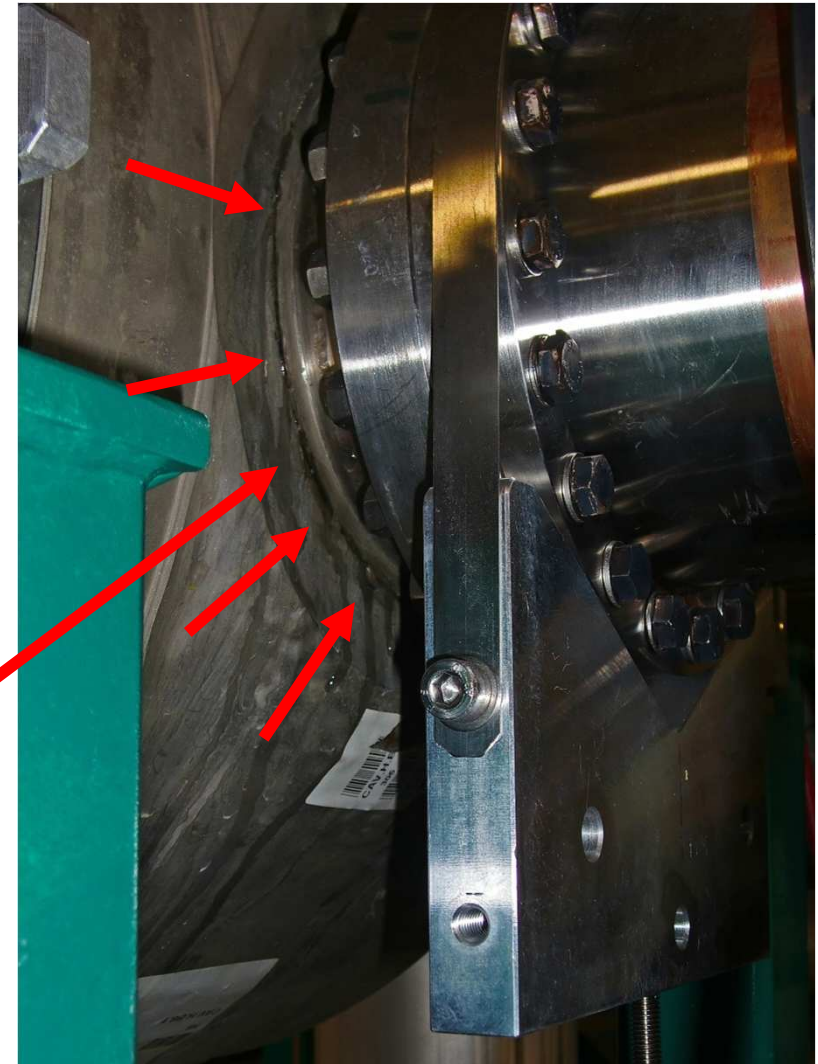


Water leakage of one DORIS body

2010 installed last spare cavity!!

Wolfgang Anders

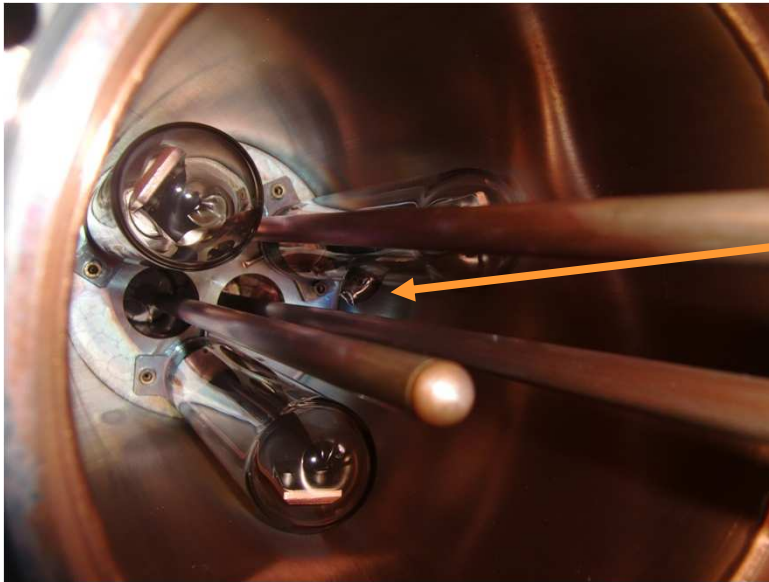
Status of RF and SRF at HZB



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Melted HOM Ferrite in Doris Cavity



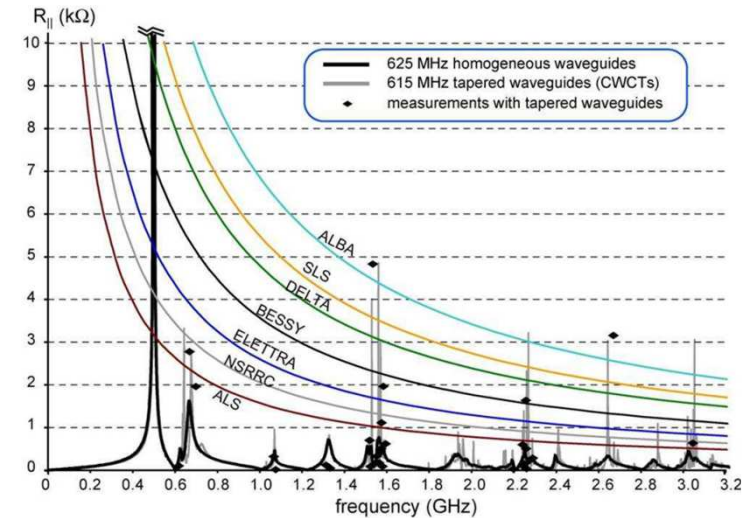
Melted HOM ferrite glass tube at Cavity 4
(Nov.2010)

HOM dampers are build 1975
In machine studies about 1 year before they
made **35 mA single bunch** !!!! There has been
a short vacuum event...

BESSY II has started with 10 mA in single
bunch mode user shift, later they increased to
20 mA --- 35 mA seem to be to much

Replacement of Doris cavities

- **Need new cavities !!!**
 - No drawings of DORIS cavities available
 - HOM damped cavities developed at BESSY by Ernst Weihreter
 - ~15 % better shunt impedance
 - 80 kW wall power capacity
 - better HOM damping
 - Prototype has been tested at DELTA
 - HOM cavity is successfully operated at
 - MLS
 - ALBA
- Ordered two HOM cavities for BESSY II and one for MLS (spare) in 2010, delivered 2012 have been installed this shutdown, now in conditioning phase
 - Three cavities (one spare) ordered in 2012 to be delivered 2014 and will be installed in 2015

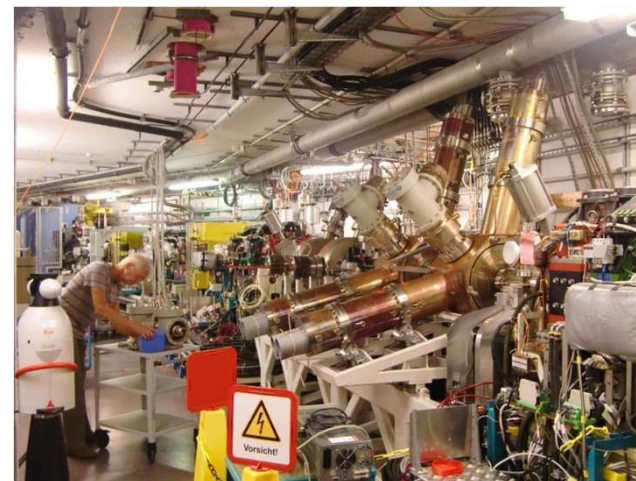


Longitudinal HOM spectrum

Cavity strait shutdown 2013: DORIS → HOM



Cavity strait section
Shutdown 2013



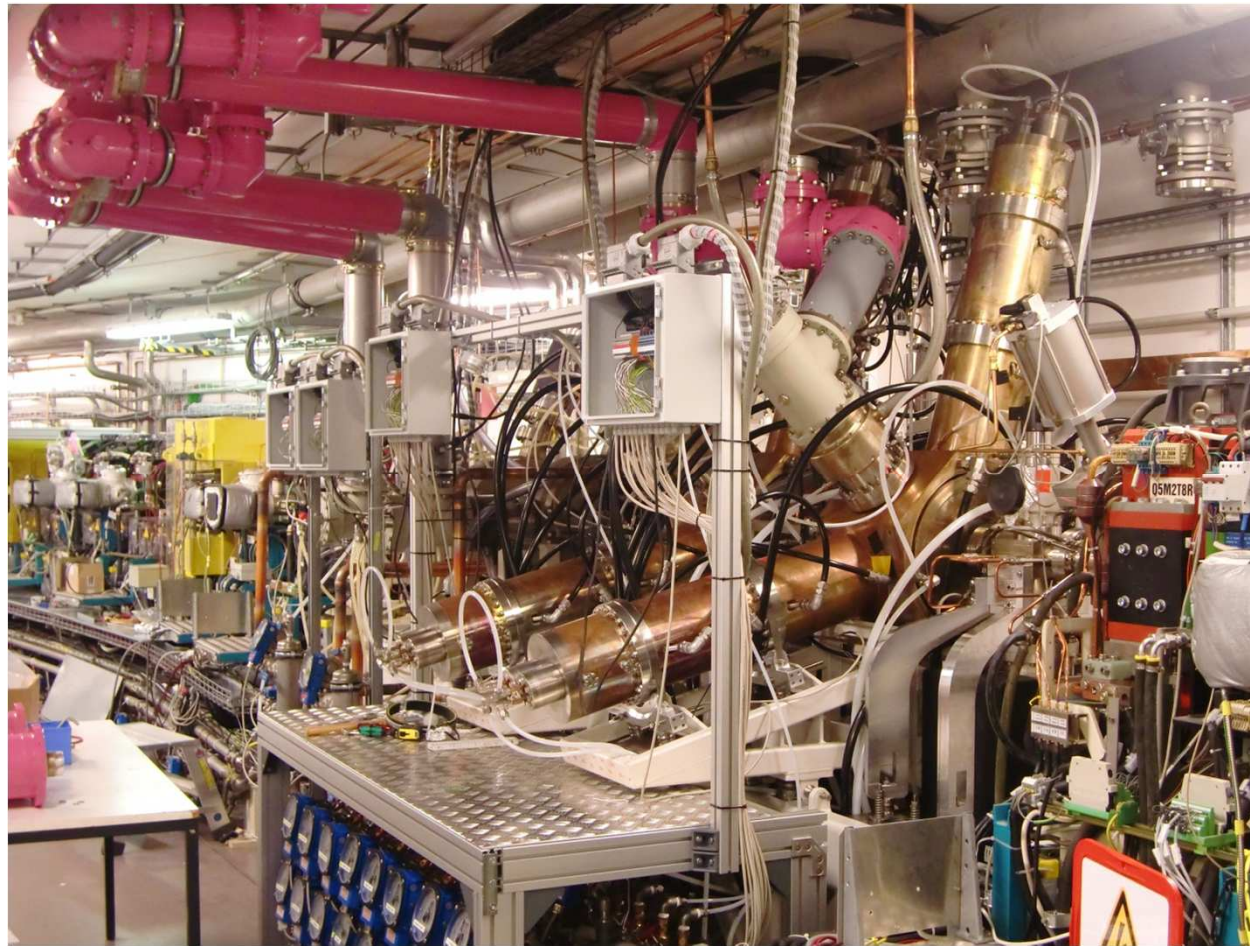
Wolfgang Anders

Status of RF ans SRF at HZB



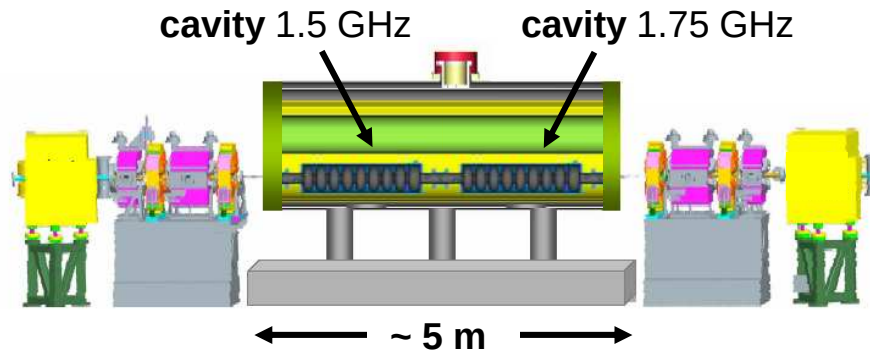
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Two HOM and two DORIS cavities at BESSY II



New cavity strait section at BESSY II containing 2 DORIS cavities and two new HOM cavities. In shutdown 2015 it is planned to replace the remaining DORIS by HOM cavities

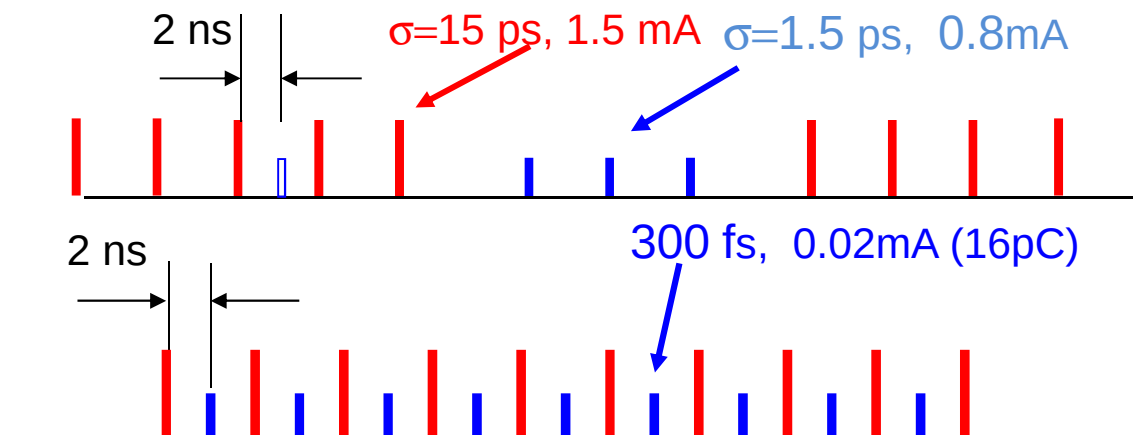
Future: BESSY VSR (variable bunch length storage ring)



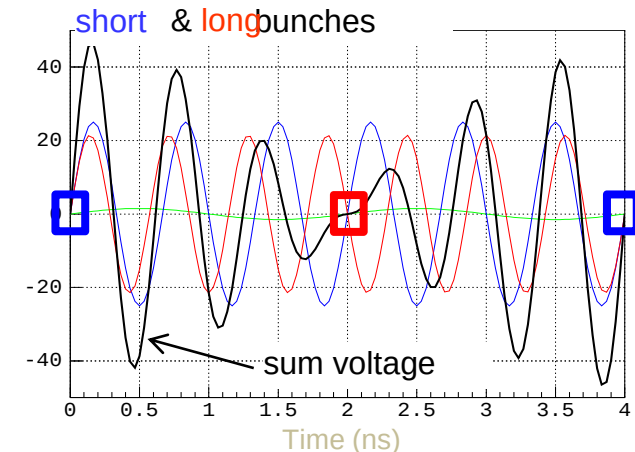
High gradient strong HOM damped cavities for VSR are similar to *BERLinPro* linac-cavities

Acceleration with 500 MHz 1.5 MV.
Add passive sc cavities with very high voltages (20-25 MV) at 3rd harmonic and 3.5rd harmonic

→ Gradient of resulting RF voltage at the position of the bunches will alternating be flat or steep resulting in long and short bunches.



Different operation modes with VSR



Resulting RF voltage

MLS: Problems with IOT Preamplifier

At the MLS we use a 1 kW 500 MHz preamplifier of the company SSB.

The general manager of SSB retired. Now they make no service on old amplifiers!!

→ We ordered new preamplifiers by CRYOELECTRA.



270 kW transmitters:

- CPI 270 kW Klystron
 - Prototype klystron: successful factory acceptance test
 - Prototype is delivered to TRIUMF
 - TRIUMF transmitter will be competed in fall 2013



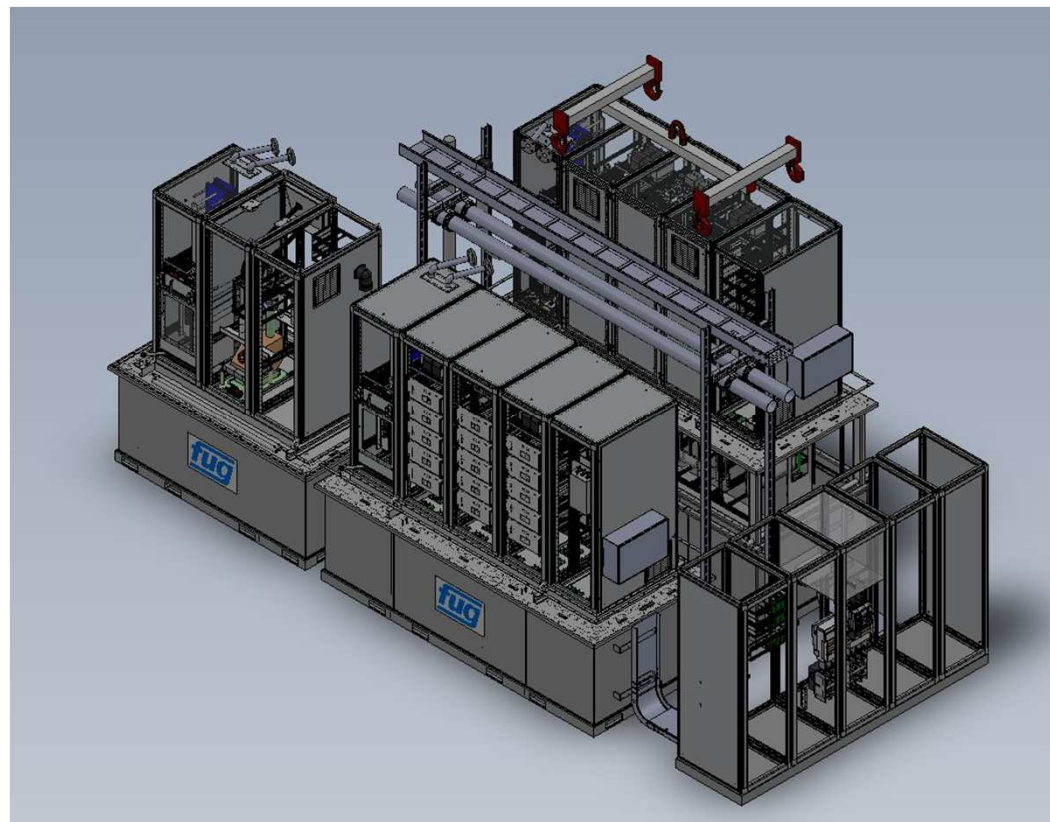
Klystron complete in trolley

- First BP klystron by CPI
 - will be produced this year
 - Stored at CPI until transmitter power supply is ready (3/2014)
- Next klystrons will be stored at CPI until building is ready



Klystron lowered into the solenoid at TRIUMF

- **FUG Transmitter power supplies**
 - Delay of first delivery to 3/2014
(fits better to delayed time schedule of building)
 - Delivery of further transmitters will be delayed until building is ready
 - *Detailed report on this transmitter ESLS 2014*



Design of 600 kW power supply for klystron transmitter
Courtesy FUG

- 15 kW 1.3 GHz solid state transmitter by SigmaPhi (former Bruker)
 - delivery scheduled 10/2013

Production of Gun1 cavity, booster cavities and related components at JLab is on schedule

Contract includes:

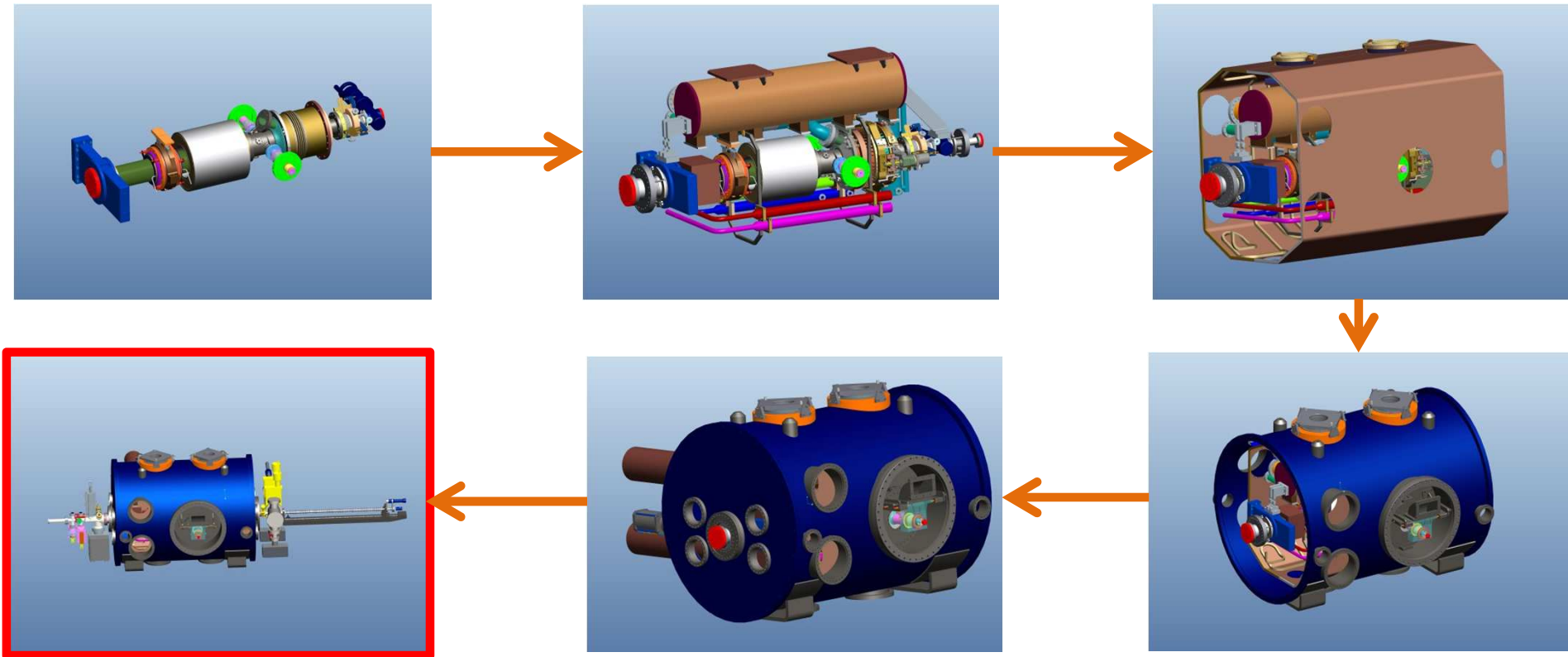
- Production of cavities
- Preparation and cleaning
- Mounting of cold string for gun1



Booster cavity production



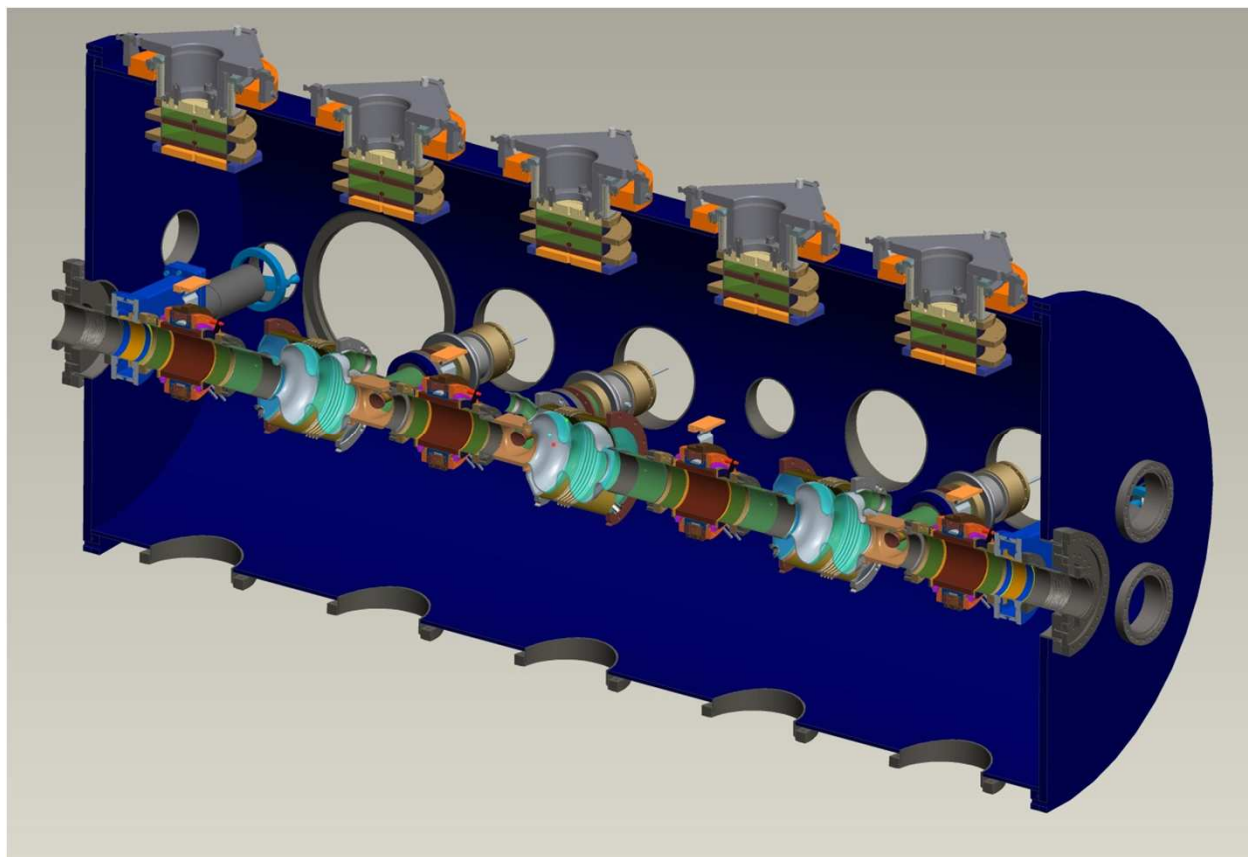
Production of GUN1 cavity at JLab



Production steps of Gun1 module. First picture show the cold string assembled at Jlab. The following steps will be done at the HZB.

BERLinPro: Status cavity modules – Booster

Components that are used as well in gun1 module and in booster have been implemented in a first design of a booster module. The booster module marries aspects of the Cornell booster design with HZB changes due to the different coupler system.



BESSY II

- **New cavities**
- **New transmitters**
- **Future: BESSY-VSR**

MLS

- **No service for preamplifier**

BERLinPro

- **production of transmitters and sc cavities**

Thank you !