25

25 Years of BESSY II:
A Success Story in
Berlin-Adlershof

HZB · **BESSY II Light Source**

STATUS UPGRADE ON THE BESSY-II LLRF MODERNIZATION AND FUTURE PLANS

P. Echevarria, A. Neumann, A. Ushakov. Helmholtz Zentrum Berlin.

ABSTRACT: BESSY-II synchrotron light source at Helmholtz Zentrum Berlin, has been in operation for almost 25 years and it is not expected that its successor, BESSY-III will be ready for user operation until the second half of the next decade. One of planned modernization measures is the replacement of the old analogue LLRF control system with modern, state-of-the-art mTCA.4 crates running the so-called "single cavity control".

MTCA-BASED LLRF CONTROL

We have no spare units of the **old analogue** LLRF system:
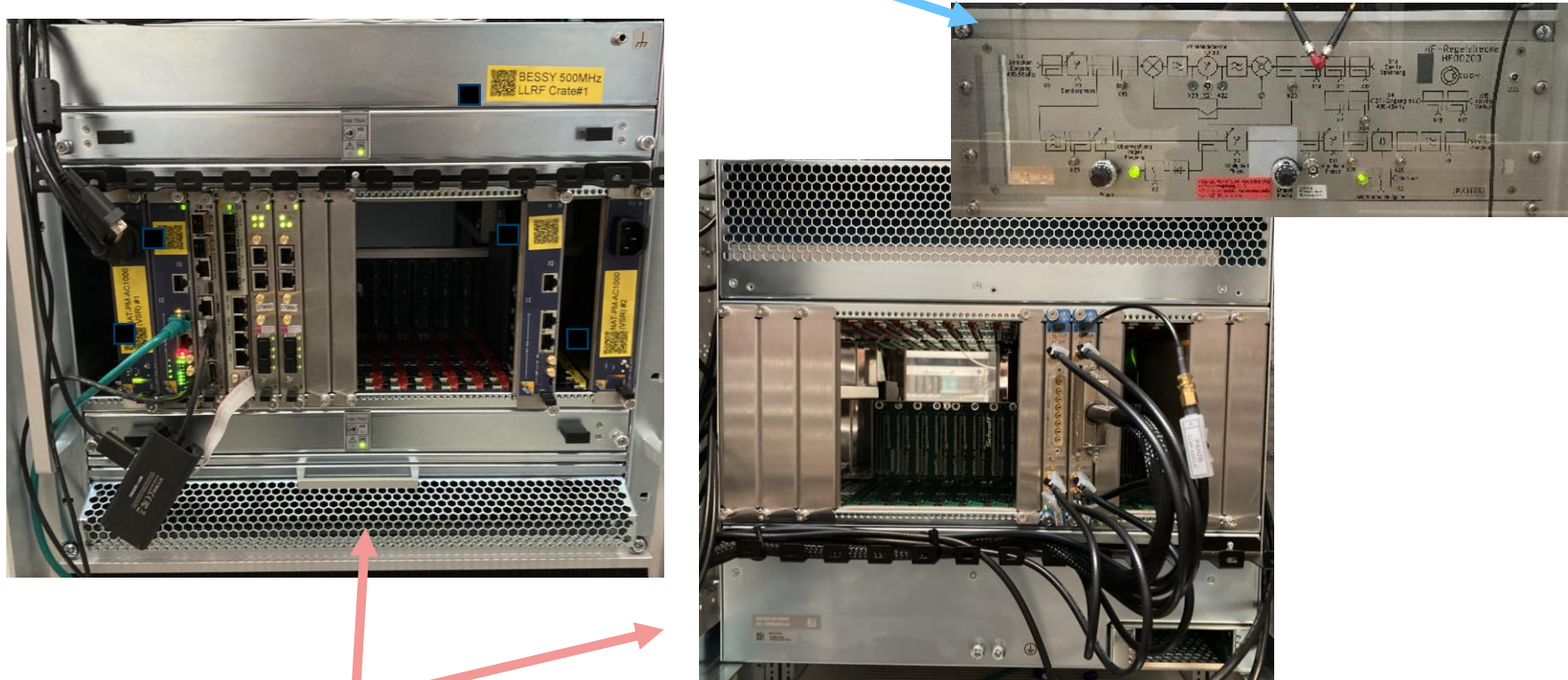
New digital mTCA system to control both new cavities.

- 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 development
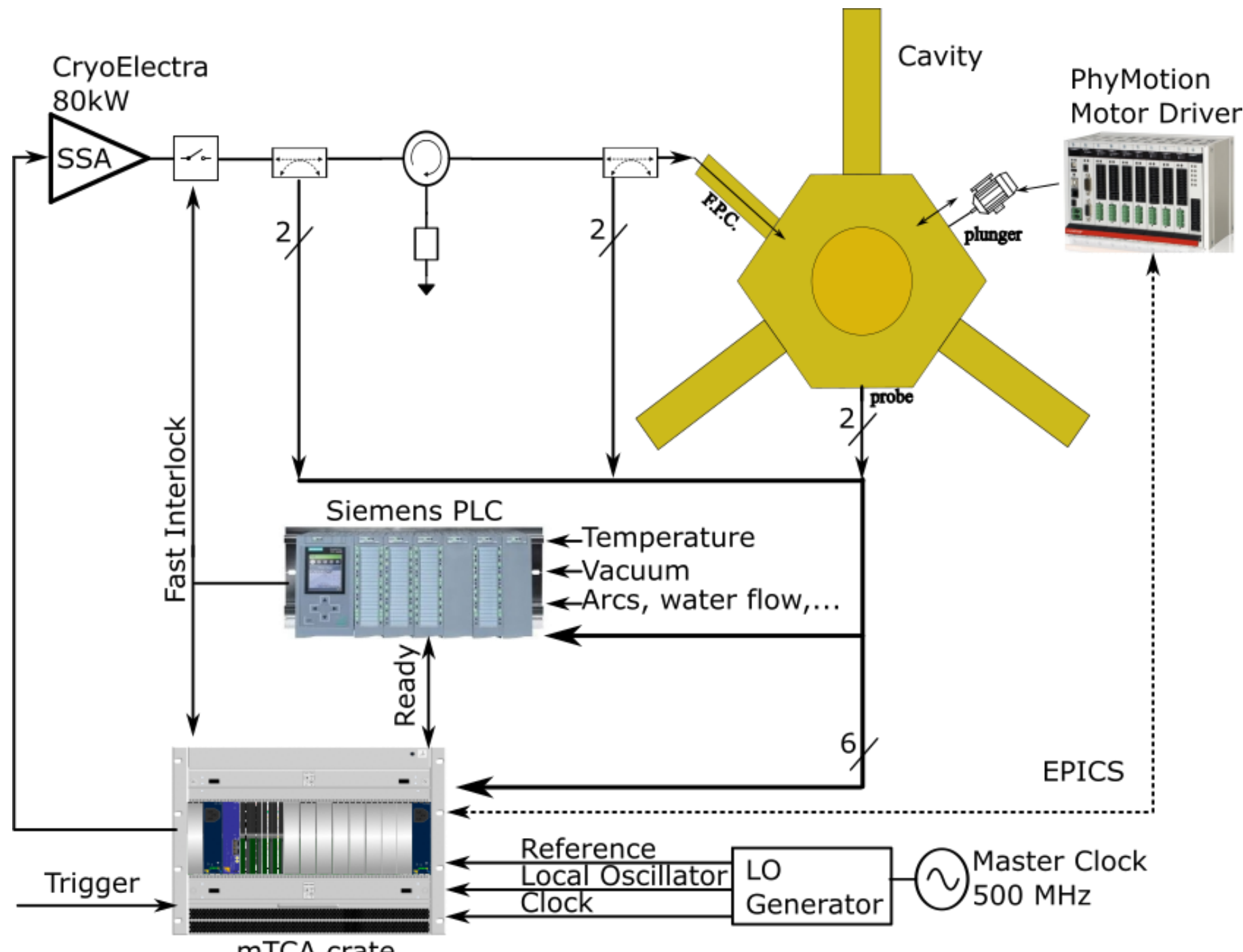
- ChimeraTK + EPICS LLRF servers
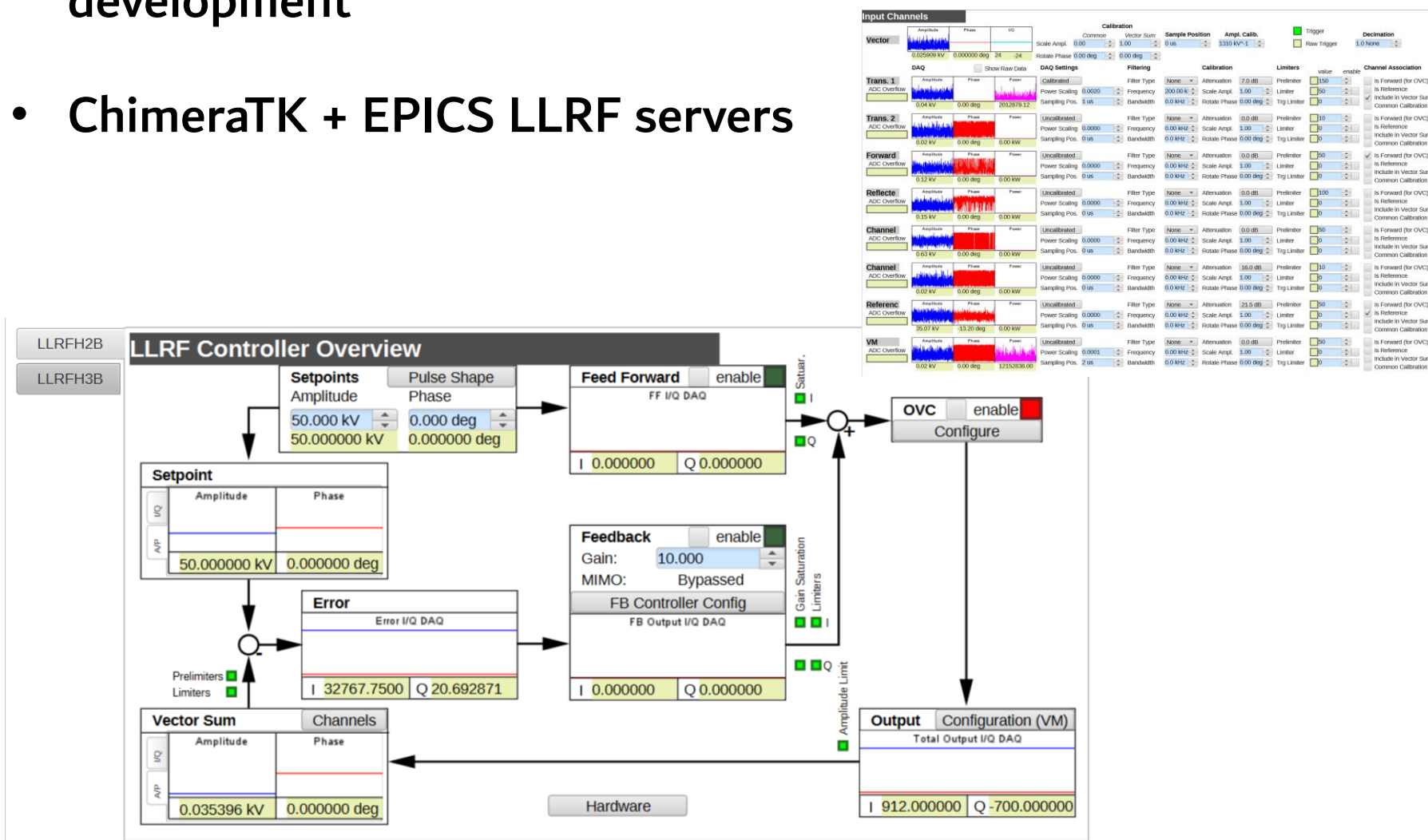
TWO NEW 80kW SOLID STATE AMPLIFIERS

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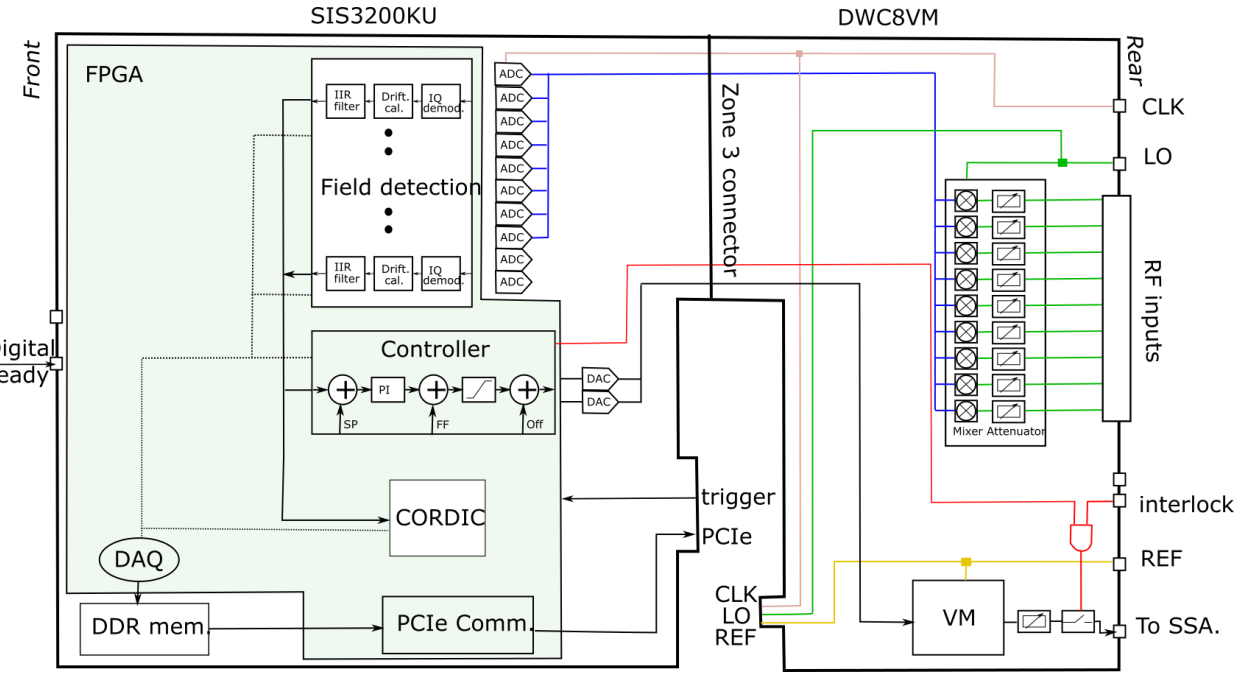

Together with a SIEMENS PLC-based interlock system:

TEST STAND SETUP

### „SINGLE CAVITY" FIRMWARE

- Each cavity has a dedicated RF amplifier → no vector sum needed

- Each cavity controlled with a pair of SIS8300-KU and DWC8VM1

PLUNGER CONTROL

- PETRA-type cavities are equipped with two plungers to tune them. SR HOM-damped cavities have only one plunger.
- They work „against" the cavities' vacuum → 3A → No chance to use in-crate MD22
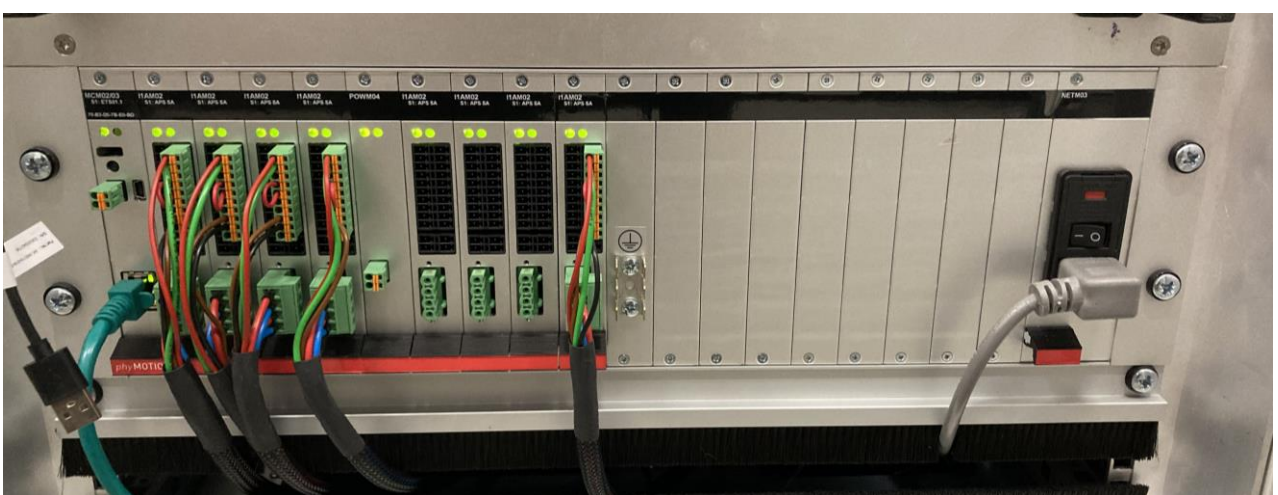
- Phytron Phymotion crate to control the tuners
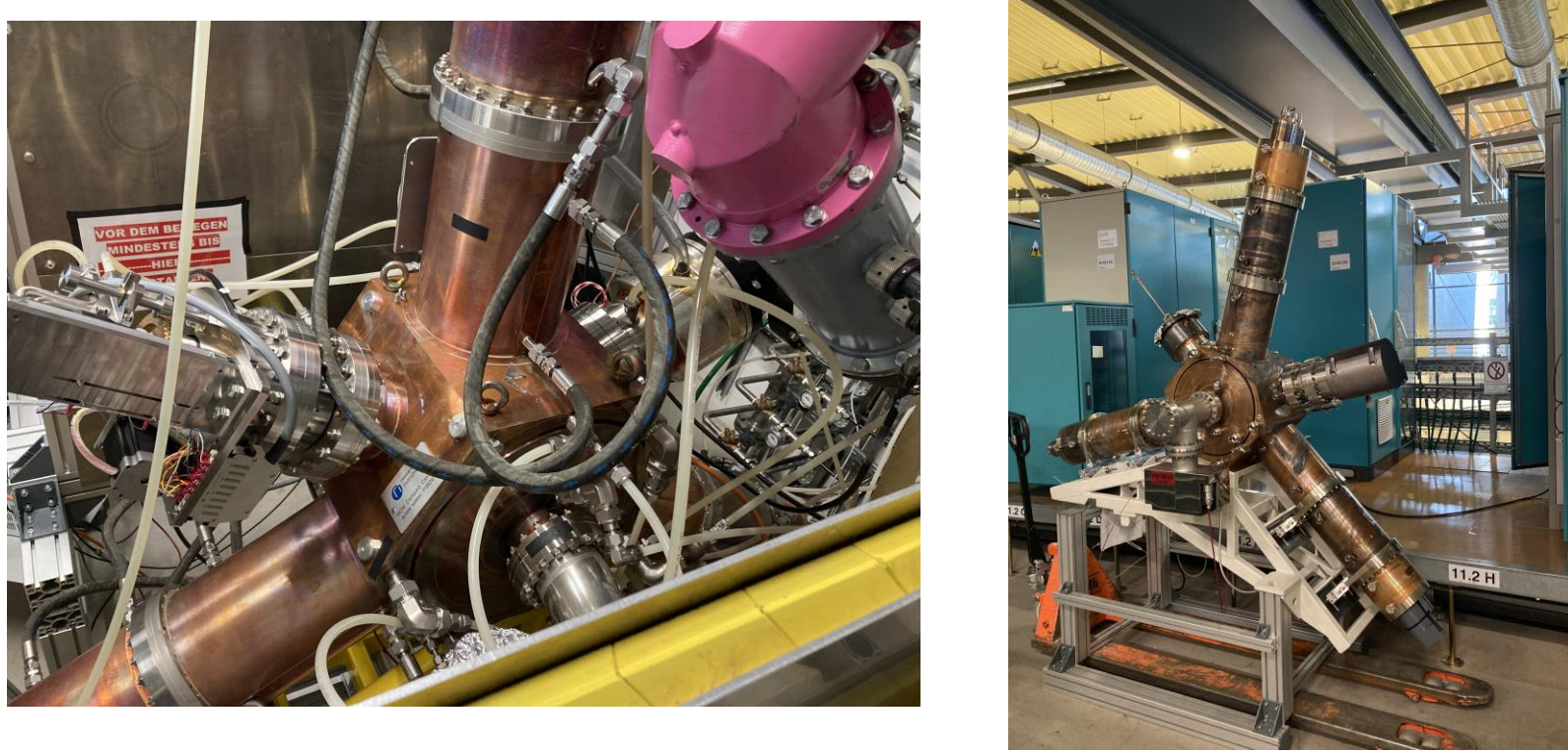- With EPICS IOCs and panels
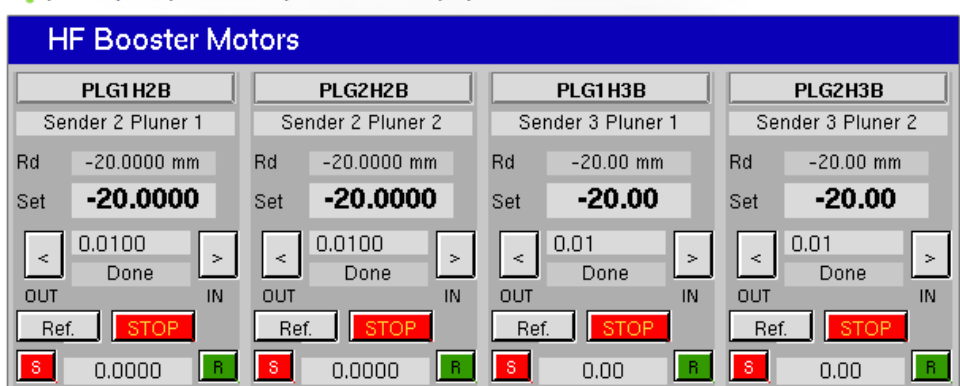
- Automatic tuning implemented
- 2 RF pick-ups + 2 plungers → field flatness control?
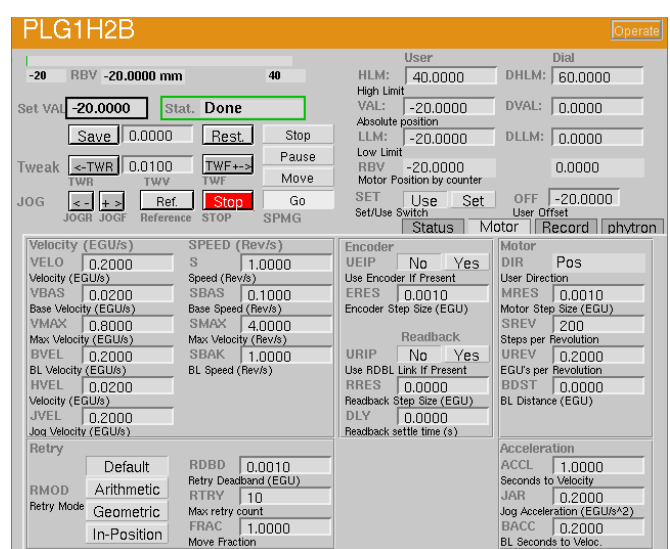
CURRENT STATUS AND PLANS

- Before deploying the system into the booster cavities, we connected the SSA to a HOM damped SR cavity in radiation controlled area. Cavity was driver last week up to 2kW in CW. Extensive tests and debugging in the following weeks.

- Next the booster's ramping up and down curve will be implemented and tested.
- Provided the proper behavior, the SSA output will be disconnected from the test stand and connected to the actual booster cavity.
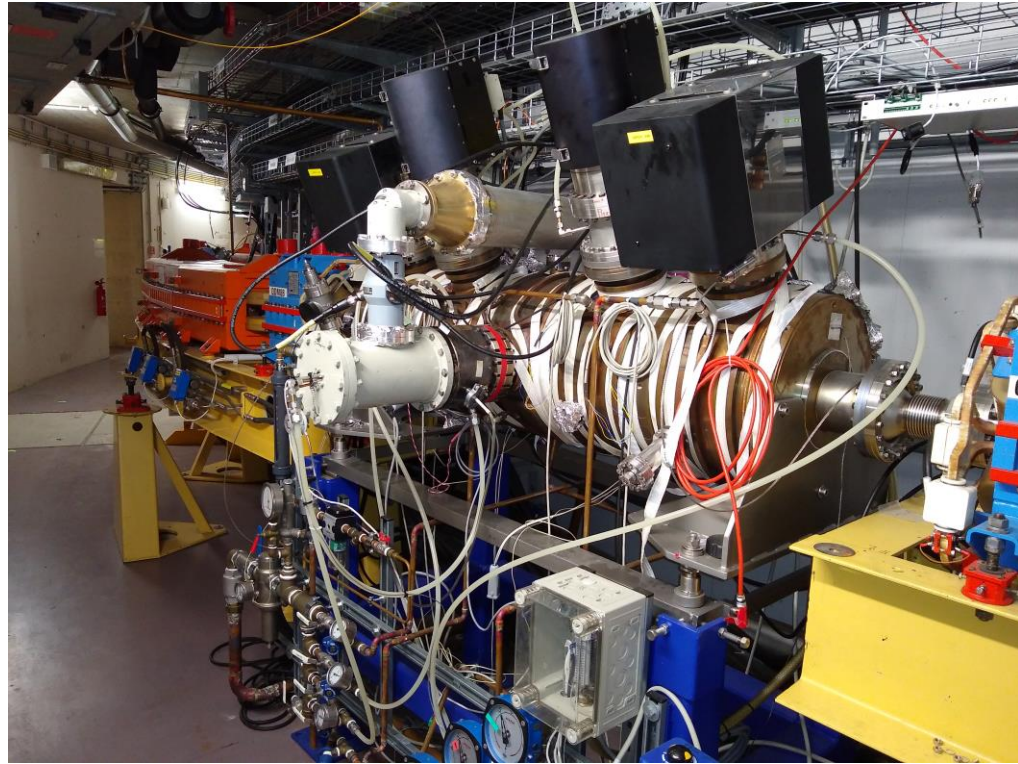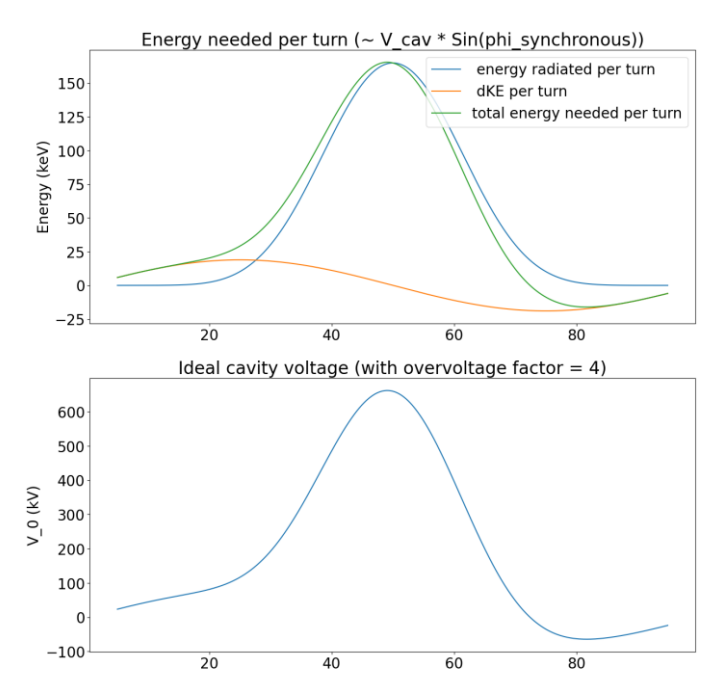
CONCLUSION AND FOLLOWING STEPS

- New booster cavities are needed to reduce the bunch length at injection and improve energy acceptance.
- 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
- Already some CW power sent to the test stand. More tests to come.
- Next ramping up and down curve will be implemented and tested. In the test stand and in the booster
- 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!

O. Schwarzkopf, A. Jankowiak, and A. Vollmer, "Materi-als discovery at BESSY", Eur. Phys. J. Plus, 138, 348 (2023).
A. Schälicke et al., "Hardware upgrades improve the reliability at BESSY-II", (IPAC'16).
T. Atkinson et al., "VSR injector upgrades at BESSY-II", (IPAC'18).
G. Varghese et al., "ChimeraTK – a software toolkit for control applications (IPAC'17).
M. Hoffmann et al., "High speed digital LLRF feed-backs for normal conducting cavity operation", (IPAC'14).
F. Marhauser and E. Weihreter, "First tests of a HOM-damped high power 500 MHz cavity", EPAC2004.

Dr. Pablo Echevarria Fernandez
pablo.echevarria@helmholtz-berlin.de
+49 (0) 30 806214782

LOW LEVEL RADIO FREQUENCY WORKSHOP 2023
LLRF2023