

Status of bERLinPro and BESSY II Installation of SSA

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- **BERLinPro**
 - **Status building**
 - **Status transmitters**
 - **Status cavity production**

- **BESSY II**
 - **New cavities**
 - **New transmitters SSA**



bERLinPro building started. To be completed christmas next year



- Building for **testing hall 1** started including a vertical test stand.
- Planning for **testing hall 2** started including a module test stand



270 kW klystron transmitter
prototype klystron and 600 kW
power supply delivered

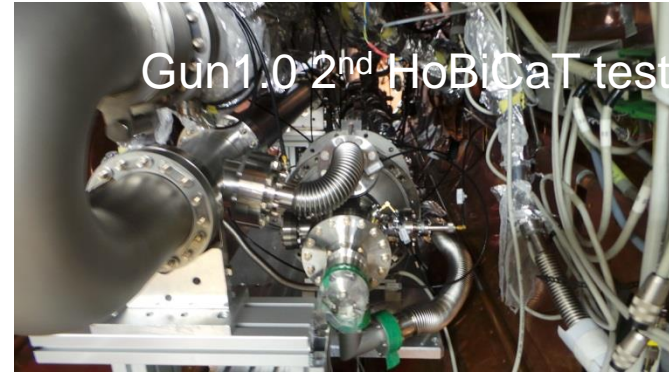
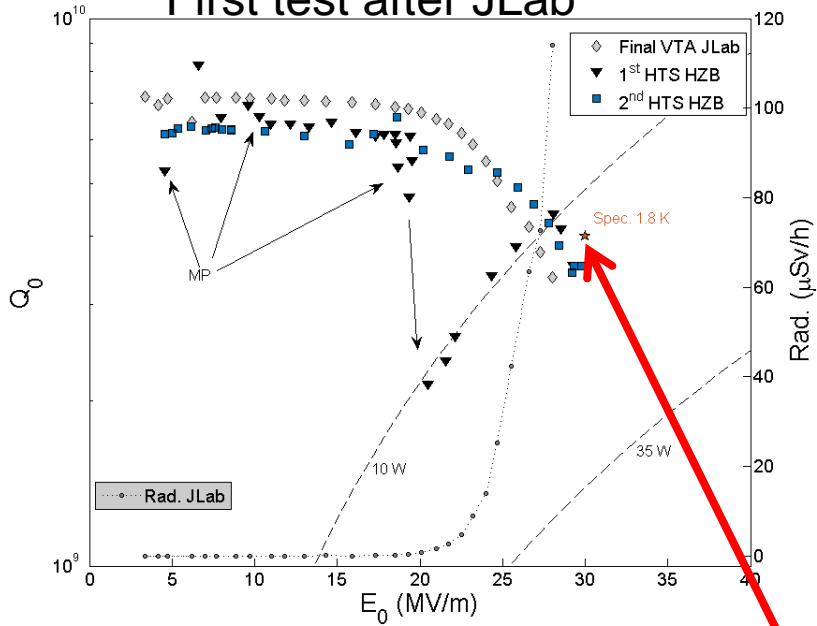
Low priority, because 120 kW
1.3 GHz couplers still not
ordered



15 kW solid state
transmitter
prototype operable
at HoBiCaT



First test after JLab



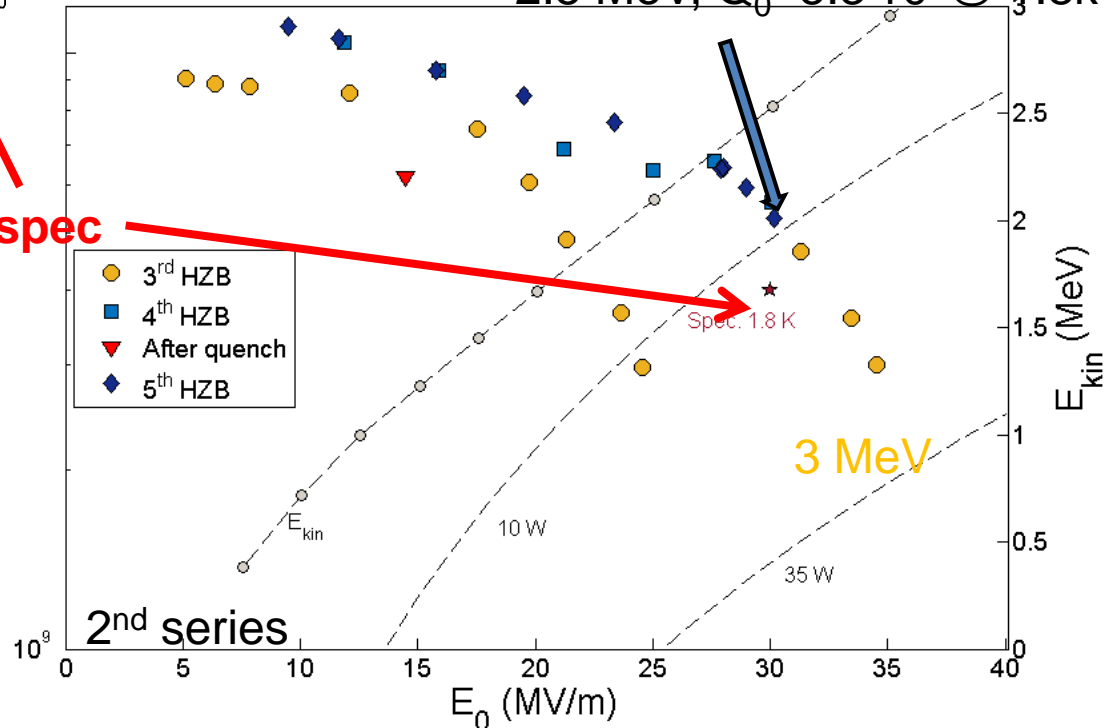
A. Neumann et al., SRF 2015

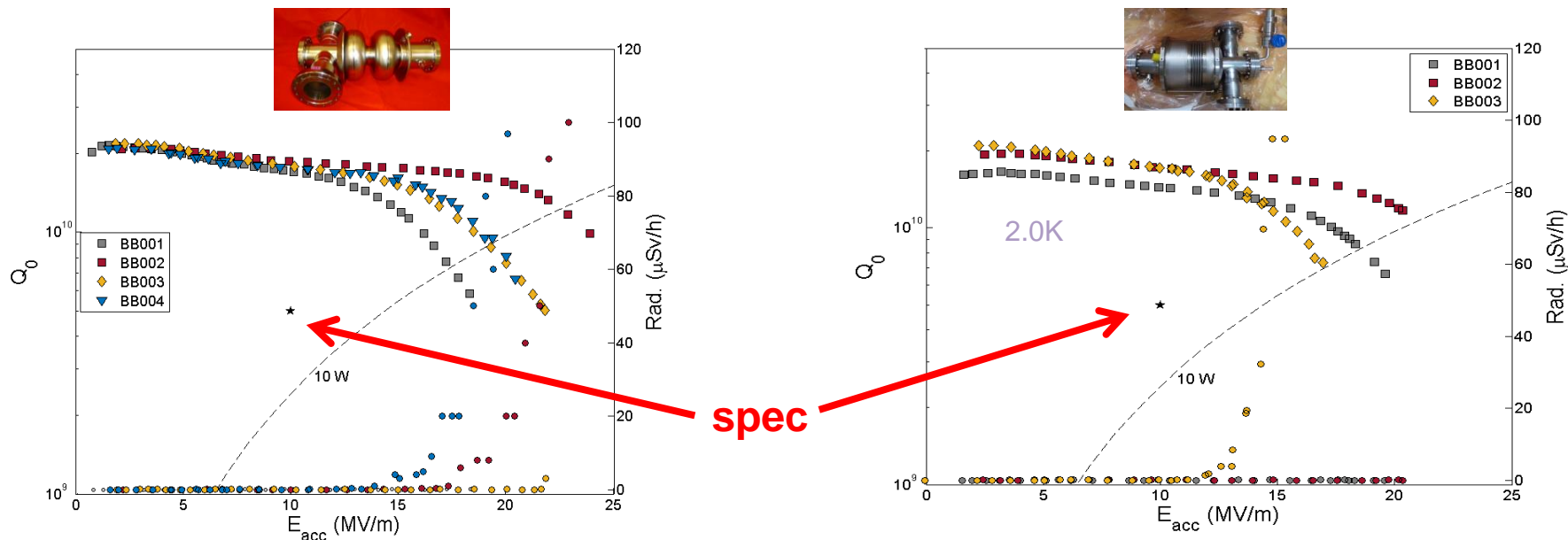
2.5 MeV, $Q_0=5.3 \cdot 10^9$ @ 1.8k

After work on the helium vessel a further test was required:

- Unfortunately the cavity was vented by a short vacuum hose
- First cavity multipacted and eventually quenched at low fields
- This was overcome by RF processing (yellow dots) → finally quenched at 35 MV/m
- The cavity was recovered by thermal cycle above T_C and achieves the design field of bERLinPro

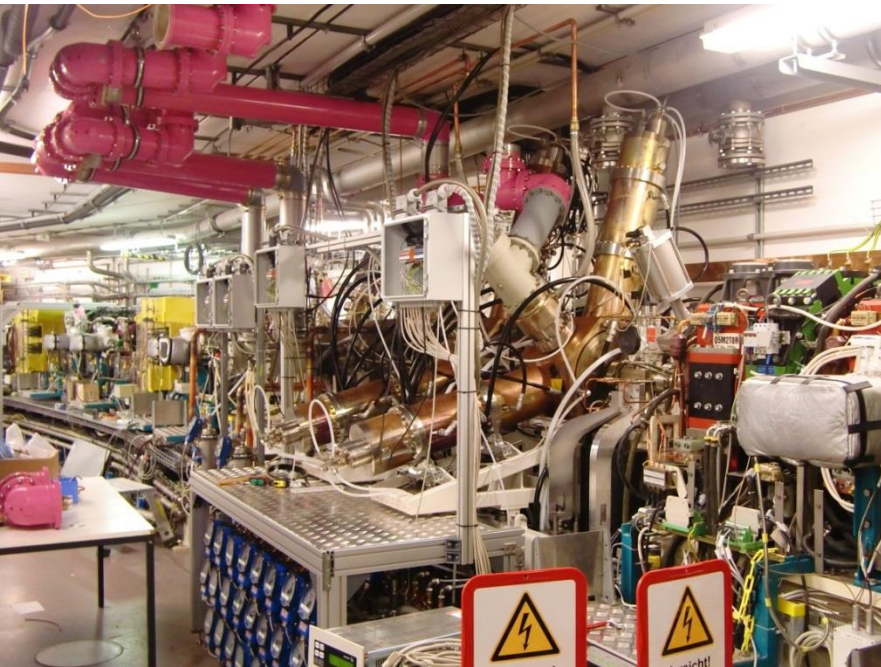
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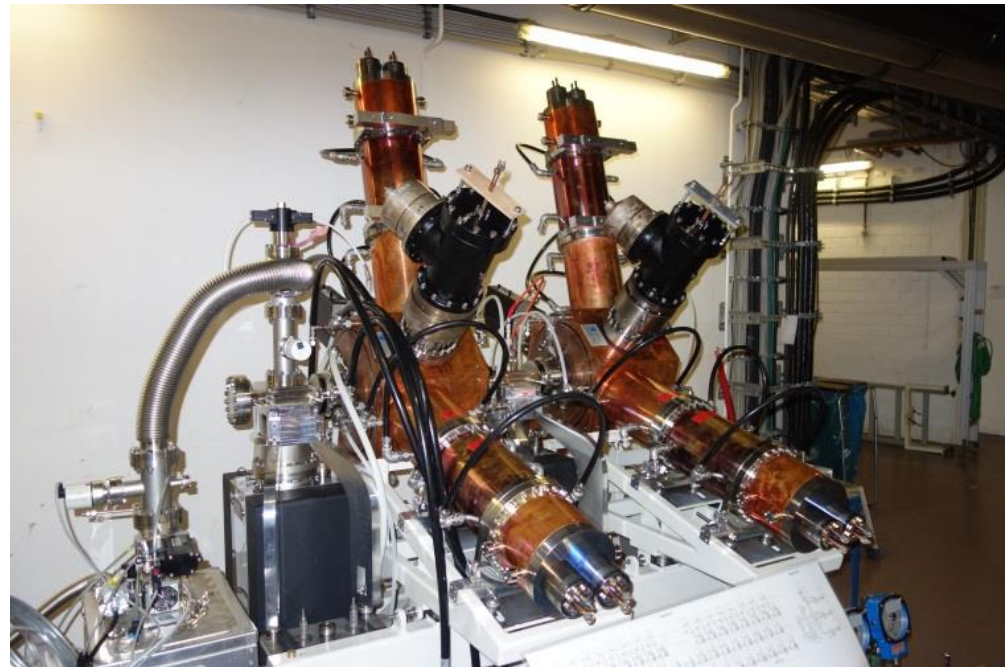


Booster cavity vertical tests at JLab before and after helium vessel welding (except for BB004) at 1.8 K. Due to leakage problems below λ point at the FPC NbTi flanges, cavity BB001 was only measured at 2.0 K.

- The booster cavities all are beyond specifications.
- Maximum field with helium vessel mostly 10% lowered after helium vessel welding
- For cavity BB003 a field emitter was uncovered after HV welding, for BB002 the emitter vanished
- All field emission onset are above the field level of 10 MV/m for bERLinPro.



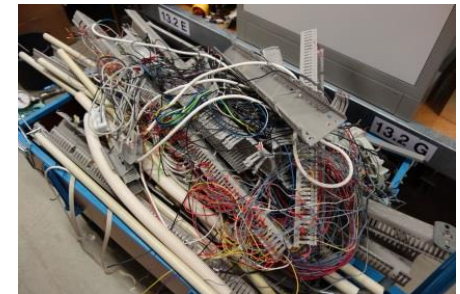
2013 two HOM cavities installed



2015 next two cavities ready to be installed in november

Still waiting for the last HOM cavity (spare) to be delivered by RI

Bye bye --- old klystron transmitters

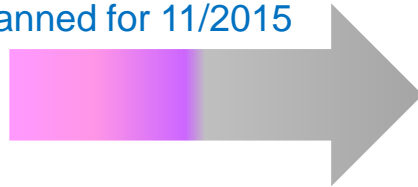


New transmitters for the storage ring and booster



Old 75 kW 500 MHz klystron based RF transmitters

Old klystron based RF transmitters are in replacement by solid state RF transmitters (SSA). (No spare klystrons available)
Two transmitters are replaced in shutdown 3/2015, one transmitter replacement in 7/2015 and last SR transmitter and booster transmitter is planned for 11/2015



New solid state transmitters (Cryoelectra)



To install SSA transmitters the klystron transmitters have to be removed first.

Once starting removing a klystron transmitter, there is **no way back!**

Two transmitters are installed during march a shutdown, one transmitter was **installed during beam operation !!!** and the last two transmitters will be installed during November shutdown.

Was only possible due to a precise time schedule and the high motivation of the HZB RF staff

-- **thank you** --

and it needs absolute **precise delivery times** and **on the day exact timing** of appearance of the **Cryoelectra commissioning personal.**

**Delivery, commissioning and debugging support by
Cryoelectra is excellent !!!**

- 12.2012 ordered 1 x 40 kW (booster) 4 x 80 kW storage ring
- 05.2014 40 kW transmitter **delivered**, used as prototype
- 10.2014 80 kW transmitter 001 **delivered**
- 02.2015 80 kW transmitter 002 **delivered**
- 03/04 2015 transmitter 001 & 002 into **beam operation**
- 07.2015 transmitter 003 **delivered**, installed during beam operation
- 08.2015 transmitter 003 **beam operation**

- 10 2015 transmitter 004 to be **delivered**
- 12.2015 **all transmitters beam operation**

- 17 month from ordering to first transmitter
- 6 month debugging phase of prototype
- 11 month from first delivery of first transmitter to first beam operation
(caused by shutdown schedule)
- 9 month installation phase of all 5 transmitters

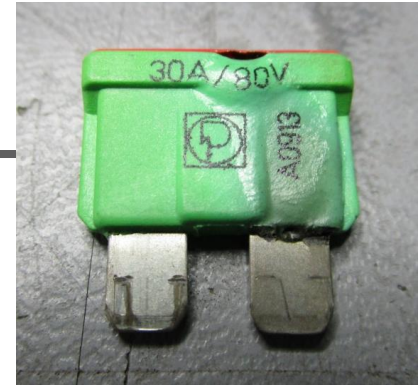
1. **Remove klystron transmitter**
2. **Delivery & installation of SSA**
3. **Commissioning SSA**
4. **3-4 weeks burn in phase**
5. **Remove control racks of klystron transmitters (PLC, LLRF, focus, heater, cavity control, interlocks...)**
6. **Install control racks of SSA (PLC, cavity control, LLRF, interlocks)**
7. **Connection PLC → control system**
8. **Commissioning of SSA in cavity operation**
9. **Ready for beam**

Total installation & commissioning time: ~ 8 weeks

After setting a transmitter into beam operation there was **no fault** due to the SSA.

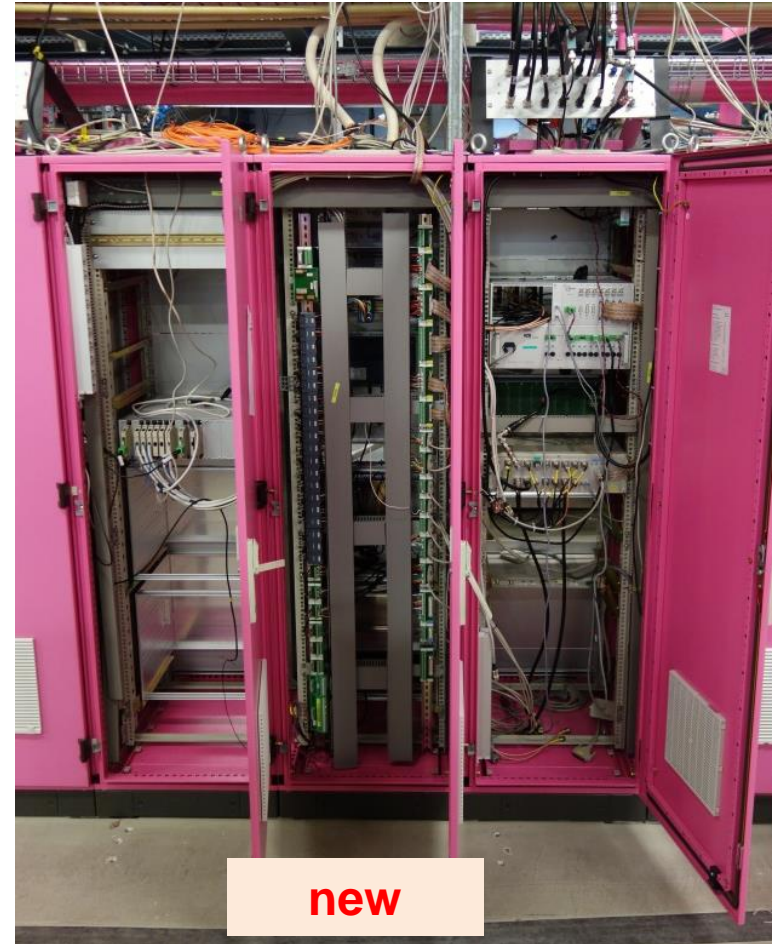
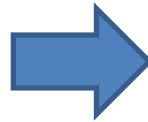
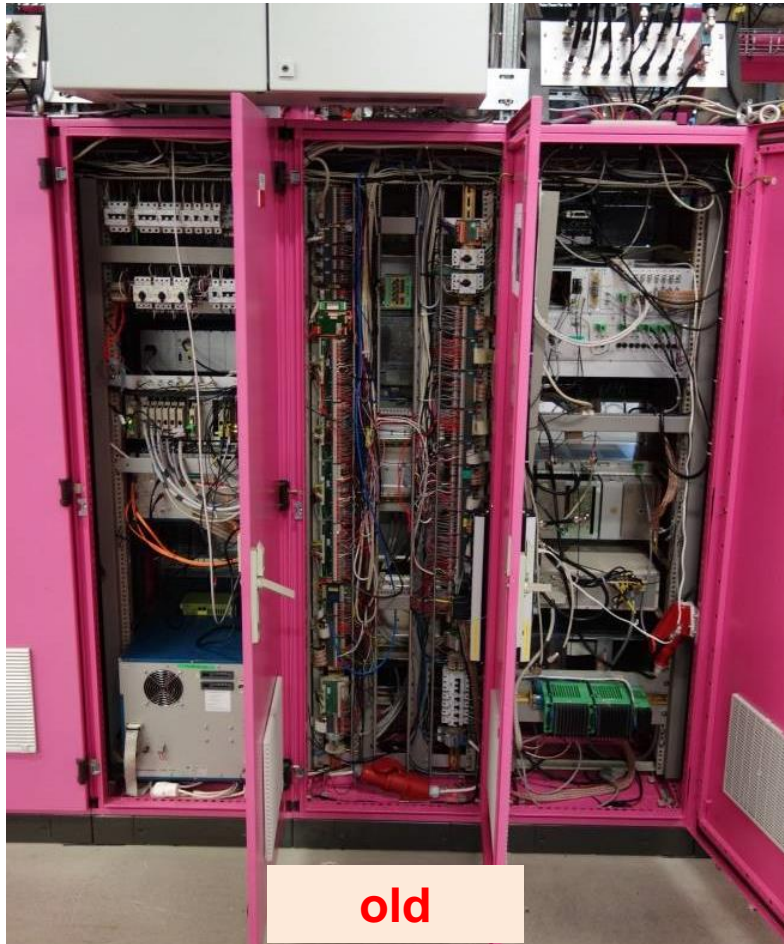
We had a handful beam losses due to control system connection and rebooting a PLC of a “passive” SSA in installation phase ... sorry ...

- Noise on Pre-pre-amplifier due to bad power supply → fixed
- 30A Fuses get to hot → fixed by exchange with 40A fuses
- Software adapted by Cryoelectra according all wishes from HZB (PLC and LabView GUI) → fixed
- Pulsed operation: Error messages of power supplies
 - Voltage is stable
 - Transmitter operation is stable
 - Messages are only warnings
 - PS company will not change software
- RF shielding of racks, cross talk between transmitters (no critical level)
 - → doors of rack will get shielding
- Some module output line burned (pre-damaged during **over-critical FAT testing procedure**)
 - Problem understood. Solder connection will be re-improved to production quality on-site



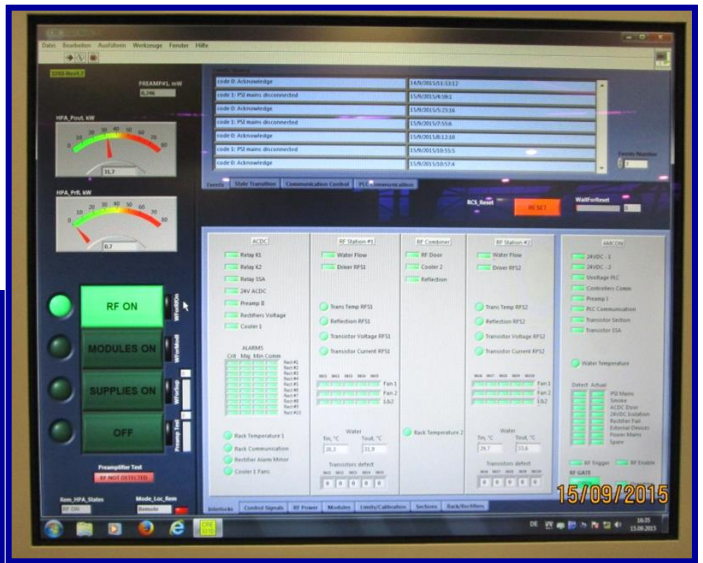
- First transmitter (prototype) **several bugs**
- Next transmitter **few bugs**
- Next two transmitter installed directly after delivery. **No bugs**
- Shielding & high temperature solder have to be fixed finally
- Debugging was done in a non-bureaucratic way in cooperation of HZB and Cryoelectra.
- Spare parts to replace delivered immediately
- Supporting personal of Cryoelectra travel to HZB within 1-2 days

3 transmitters in beam operation now
Last two will follow in November/December



Control racks has to be dismantled completely and build up completely new.

Left picture backplane of the control racks of the old klystron transmitter – right side control racks for the new solid state transmitters.



Control racks
HZB (pink)
Cryoelectra
(middle & right)



Cooler

power supplies

modules combiner modules

control rack

- bERLinPro
 - progress in building & injector cavity production
 - Prototype transmitters delivered
- BESSY II
 - Last HOM cavities will be installed end of the year
 - Solid state transmitters replace klystron transmitters
 - Solid state transmitter by Cryoelectra now “debugged”
 - 60% if installation finished, rest will follow end of the year
 - Very tight schedule due to shutdown / beam operation
 - Delivery, commissioning and debugging support by Cryoelectra is excellent !!!

Thank you !