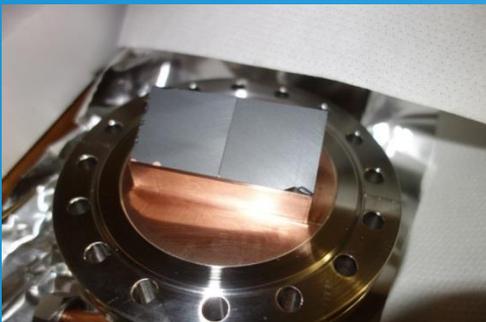


# Status of BESSY II and bERLinPro

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20th ESLS-RF Meeting 16.-17.11.2016 at PSI



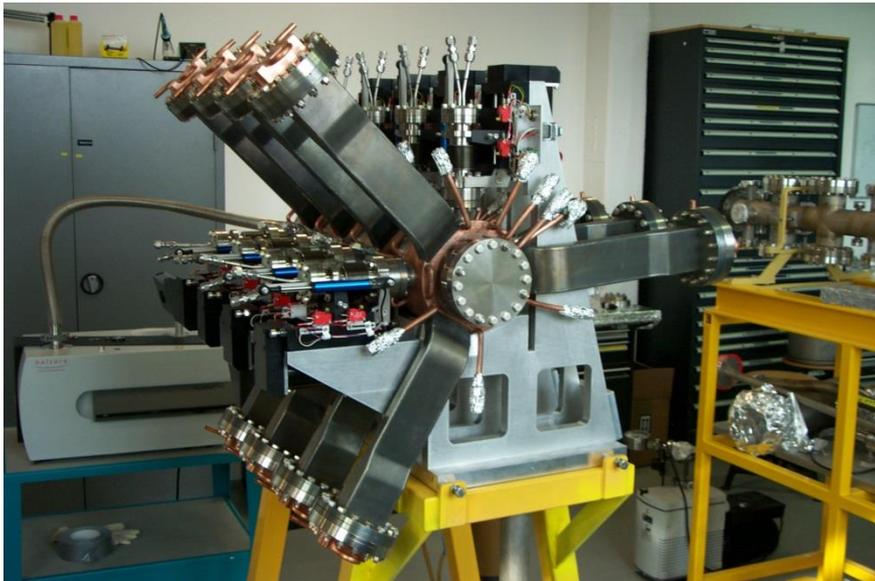
- **BESSY II**
  - **Problems with circulators**
  - **Landau cavity leakage**
  - **HOM cavity vacuum problems**
  - **SSA – experience after one year of operation**
  
- **BERLinPro**
  - **Status of the building**
  - **Klystron problems**
  - **Gun module production**
  
- **BESSY VSR**
  - **Status**
  - **SSA dreams**



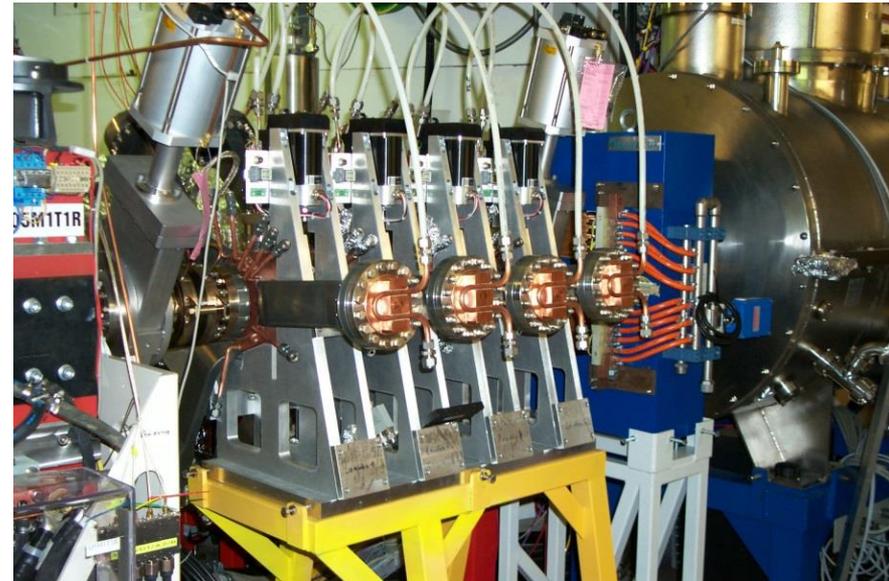
AFT circulator with RF shielding

- We bought new temperature compensation units (TCU) because of aging problems
- All circulators are sent to AFT for adaption
- New TCU units do not work.
  - TCUs switch off transmitters at a temperature slightly too low
  - Potentiometers on maximum setting
- No support by AFT, but they offered a software for a high price to get better settings. → We decided not to buy and run with lower performance
- We detected RF radiation from circulators → adapted a shielding

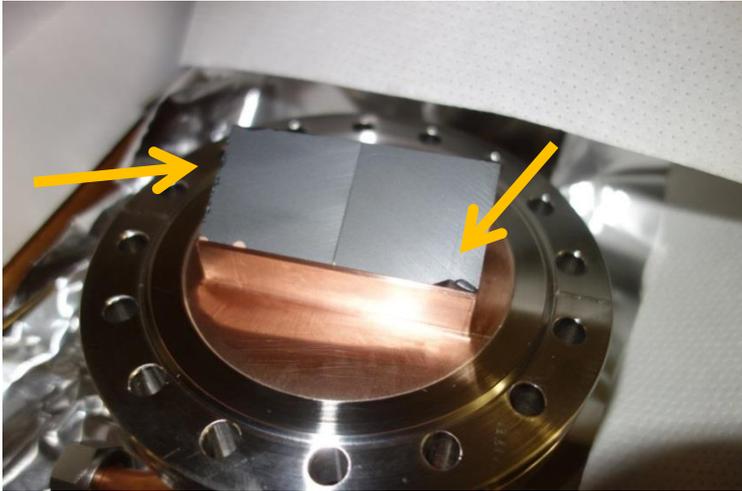
- Due to fail of the control system landau cavity 2 has been on 18 kW power for half an hour (water return temperature 48 deg.)
- Typical operation 2 kW! Interlock 20 kW
- In the beamline of the straight section of the landau cavities and a sc wave length shifter magnet high radiation levels were detected since this event.
- Radiation officer says it is radiation by bad vacuum
- Vacuum gauges few meters away show good vacuum, leak detection negative
- In shutdown we opened landau cavities and looked into the cavities



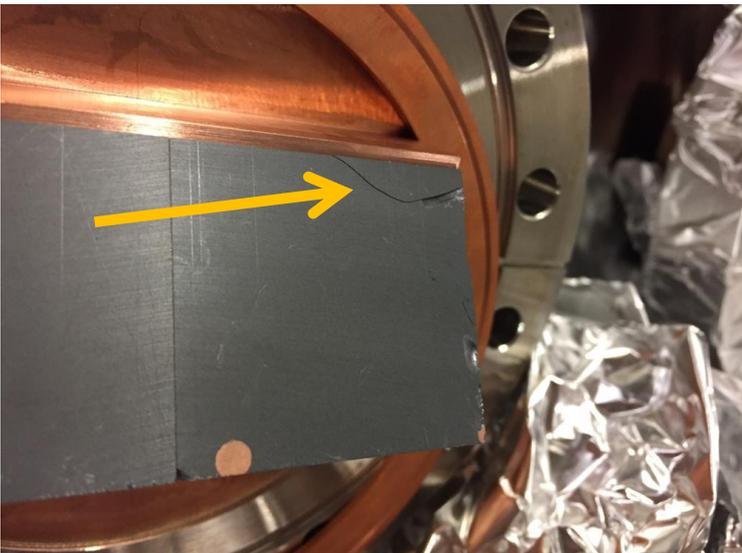
Landau cavities with waveguide HOM dampers



Landau cavities in BESSY II Ring



broken ferrite tiles in HOM dampers



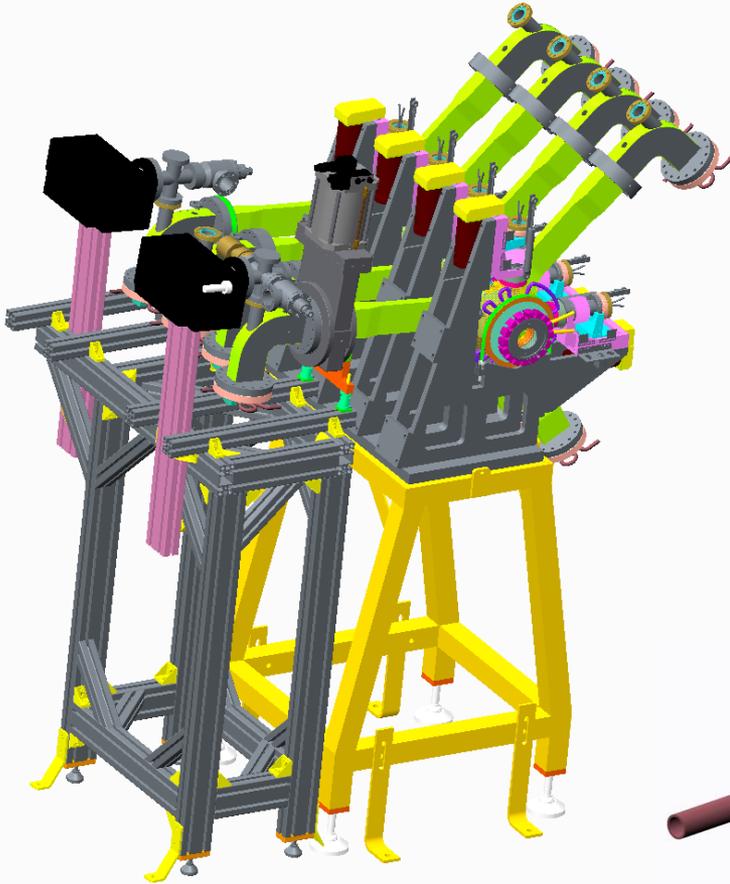
- In the cavities we saw broken ferrite (C48) tiles
- Some small ferrite pieces from upper waveguide have been fallen into the cavity body
- Carefully performed search for leakages detected a vacuum leak between body and lit of landau cavity #2
  - → impossible to repair

## History:

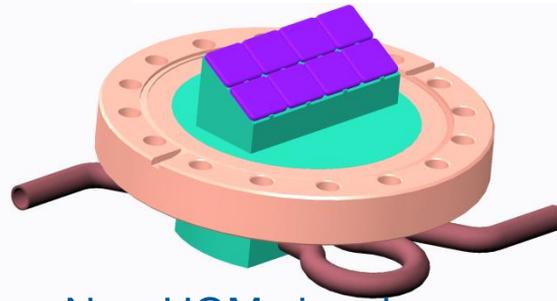
- Starts at production by SDMS
- Pot and lit have been brazed at 780 °C
- Was leaky, second brazing at 600 °C. Solder contains cadmium making the copper brittle. Still not leak tight. More brazing by hand.
- Due to the high power load it opened a vacuum leakage

Counter measures in preparation:

- Bended upper HOM waveguides to prevent ferrite pieces to fall into the cavity body
- Smaller ferrite tiles with rounded edges, same as the 500 MHz HOM cavity
- Ports for vacuum pumping and vacuum measurement
- Ports for in situ optical / infrared inspection
- One waveguide with vacuum valve planned as a test station for different absorbers sizes and material (SiC) for bERLinPro and Bessy VSR



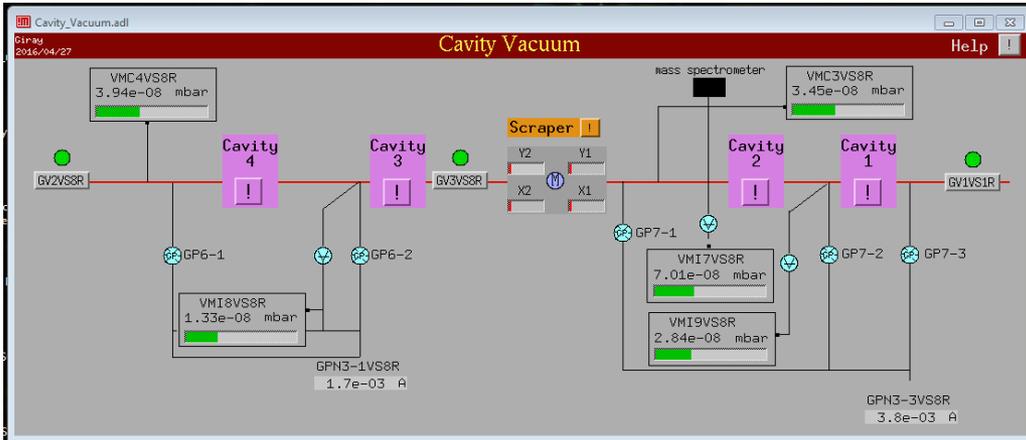
New setup for landau cavities



New HOM absorber  
with rounded edges



HOM absorber of  
500 MHz cavity



Vacuum reading in cavity section  $10^{-8}$  mbar range



Four HOM Cavities in BESSY II storage ring

- **2013** two HOM cavities were installed at BESSY II
- No in situ bake out
- Poor vacuum in section ( $10^{-8}$  mbar)
- **2015** next two cavities installed
- Bake out
- Vacuum stays bad for the “old” cavities
- New installed cavities  $10^{-9}$  mbar
- **2016** section opened. Look with endoscope and intensive leak detection → nothing detected
- Spare cavity still in production at RI
- Now spare cavity is delivered
- **2017** still open, if we exchange cavity #2 and section between cavities



500 MHz 80 kW SSA (Cryoelectra)

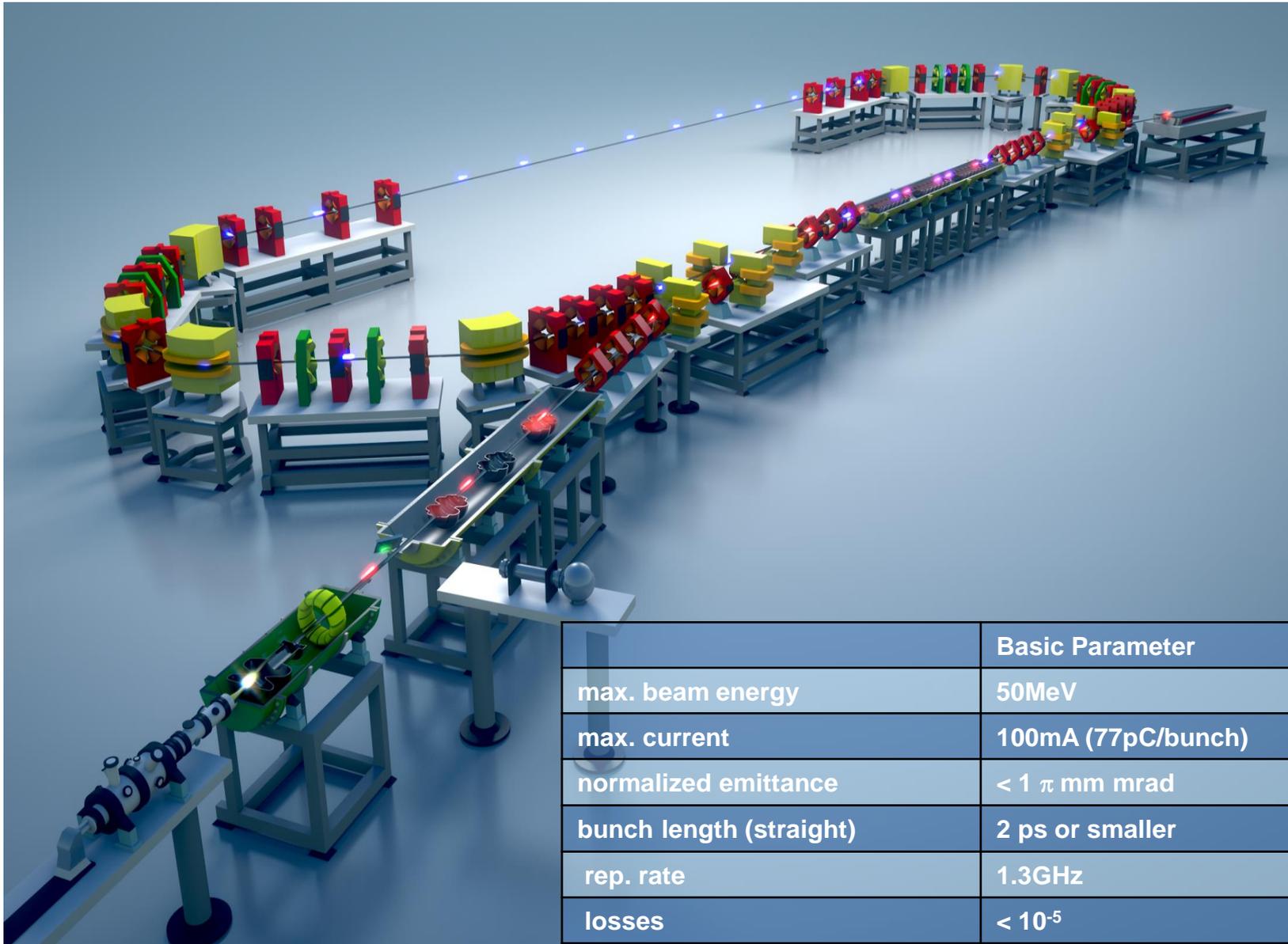
- In the shutdown 2015 all modules were resoldered with high temperature solder
- **11 months of operation:**  
**12 modules failed out of 630 modules** (all burned output section in the module)
- **No other failures**
- **No beam loss due to the SSA**
- Best support by Cryoelectra
- Few beam losses by circulator and water
- Few beam losses by work on our PLC



Modules for resoldering



Burned output in a module



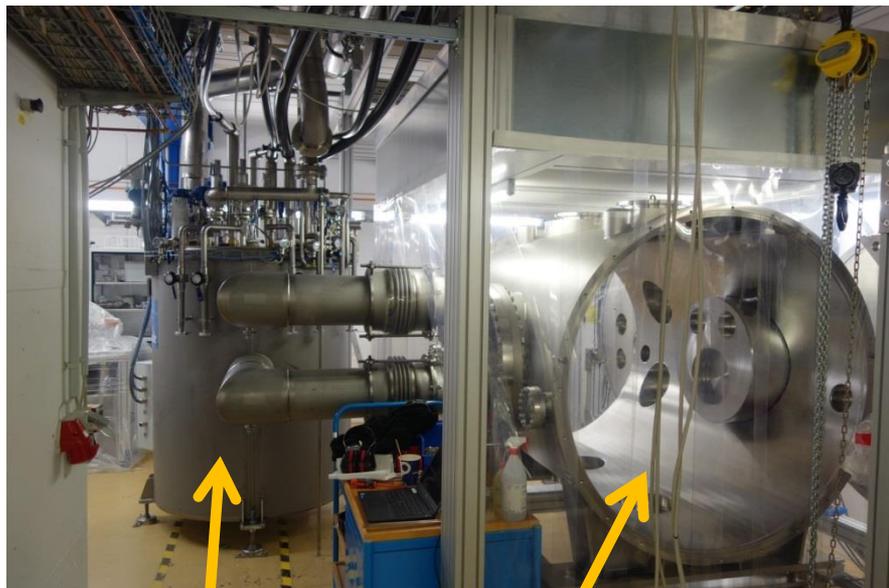
	Basic Parameter
max. beam energy	50MeV
max. current	100mA (77pC/bunch)
normalized emittance	$< 1 \pi$ mm mrad
bunch length (straight)	2 ps or smaller
rep. rate	1.3GHz
losses	$< 10^{-5}$



- Shell of building is close to finalization
- Interior construction is ongoing
- Expected start of accelerator installation: February 2017

Technic hall  
Klystron gallery  
Accelerator hall

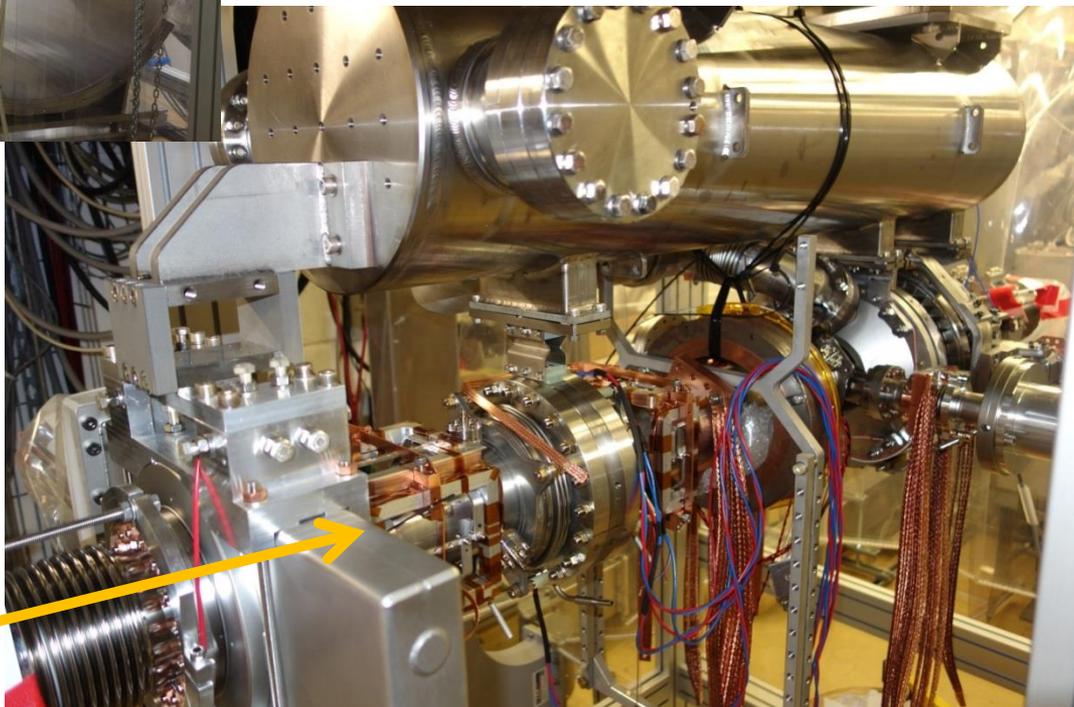




- Now: sc photo injector gun module mounting
- Hope to pump vacuum by the end of the year
- Try to have first electrons from gun module in testing hall in spring 2017

cryogenic feed box

module

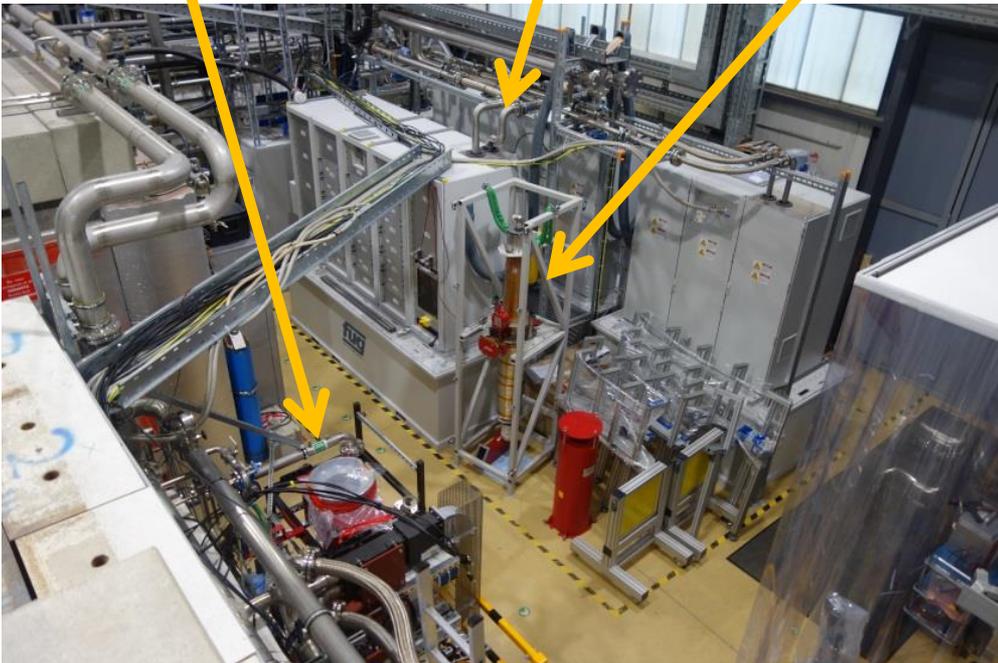


cold string

## RF Transmitters bERLinPro:

- three 1.3 GHz 270 kW<sub>cw</sub> klystron based transmitters for the injector
- four 15 kW SSA for recovery linac (and one for booster)

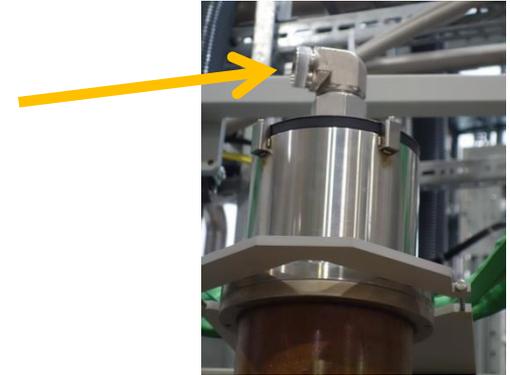
Prototype transmitter in the testing hall  
klystron magnet      power supply      klystron



## Klystron transmitters:

- Two power supplies (FUG) 65 kV 9A are delivered, third will be delivered in December
- First transmitter is installed in a testing hall
- All klystrons (CPI) are produced
- All klystrons factory acceptance test o.k.

- First klystron was delivered, vacuum o.k.
- There is a large Swagelock water connector at the collector
- CPI fastened the connector → vacuum leakage

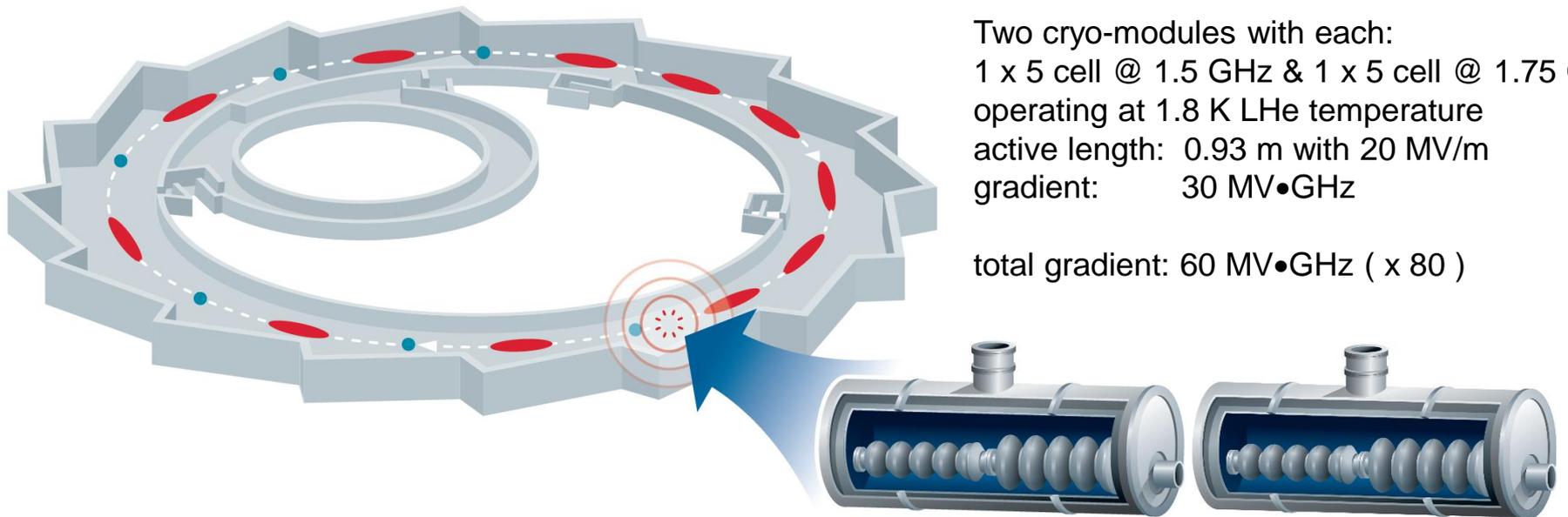


- Second klystron was delivered
- Difficult to install in the magnet, because there was a little angle between collector and tube
- CPI assisted to install
- → high body current at different voltage levels

Now waiting for the third klystron



- BESSY VSR is a project to install high gradient sc cavities at 1.5 GHz and 1.75 GHz in the BESSY II storage ring to produce long and short bunches simultaneously
- Project is still not approved
- Directors give 15 positions and 3 Mio€ for prototypes and calculations
- Try to acquire third party money



- There is hope for third party money next year to buy some cryo stuff and the solid state transmitters
- In this case we would buy SSA for BESSY VSR and bERLinPro in parallel to have all transmitters from same company to reduce spare part costs

Our shopping list:

- 3 x 15 kW 1.5 GHz (BESSY VSR)
- 3 x 15 kW 1.75 GHz (BESSY VSR)
- 4 x 15 kW 1.3 GHz (bERLinPro)

Need some luck



- Some problems solved or to be solved
- Much work on new projects using superconducting cavities

A wide-angle photograph of a construction site under a dramatic, overcast sky. A vibrant, multi-colored rainbow arches across the entire width of the frame, connecting two buildings. On the left, a large, modern building with a metallic, reflective facade is partially visible. On the right, a smaller, white, rectangular building is under construction, with scaffolding and construction equipment nearby. The ground is a mix of dirt, gravel, and some greenery. The overall mood is one of hope and progress.

**Thank you !!!**

Arc of light between BESSY II (left, present age) and bERLinPro (right, future)