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HZB BESSY II Light Source

BESSY-II NEW DIGITAL MTCA.4-BASED LLRF CONTROL FOR THE BOOSTER UPGRADE

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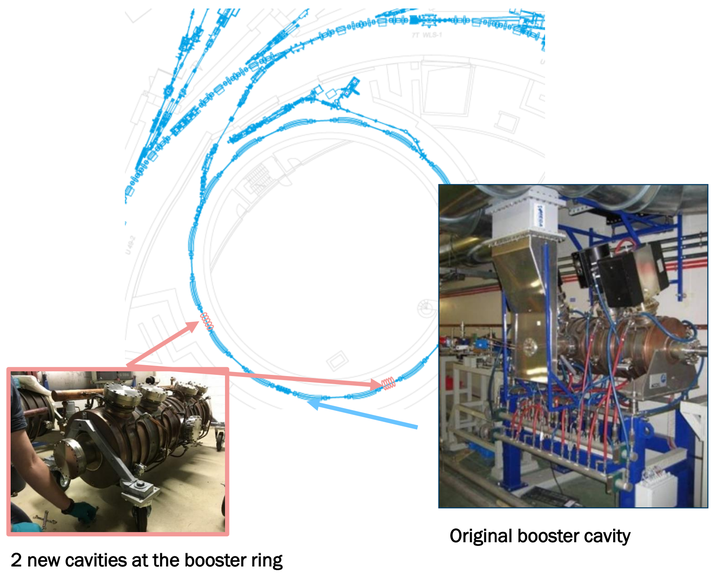
ABSTRACT:In the framework of the **BESSY-VSR** upgrade, the beam injection from the booster to the storage ring has to be modified in order to inject **shorter bunches:**

- A new PETRA-type 5 cell cavity (500MHz, normal conducting) has been installed in the booster ring and a second one is to be installed.
- Powered by two already installed and tested 80kW Solid State Amplifiers
- mTCA chassis: Concurrent CPU AMC, x2-timer, SIS8300-KU, DWC8VM1
- “Single cavity” firmware + ChimeraTK EPCIS adapter

SHORTER BUNCHES INJECTED TO SR



2 new cavities at the booster ring

Original booster cavity

In the framework of the BESSY-VSR upgrade, the beam injection from the booster to the storage ring has to be modified in order to inject shorter bunches. For this purpose, a new PETRA-type 5 cell cavity has been installed in the booster ring and a second one is to be installed.

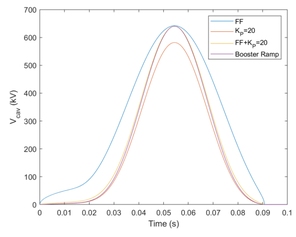
TWO NEW 80kW SOLID STATE AMPLIFIERS

These two new normal conducting 500MHz cavities are to be powered by two already installed and tested 80kW Solid State Amplifiers

Together with a SIEMENS PLC-based interlock system:

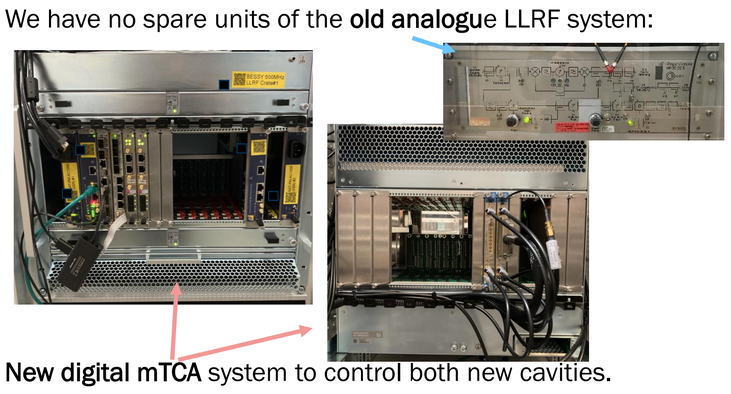
RAMP VS. CW OPERATION

Contrary to the Storage Ring cavities (CW operation), the Booster needs to be ramped up and down. The existing firmware allows this feature, but the software server needs to be adapted.

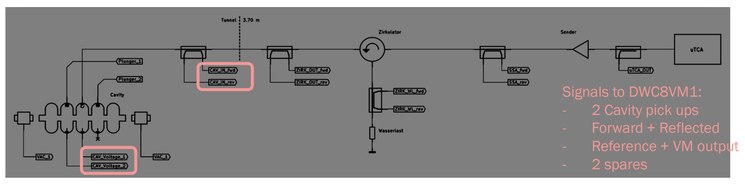


NEW DIGITAL LLRF

We have no spare units of the **old analogue** LLRF system:

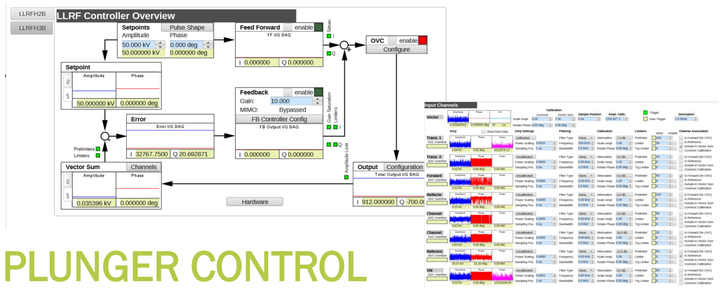


New digital mTCA system to control both new cavities.



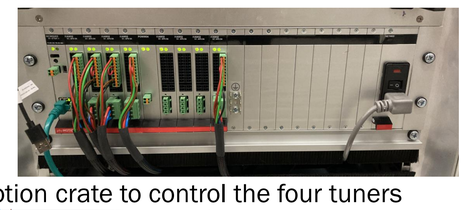
- 12-slot Schroff crates: possibility of fitting a RF backplane in the future
- Concurrent AMC CPU AM_G64/471-41
- X2-timer: to be replace in the future by MicroResearch Finland mTCA-EVR-300U
- 2x SIS8300-KU FPGA boards
- 2x DWC8VM1

- DESY‘s new Gitlab-based framework for firmware



PLUNGER CONTROL

- PETRA-type cavities are equipped with two plungers to tune them
- They work „against“ the cavities‘ vacuum → 3A → No chance to use in-crate MD22



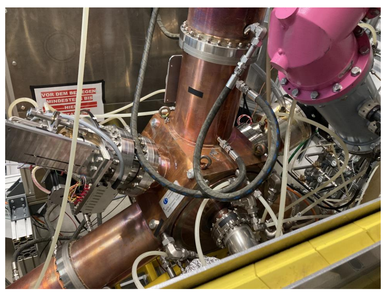
- Phytron Phymotion crate to control the four tuners

- Automatic tuning still to be implemented
- 2 RF pick-ups + 2 plungers → field flatness control?

TEST STAND

Before deploying the system into the booster cavities, we connected the SSA to a HOM damped SR cavity in radiation controlled area.

Test are to start in the following weeks. Then the SSA will be connected to the booster cavity.



CONCLUSION AND FOLLOWING STEPS

- New booster cavities are needed to reduce the bunch length at injection
- One cavity is already installed
- 2 new 80kW SSAs installed and commissioned.
- There are no spare analogue units → good excuse to turn to mTCA.4!
- Plunger control to be done by a Phymotion crate
- 12-slot crate to control two cavities
- DESY‘s new firmware Gitlab framework
- ChimeraTK + EPICS server
- Still to implement the ramp for the booster
- To be tested in the following weeks in a radiation controlled test stand
- Provided a successful deployment, old analogue units shall be replaced
- New frequencies in the future: VSR upgrade, NC 1,5GHz, NC 1,75GHz,...
- Also Metrology Light Source!

T. Atkinson, BESSY-II Machine Advisory Committee, 03-04.12.2018
L. Butkowski, Open Source Projects at DESY, This Workshop.
P. Nonn, Implementation of LLRF control software outside of DESY using EPICS, This Workshop.

Setting the system up and debugging it wouldn‘t have been possible with the collaboration and help of many people. Below there is a list, in arbitrary order, of some of them.

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