Status of RF at BESSY II and bERLinPro

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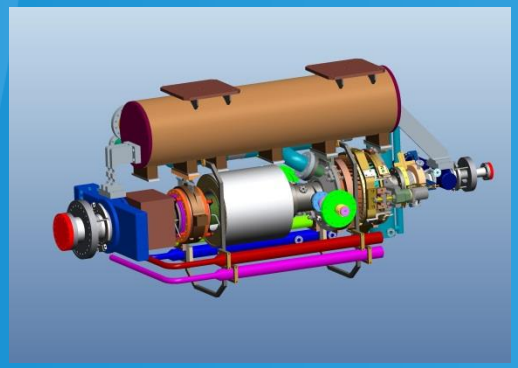
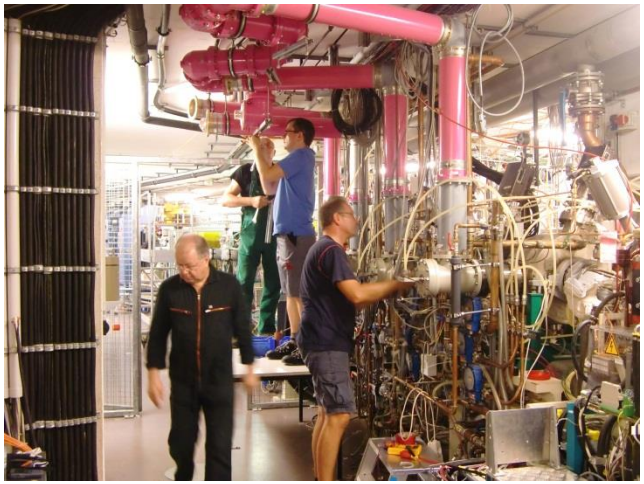


Outline

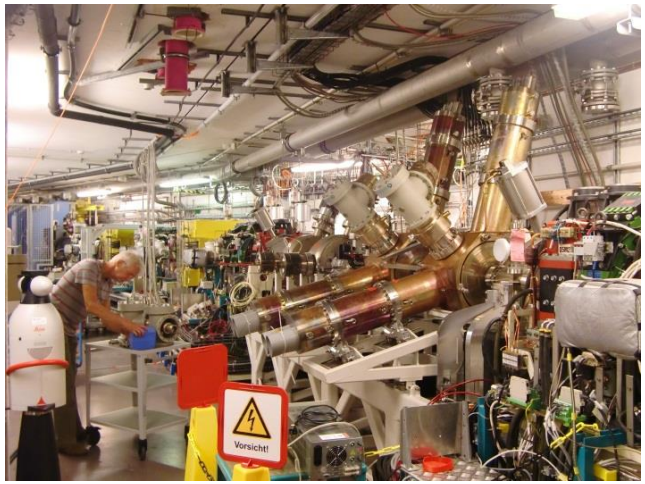
- BESSY II
  - New cavities
  - New transmitters
  - Burned RF-Line
  - Arcs at circulator
- MLS
  - Nothing to report
- BERLinPro
  - Status transmitters
  - Status cavity production & modules
  - Status test stands

Cavity installation shutdown 2013



Cavity strait section
Shutdown 2013

Installation of two
HOM Cavities



Last year while ESLS-RF workshop

Vacuum in cavity first beam operation

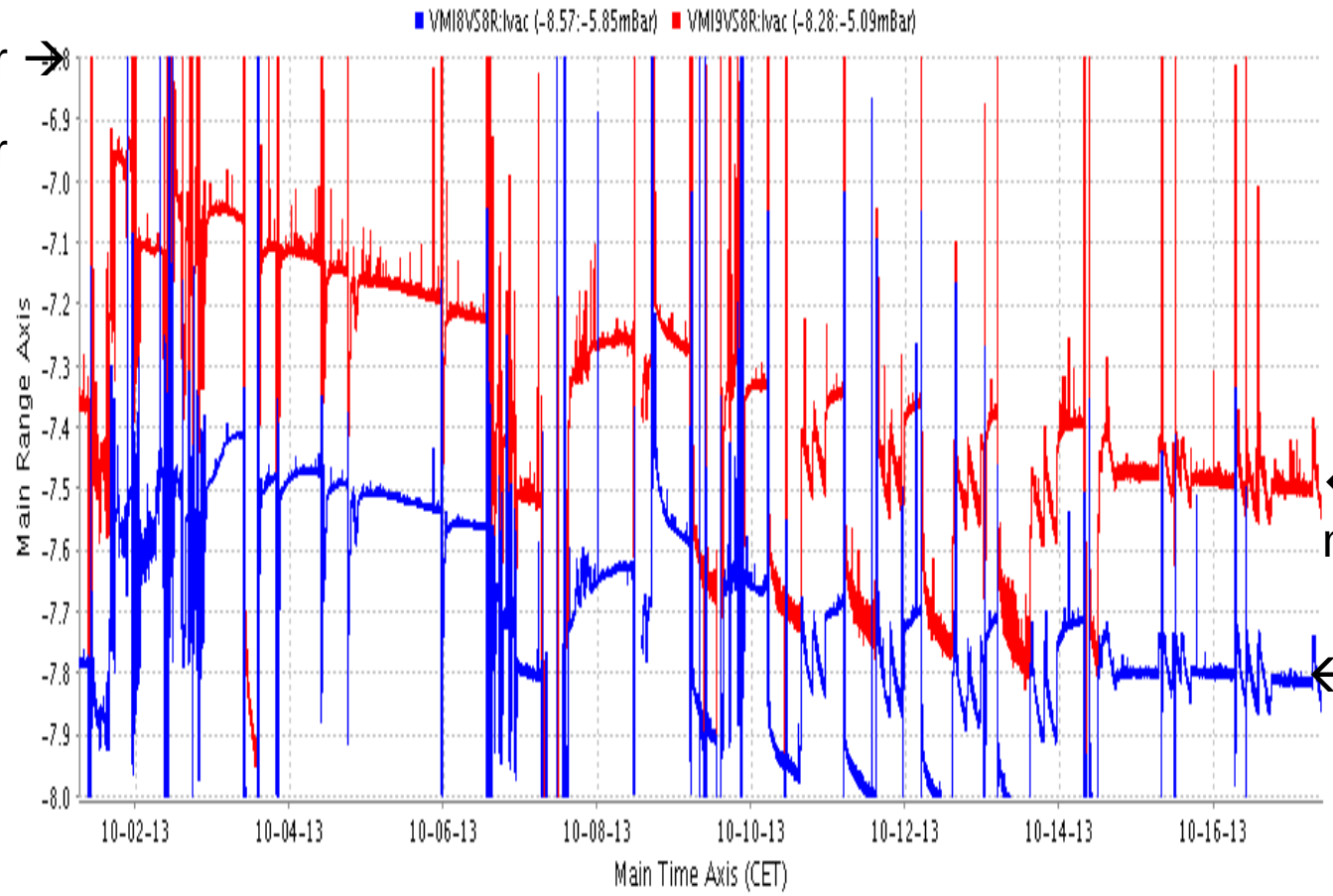
Vacuum in Cavity section after shutdown 2013

All cavities replaced, 2 new HOM and 2 old DORIS

1.6E-7 mbar →

1.1E-7 mbar →

5E-8 mbar →



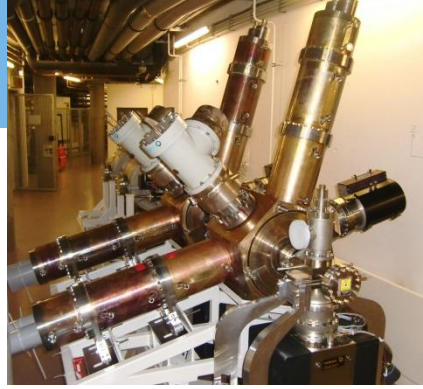
← 3E-8 mbar

← 1.6E-8 mbar

1E-8 mbar →

← 2.5 weeks →

History of cavity installation



History of new cavities:

Before shutdown:

- Produced at RI and baked out
- Shipped to HZB
- **Vacuum opened short** to mount HOM dampers , plunger, …
- Conditioned up to 30 kW wall losses (450 kV) vacuum 10^{-9} mbar range
- HOM Cavities installed on new girder

Shutdown:

- Girder with DORIS cavities removed (start with work first day)
- Two DORIS cavities relocated to new girder
- New girder installed in SR tunnel, cabling, water etc.
- Vacuum was open few days, no bake out ☹
- Vacuum closed and leak check
- Conditioned up to 40 kW wall losses (520 kV) vacuum 10^{-7} -10^{-8} mbar range
- Conditioning only possible over night because of radiation → reduced time

not optimal

Beam operation:

- Beam operation starts when conditioning pulsed was o.k., CW not really ready
- Vacuum conditions get continuously better – but very slowly
- $2*10^{-7}$ mbar → $3*10^{-8}$ mbar at high current in 2.5 weeks
- old "normal" value after long operation $3*10^{-9}$ mbar
- Two extra leak checks – no leak detected

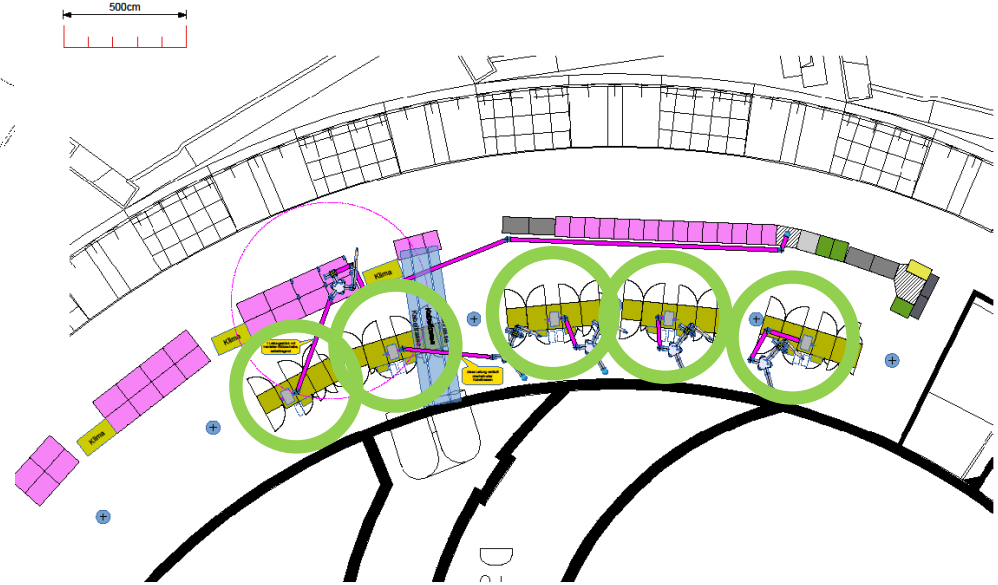
What to learn for next installation period

What do we learn, what do we will change for shutdown 2015:

- In shutdown 2015 it is planned to replace remaining two DORIS cavities by HOM cavities
- Work is less, because girder is already on place
- Now installed HOM cavities have not to be vented
- Open vacuum of new cavity only shortly, maybe through flow of N2 while open
- **Need enough time in shutdown for bake out cavity and HOM dampers in SR**
- **Need enough time for conditioning with PSI set (radiation), make clear schedule for conditioning in advance in coordination with external companies and radiation safety department!**

SSA for BESSY II

At BESSY II the five klystron based transmitters will be replaced by solid state transmitters (Cryoelectra)



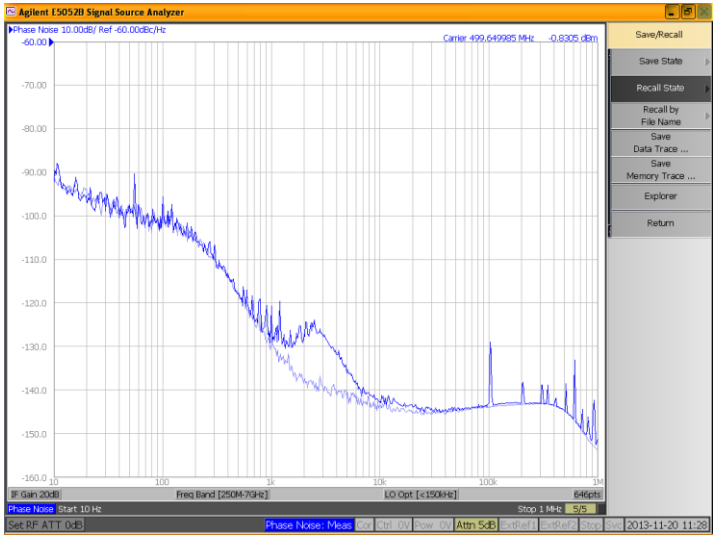
First SSA prototype arrived from Cryoelectra

500 MHz 40 kW SSA transmitter by Cryoelectra

40 kW transmitter for booster is delivered.

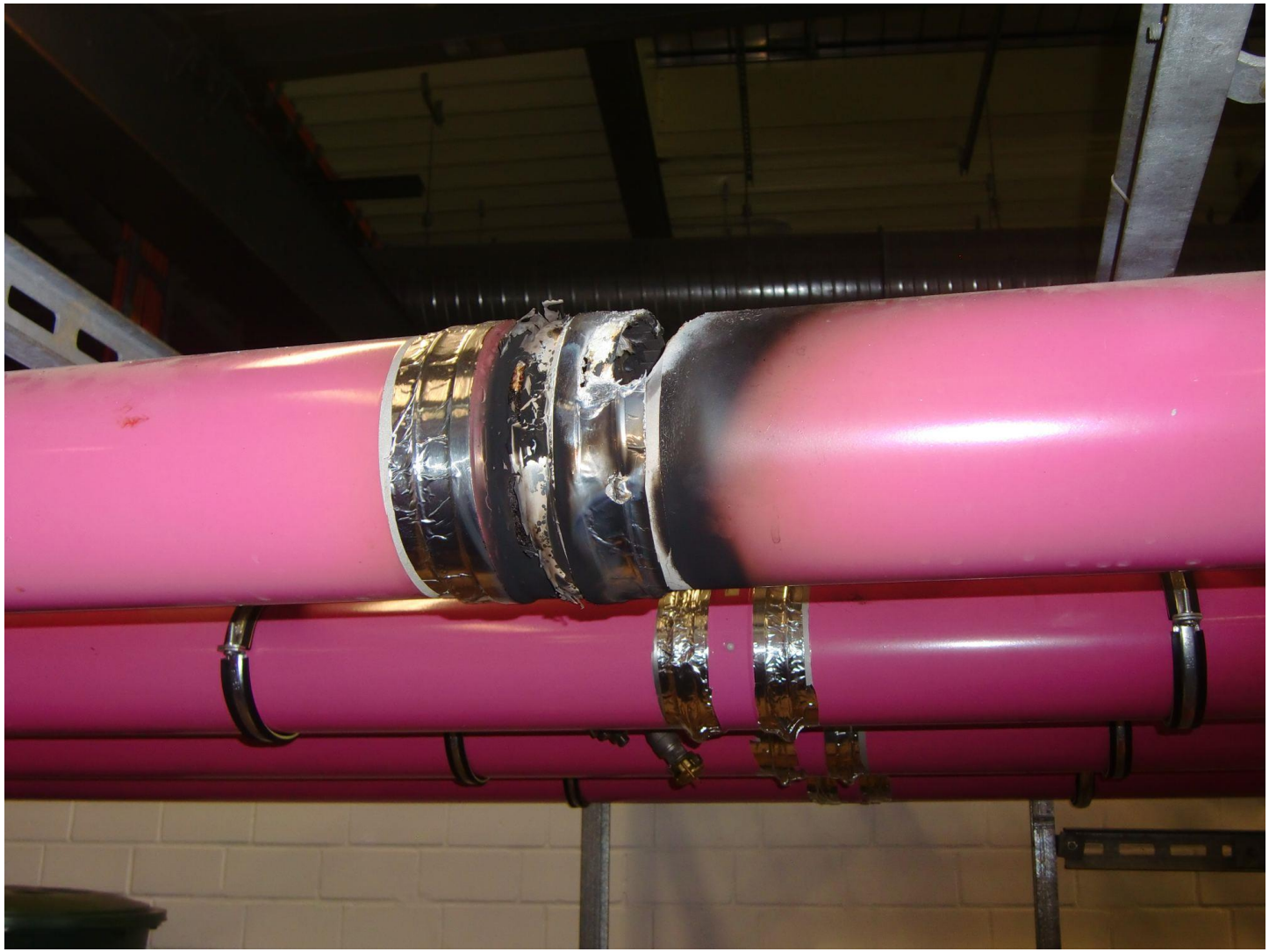
Details of commissioning see talk of Bernhard

Four 80 kW storage ring transmitters will be delivered within the next 9 month.



Excellent low noise

Burned RF power line



Burned coaxial power line

Burned RF power line

Burned contact springs of inner conductor

- BESSY has a burned coax line every 8 years: 1998 - 2006 – 2014
- Contact springs of inner conductor was cause, 20 m line was affected
- We will install more discs without holes to prevent spread out of fire
- We have power line interlock with 4-5 kW sensitivity limited by directivity of directional couplers
- Interlock has been resseted a few dozen times
- Thermal calculations show you need 250 W sensitivity to avoid inflaming teflon discs

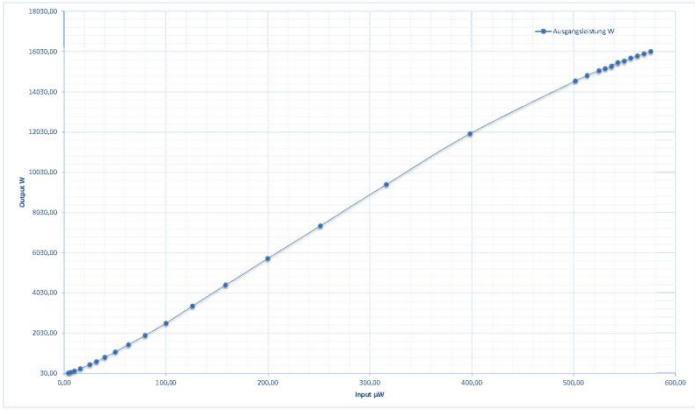
Holes in teflon discs

Arc in circulator 500 MHz 75 kW

Arcs in port of circulator

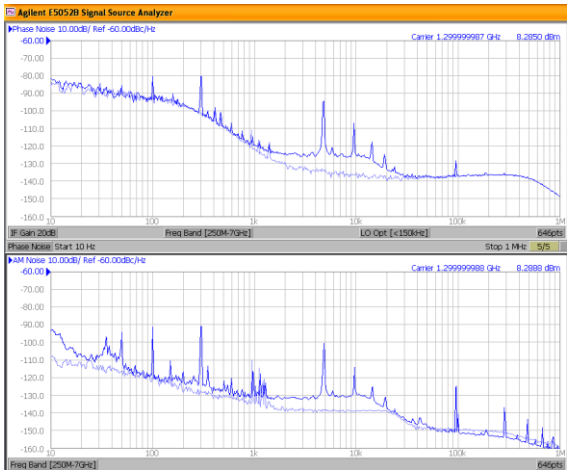
SSA15 kW 1.3 GHz by SigmaPhi

15 kW SSA at HZB



16 kW output power reached

- 15 kW 1.3 GHz solid state transmitter
  - Prototype by SigmaPhi delivered
  - Acceptance test successful
  - Now in use at HoBiCaT to test in real life
  - Next transmitter will be ordered soon for tests with transversal deflecting cavity
  - Linac transmitters will be ordered later when they will be needed

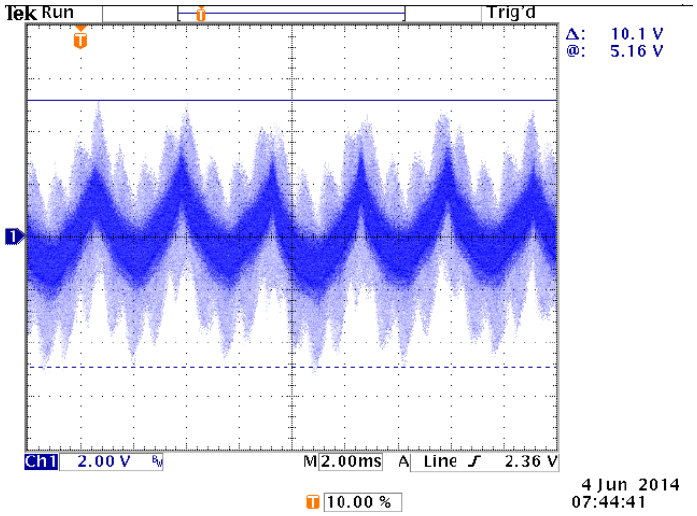


Phase noise (upper) and AM noise at 15 kW
Scaling: 10 Hz- 1MHz -60 dBC - -160 dBC

Klystron transmitter 270 kW 1.3 GHz (FUG/CPI)

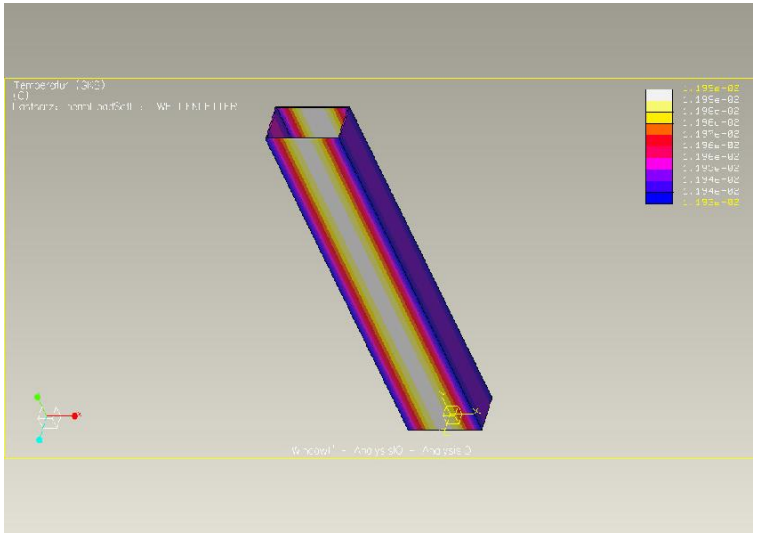
600 kW power supply for 270 kW transmitter at FUG

- 270 kW 1.3 GHz klystron transmitter
  - First CPI klystron fabricated, factory acceptance test o.k.
  - Factory acceptance of power supply test successful (FUG)
  - First transmitter will be delivered next week



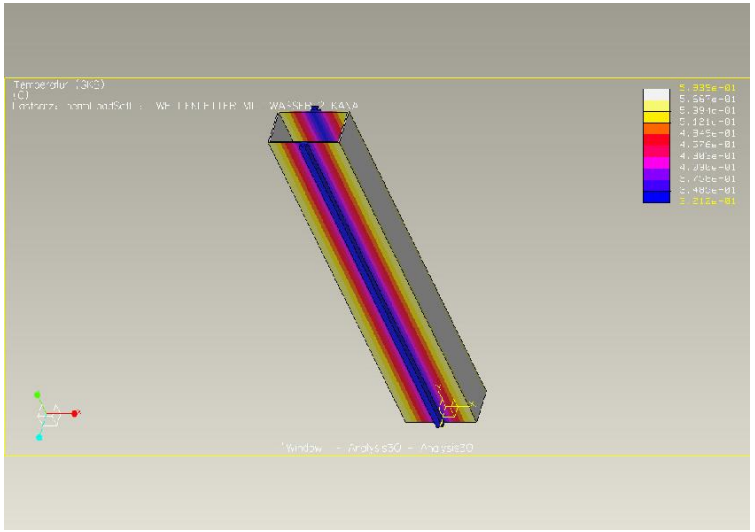
$10V_{pp}$ ripple at nominal power 61 KV 9.1A

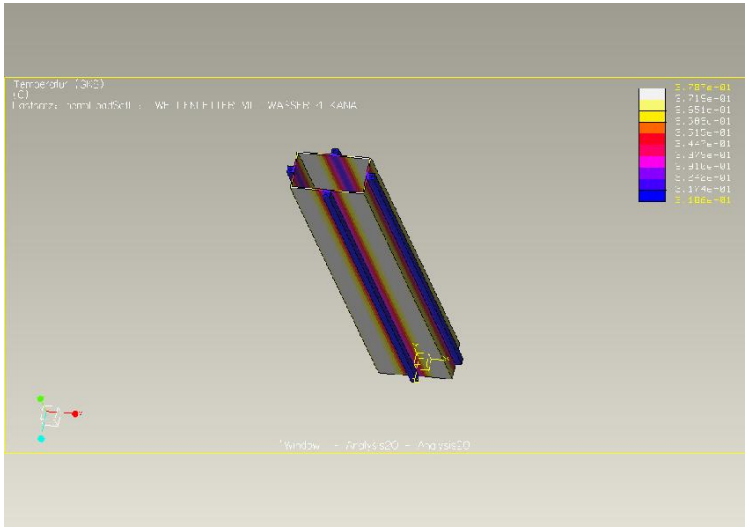
Wave guide cooling



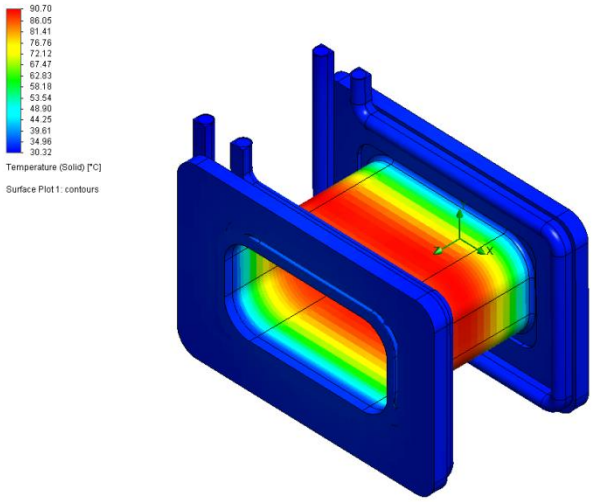
300 kW_{cw} 1.3 GHz operation of waveguides: (material: Al)

- Top left : 120 ^{0}C without cooling
- Bottom left: 60 ^{0}C two cooling channels
- Bottom right: 38 ^{0}C four cooling channels



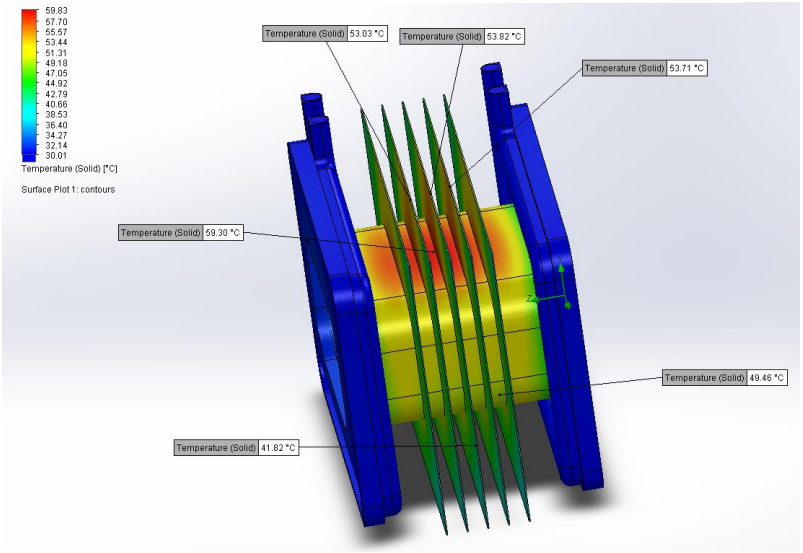


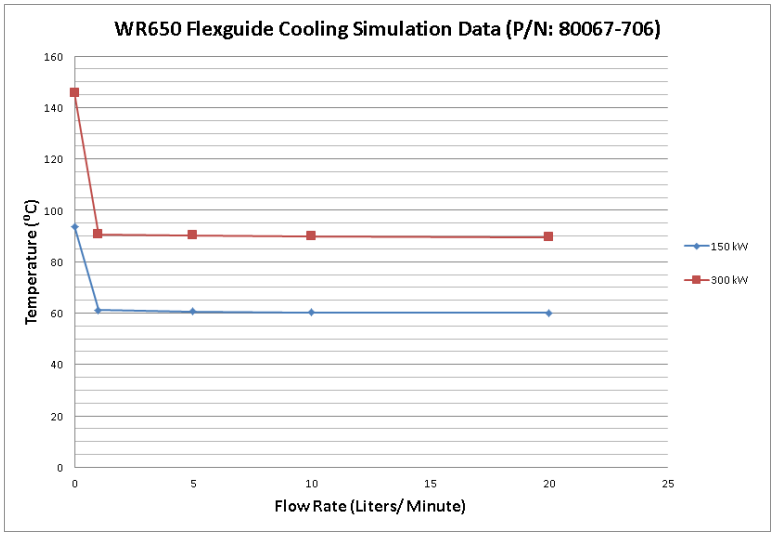
cooled waveguide bellows



300 kW_{cw} operation of a waveguide bellow:

- Top left: 90 ^{0}C only flange cooling
- Bottom left: 54 ^{0}C flange cooling and fins
- Bottom right: flow rate simulations





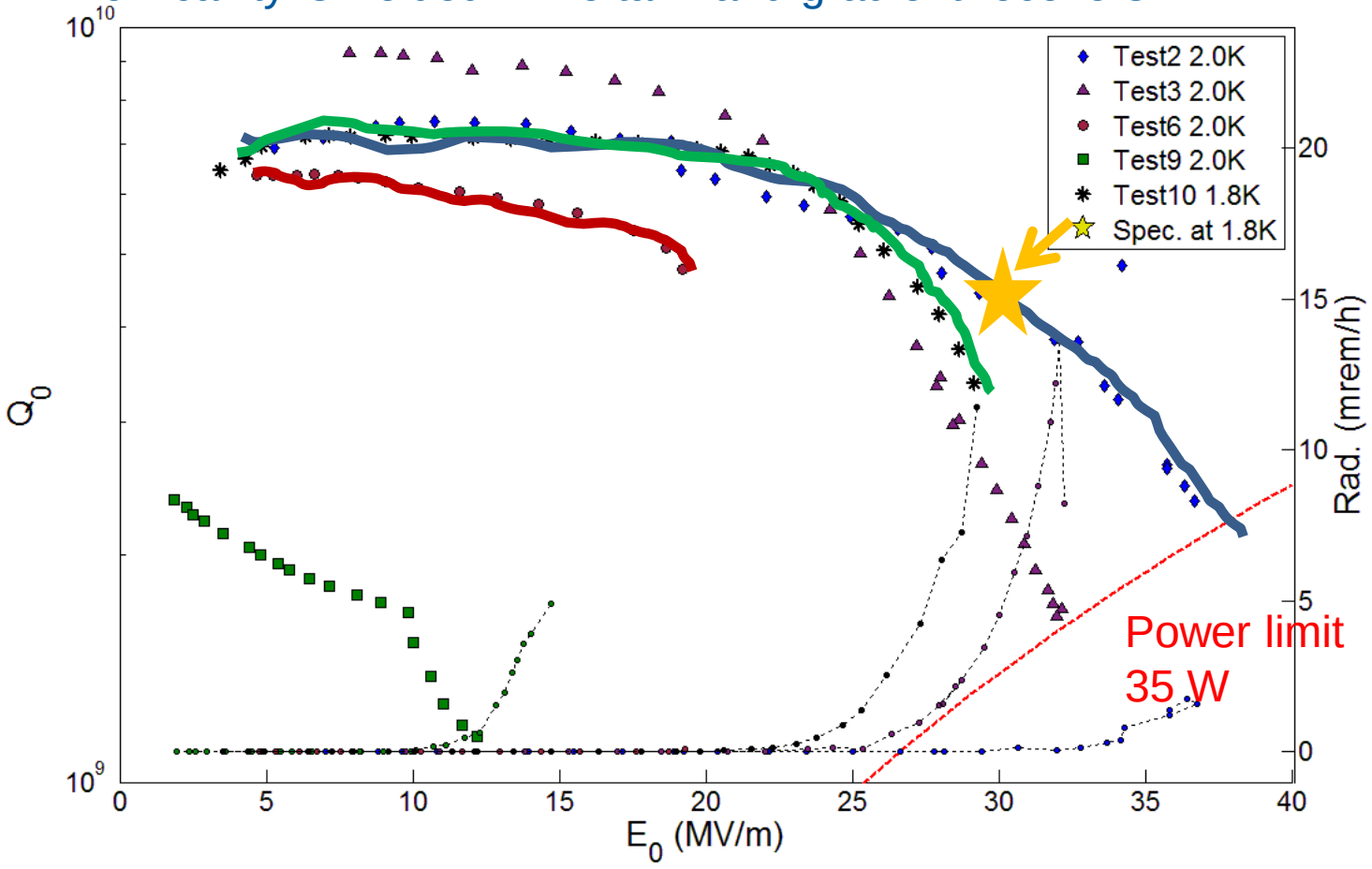
Vertical tests of Gun 1 cavity

Gun1 cavity is produced by Jlab far out of tolerances (8mm wrong)

➔ New cavity shape has multi-pacting barriers (in theory and measurements)

➔ Gradient an Qo get worse with every new test

➔ Now cavity is welded in He tank and gradient recovers.



Module production bERLinPro

1.5 cell gun cavity in He vessel

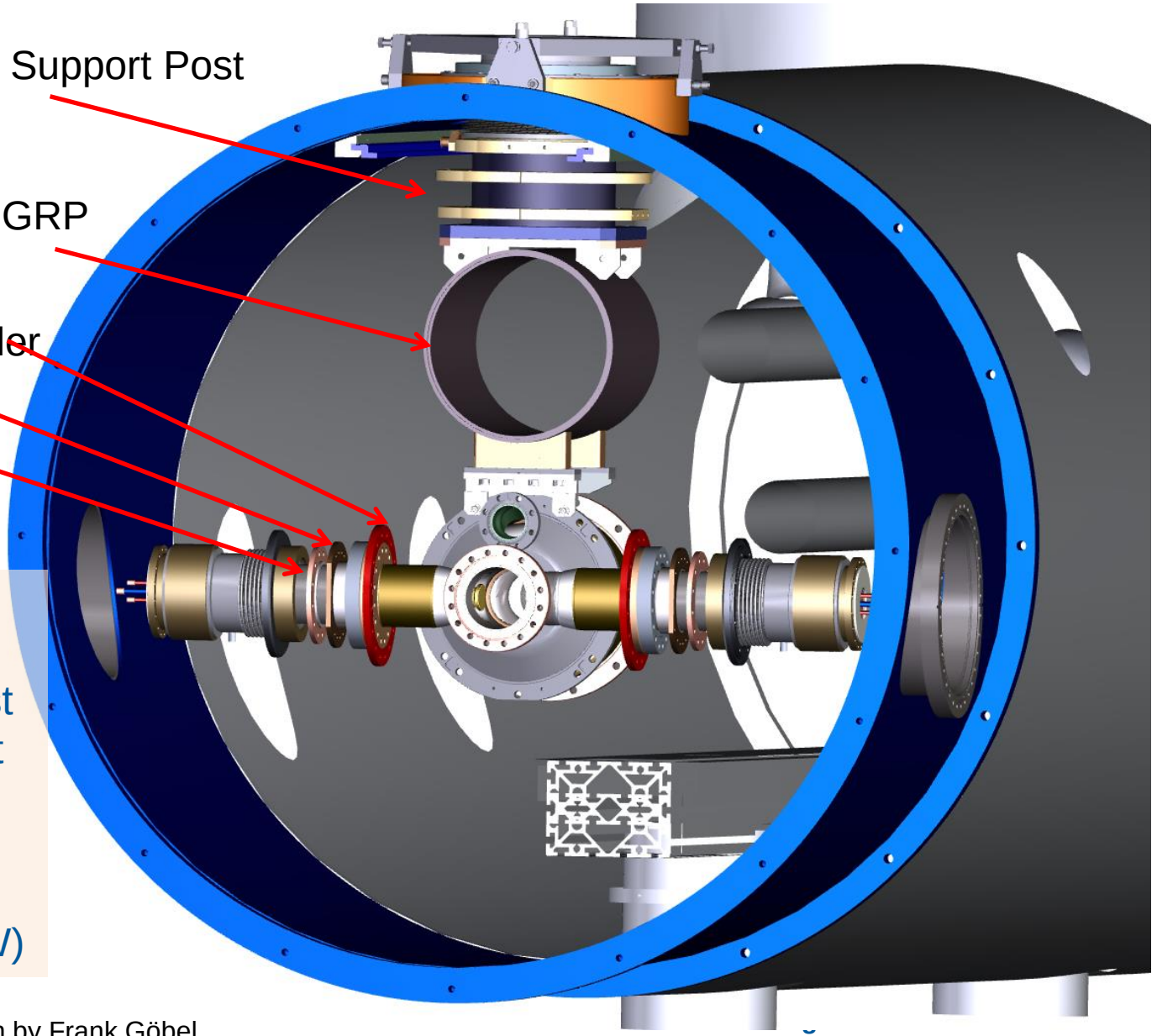
Production for gun1 module and booster cavities for bERLinPro is ongoing.
First parts are delivered.

Sc solenoid magnet

Booster cavity

Vacuum vessel for gun 1 module

HoBiCaT Extension for KEK couplers



We will build an extension to the horizontal sc cavity test facility HoBiCaT to test injector cavities for bERLinPro using two modified KEK type couplers (up to 150 kW)

Design by Frank Göbel

Test facilities for sc cavities at HZB

bERLinPro includes installtion of several test facilities to test sc cavities:

- Horizontal testing: HoBiCaT – in operation since 2003
- Vertical testing:
  - Teststand for 2-cell cavities -- delivered
  - Test stand for 7-9 cell cavities – need building
- Clean room for mounting and high pressure rinsing: cleanroom ready, HPR start qualifying
- Chemical etching: ready end 2015

Small vertical test stand for testing up to 2-cell cavities or for use for the quadrupole resonator is delivered by Kriosystems

Clean room with HPR

Thank you !