

SFB-related Accelerator R&D at ELSA

SFB Mitgliederversammlung

19.03.2013, Bonn

ELSA-Statistics and Performance

ELSA operation 2008 - 2012:

$\Sigma = 12,600$ operating hours

> 3000h/a

Mode of operations:

- linearly polarized photons ($E_{e^-} = 3.2$ GeV)
- circularly polarized photons ($E_{e^-} = 2.35$ GeV)
- CB & BGO tests, PANDA, ILC, student experiments, irradi. @ LINAC I (COMPASS, DEPFET), acc. R&D, etc.

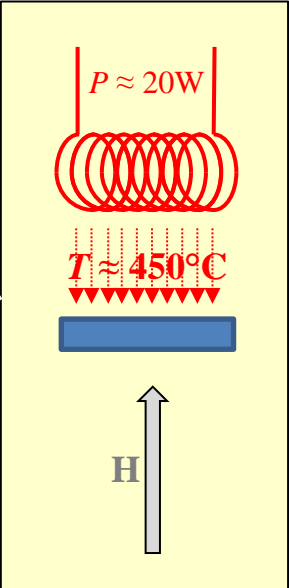
ELSA is again working reliably after fire incident

(fire caused by insulation fault of PS transformer in June 2011)

R&D: Main Goals

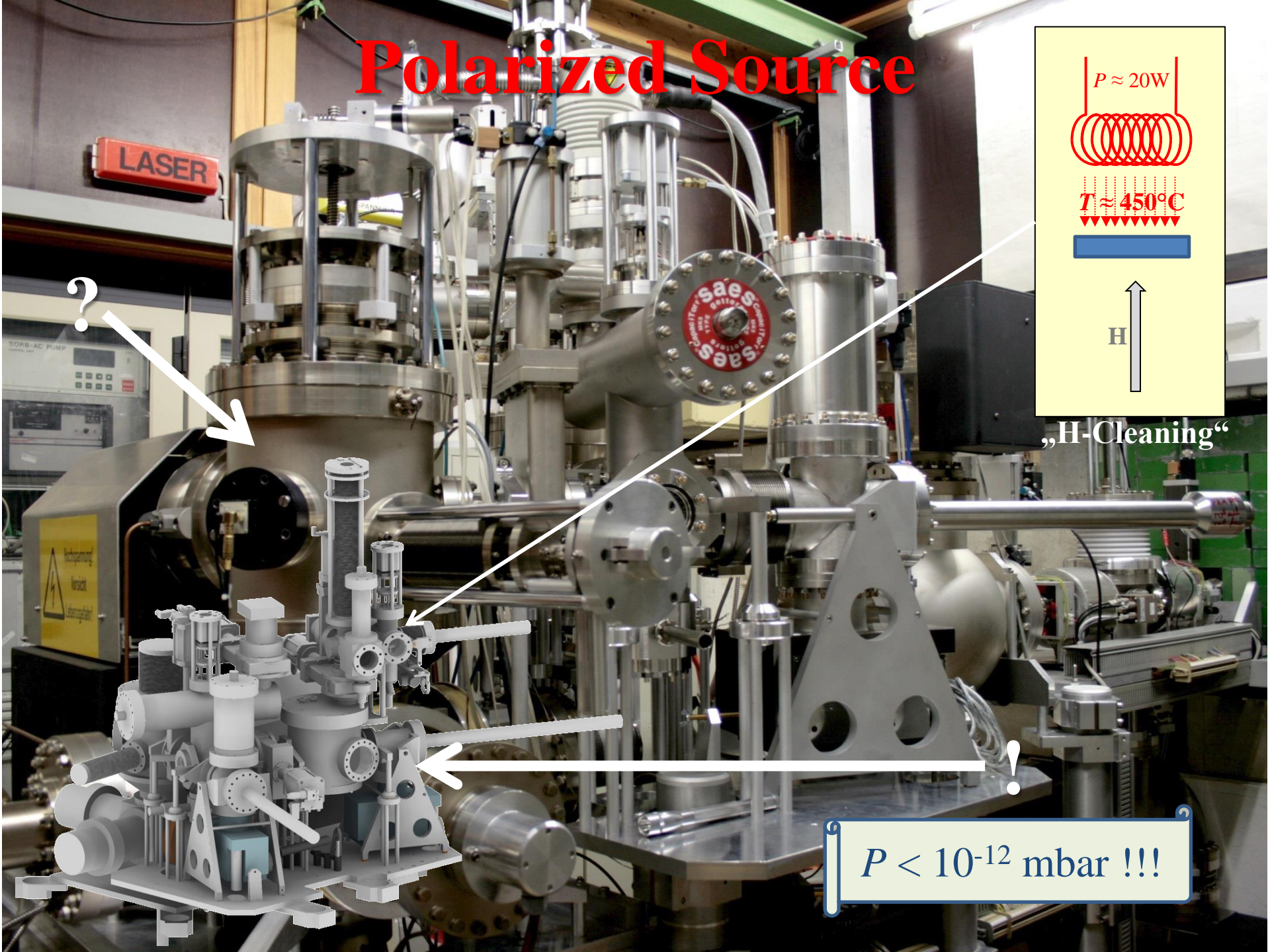
- **Polarized Beam @ 3.2 GeV**
 - upgrade source of polarized electrons
 - optimized crossing of depol. resonances in ELSA
 - internal polarimetry in ELSA (Compton-polarimeter)
- **External Beam-Current of up to 10 nA**
 - commissioning of LINAC I, injection into booster
 - increase of shunt impedance and RF power
 - damping of influences of PETRA-resonator HOMs
 - reduction of beam pipe's impedance
 - better understanding and compensation of ion effects
- **Improved Beam Quality @ 3.2 GeV**
 - detailed study of slow extraction @ 3.2 GeV
 - increase of overvoltage factor

Polarized Source

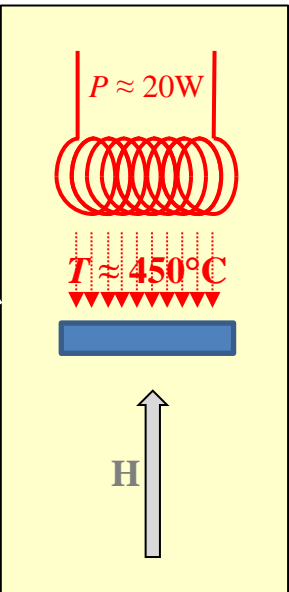


„H-Cleaning“

$P < 10^{-12}$ mbar !!!



Polarized Source



„H-Cleaning“

Actual Status:

Gun Chamber:

- operational after insulator reconfiguration
- QE-lifetime approx. 3 weeks
- one photocathode ready for operation

Activation Chamber:

- operational

Storage Chamber:

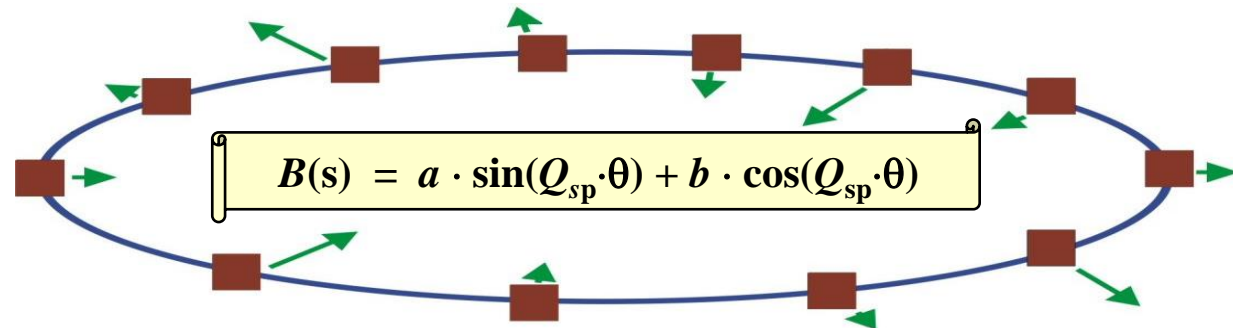
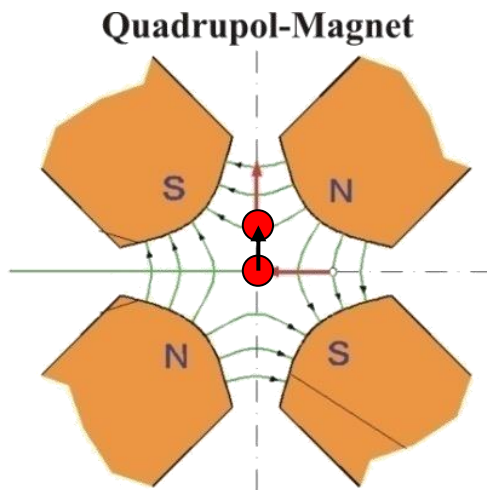
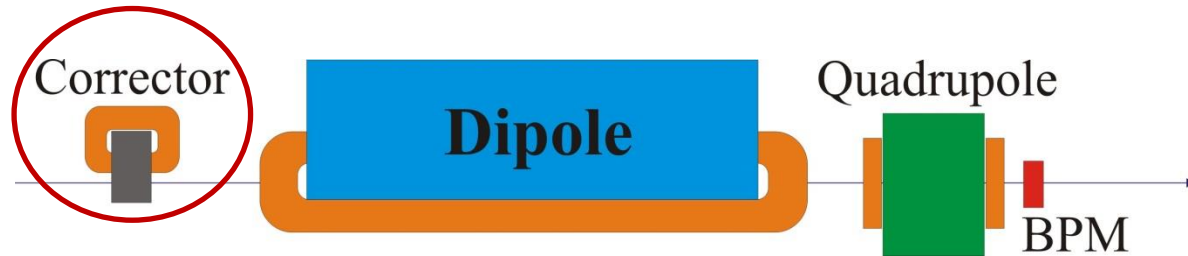
- operational, 5 photocathodes stored
- problems: storage wheel blocked!!!

Loading Chamber:

- comm. of H-cleaning starting next week

$P < 10^{-12}$ mbar !!!

Improved Harmonic Correction



Take care of the orbit distortions caused by harmcor!

New (more sophisticated) method:

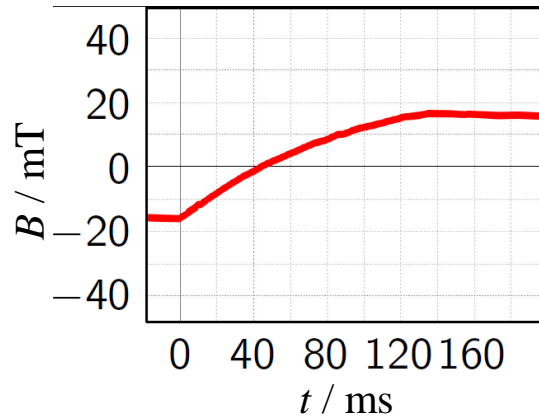
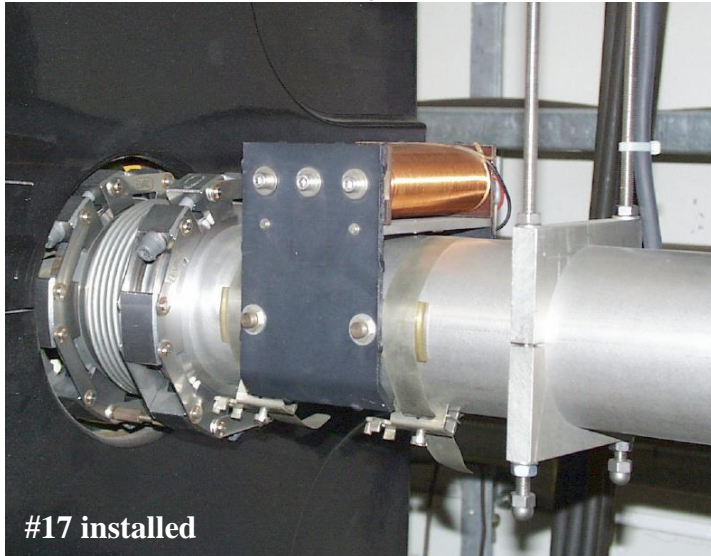
Use of a Spin-Response-Matrix to determine the required corrector fields:

$$b_{\text{harm}} = \mathbf{M} \cdot (\mathbf{I} + \mathbf{g} \cdot \mathbf{R}) \cdot b_{\text{cor}}$$

Due to partial cancellation significantly higher fields and a faster time response are required!

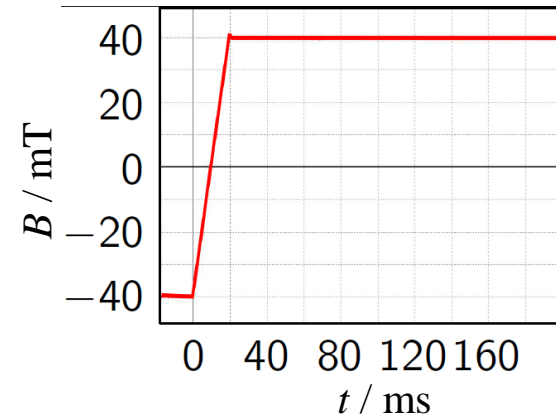
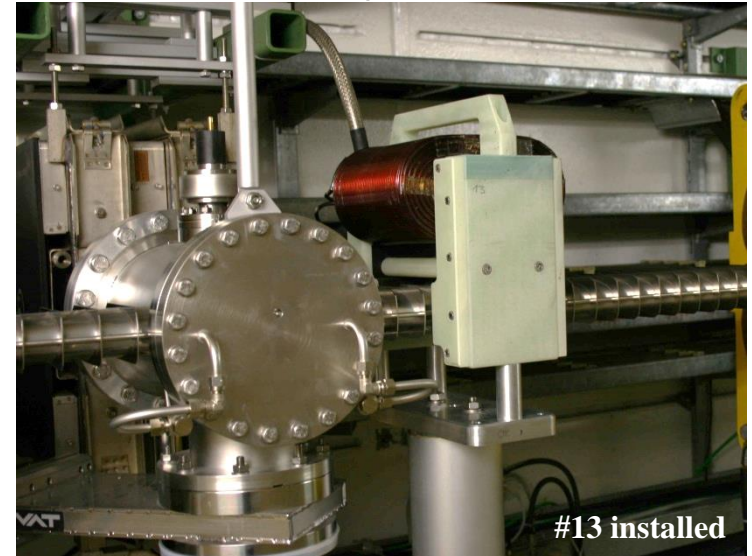
Improved Harmonic Correction

Old System



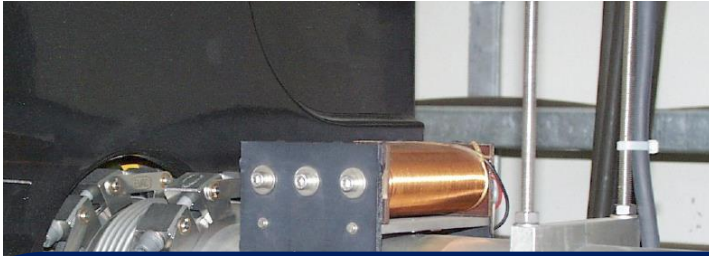
rise-time
of
magn. field:

New System



Improved Harmonic Correction

Old System



Actual Status:

Correctors:

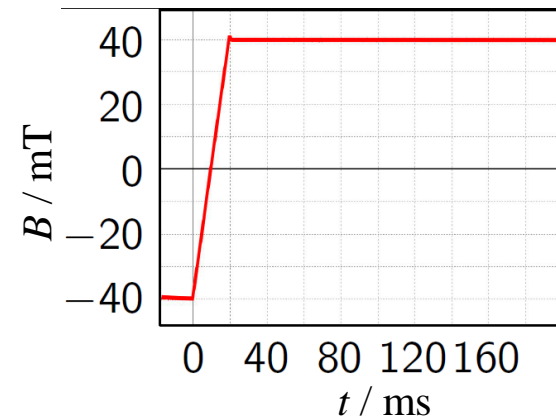
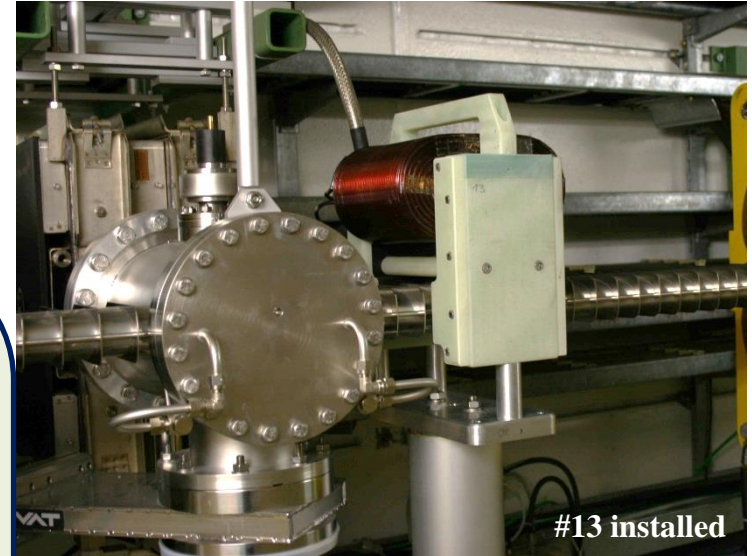
- step by step installation of new system:
- replacement of 3 shortly possible
- remaining 14 require add. constructions

New Harmcorr approach:

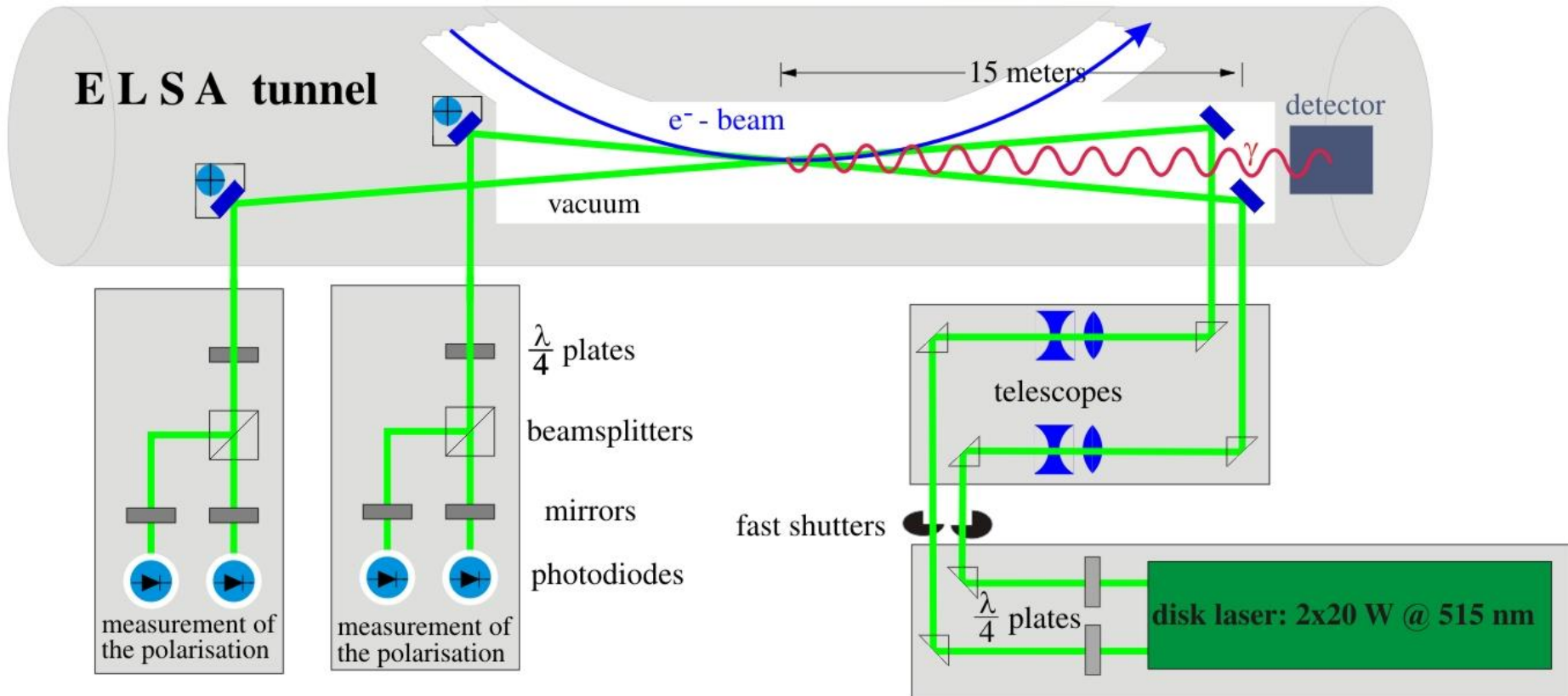
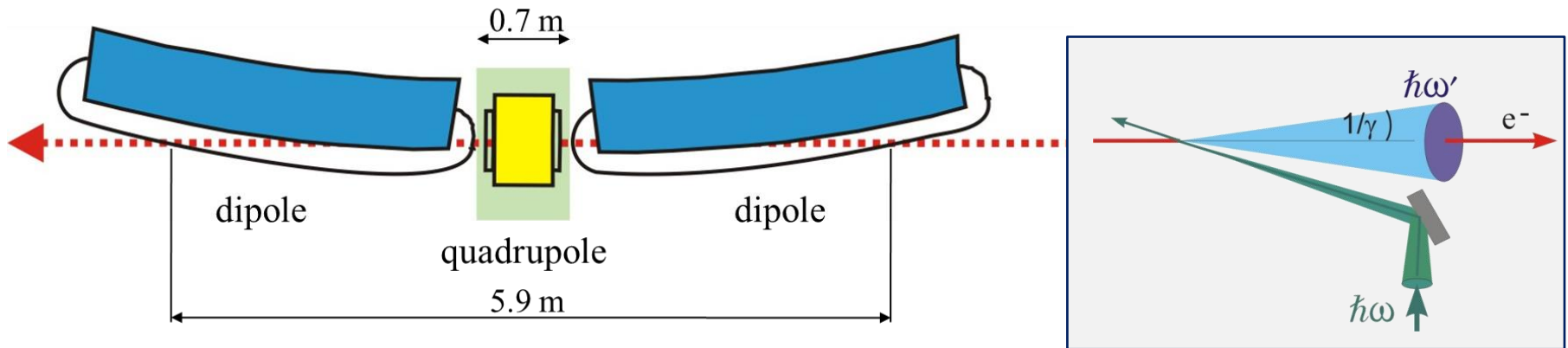
- software operational
- identification of limiting correctors
- upgrades first concentrating on replacement of those

→ **ELSA shut-downs required**

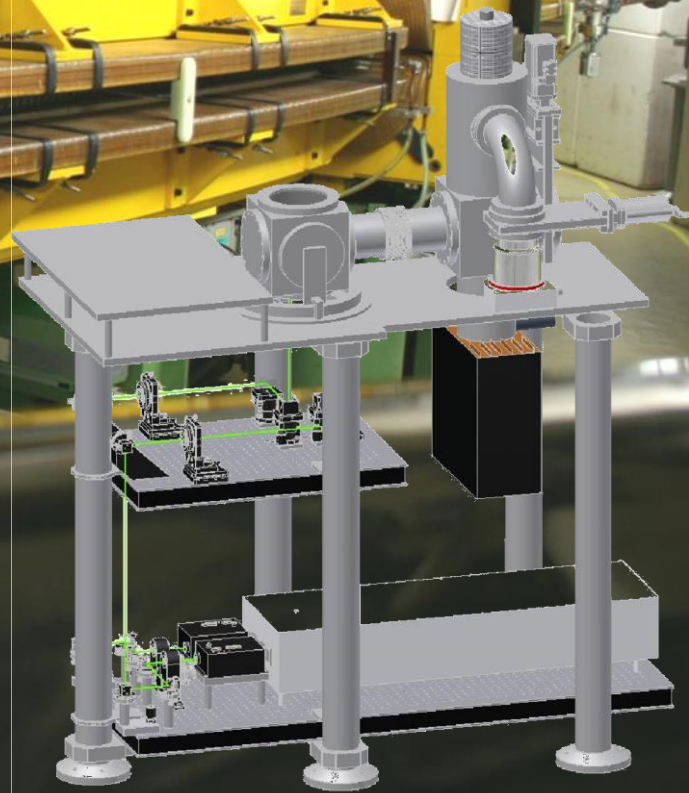
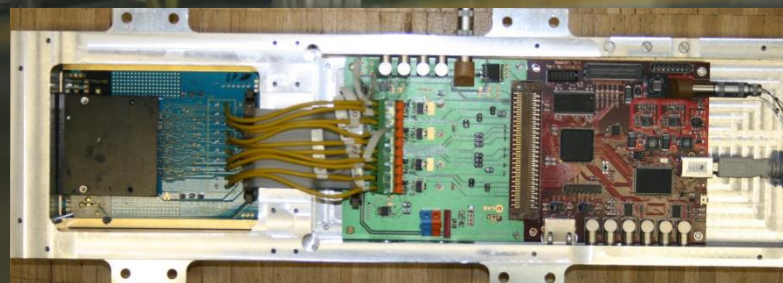
New System



Compton Polarimetry



Compton Polarimeter



Compton Polarimeter

Actual Status:

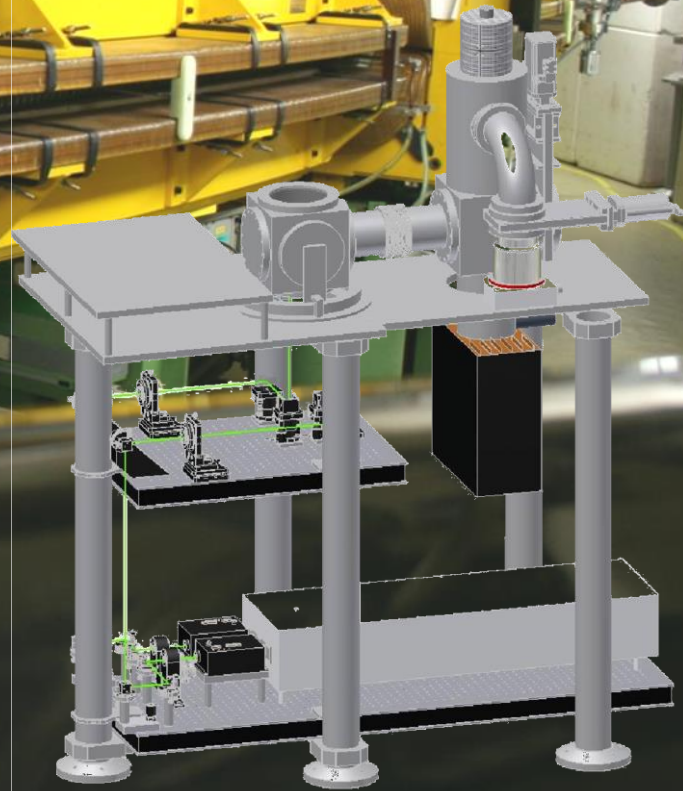
Laser and Optics:

- disk laser repaired, delivers 32W@515nm
- local laser hutch assembled
- rebuilding of light optics starts soon

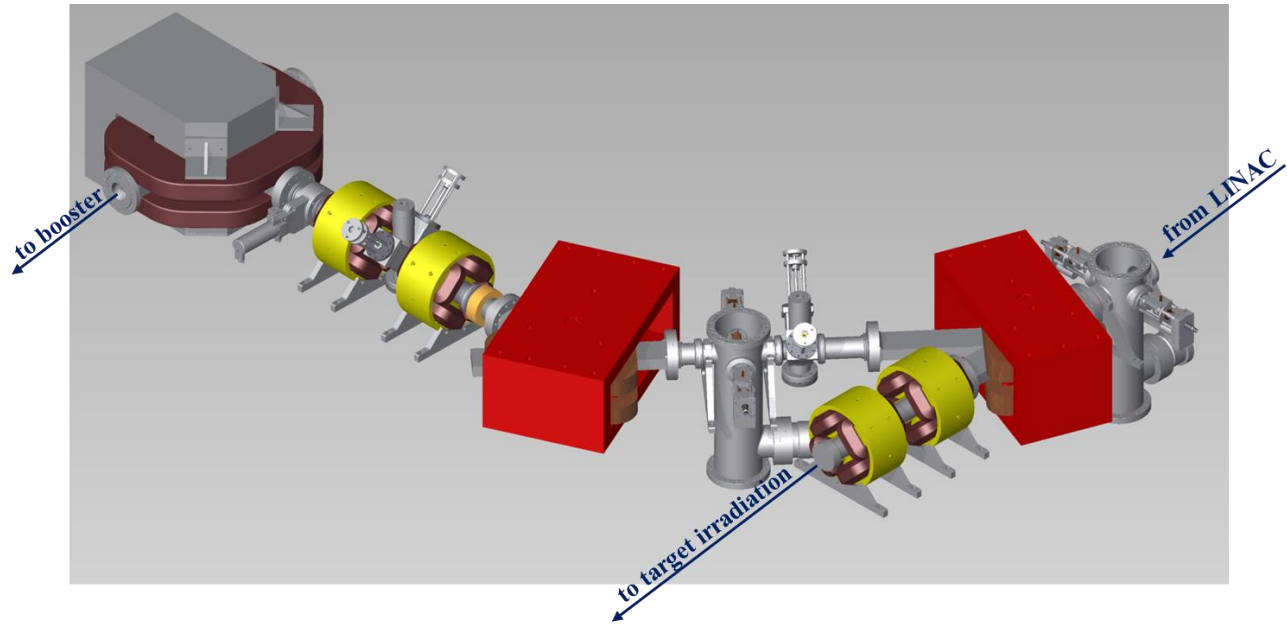
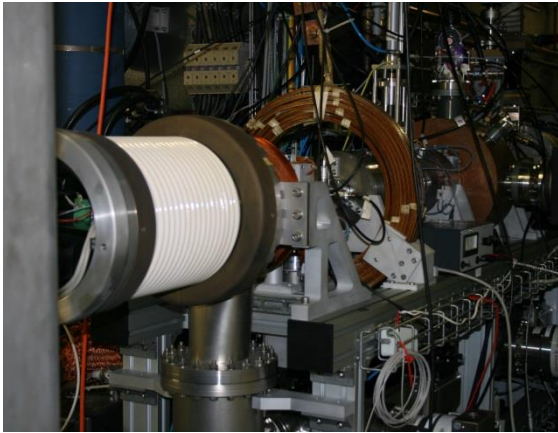
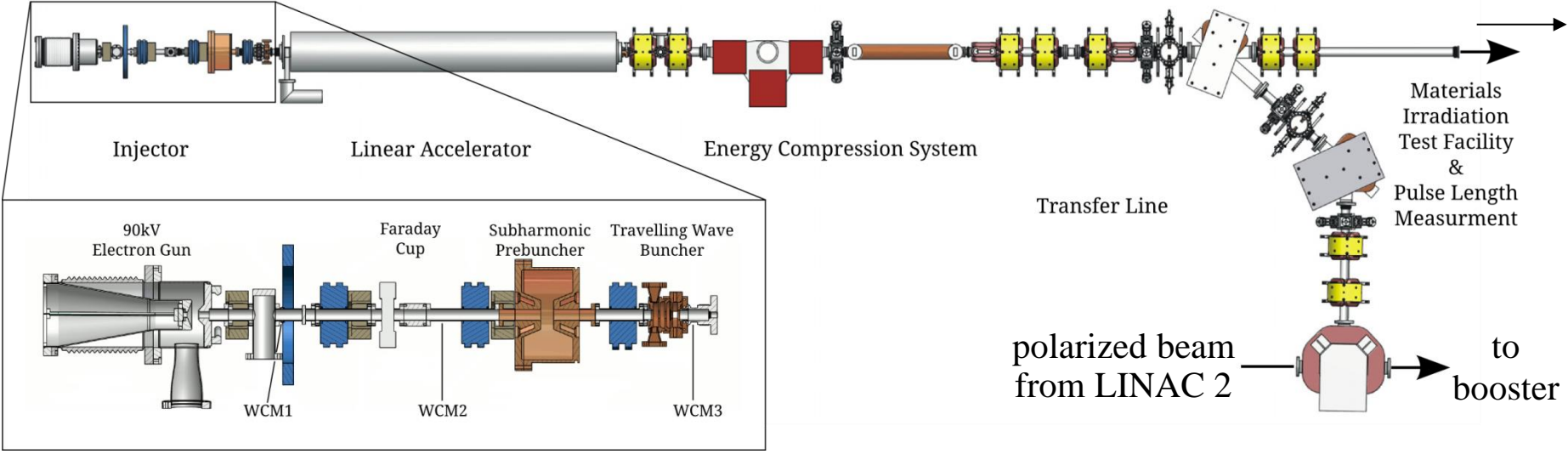
Silicon Strip Detector:

- prototype assembled, 1 asic not working
- readout-software almost ready
- comm. starts after parental leave of PhD

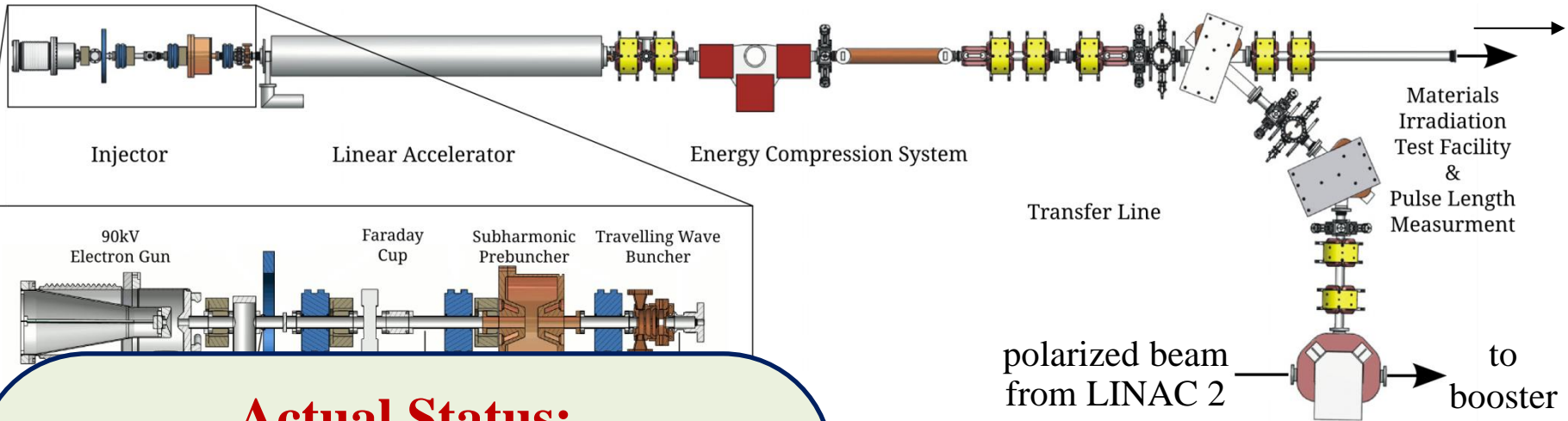
→ **ELSA shut-downs required!**



LINAC I: injection into booster



LINAC I: injection into booster



Actual Status:

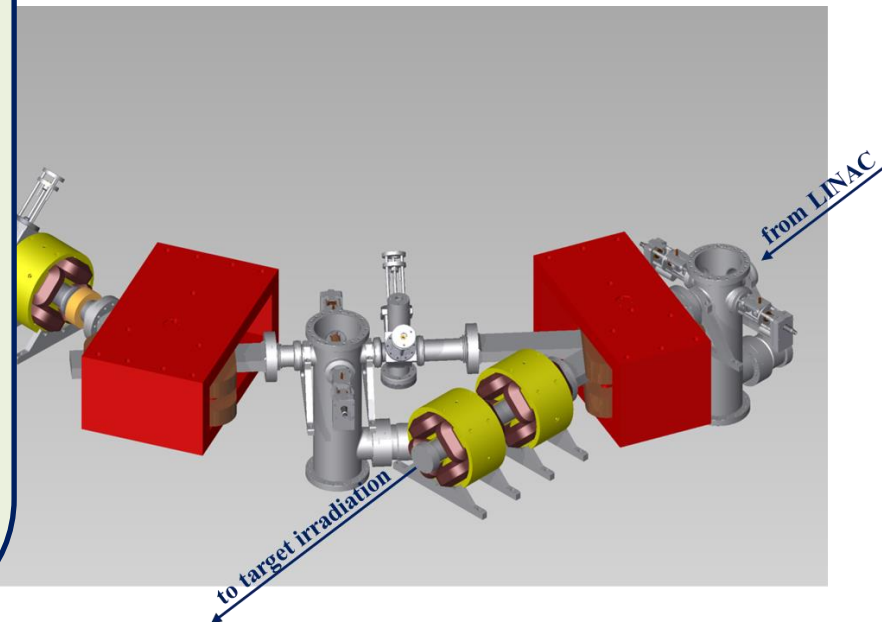
Injector and Linac:

- operational after replacement of PS, but:
- problems with loop-coupler of prebuncher
- TWB not connected to RF
- arcing of old waveguide-system

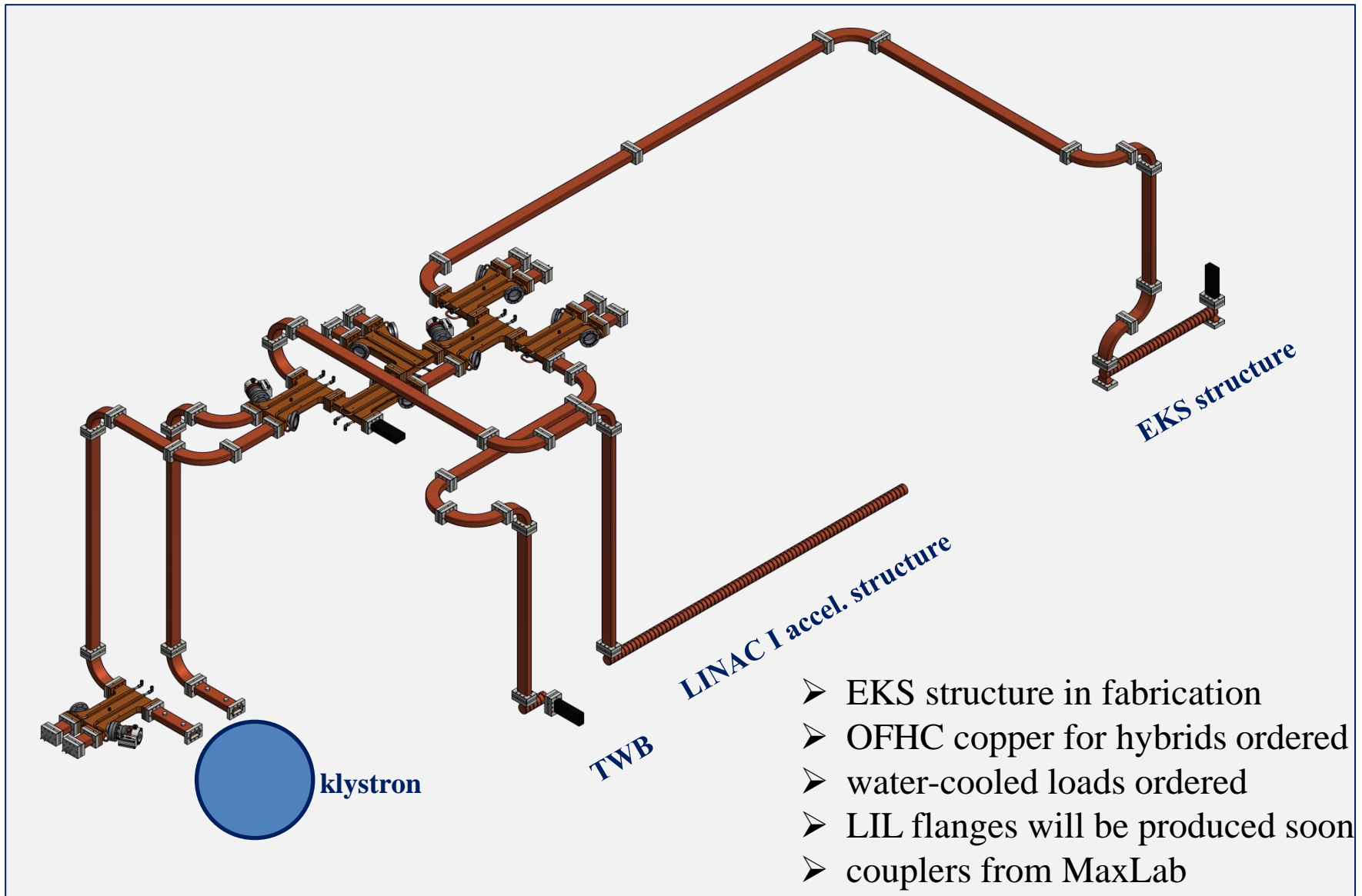
Transfer Line:

- set-up completed, comm. ongoing
- EKS structure in fabrication
- beam energy spread too large for injection

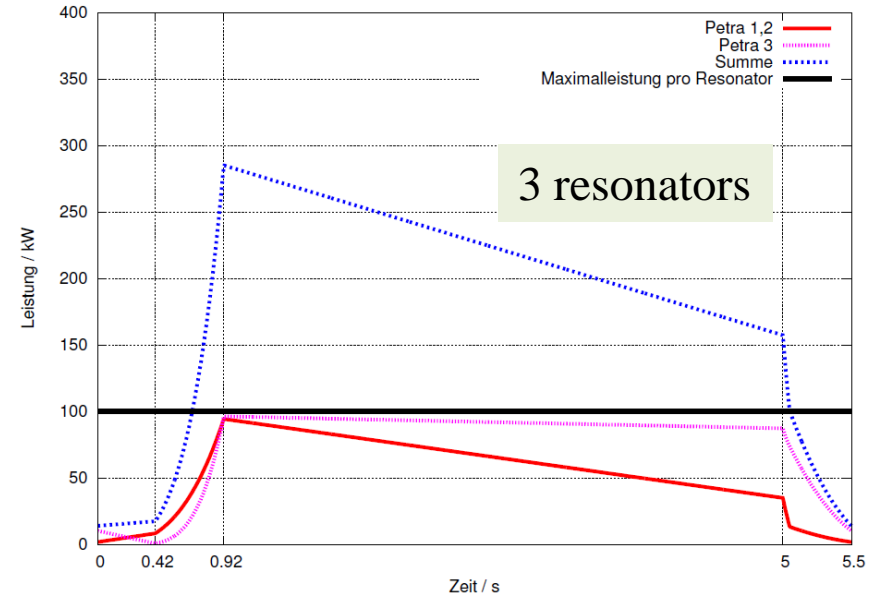
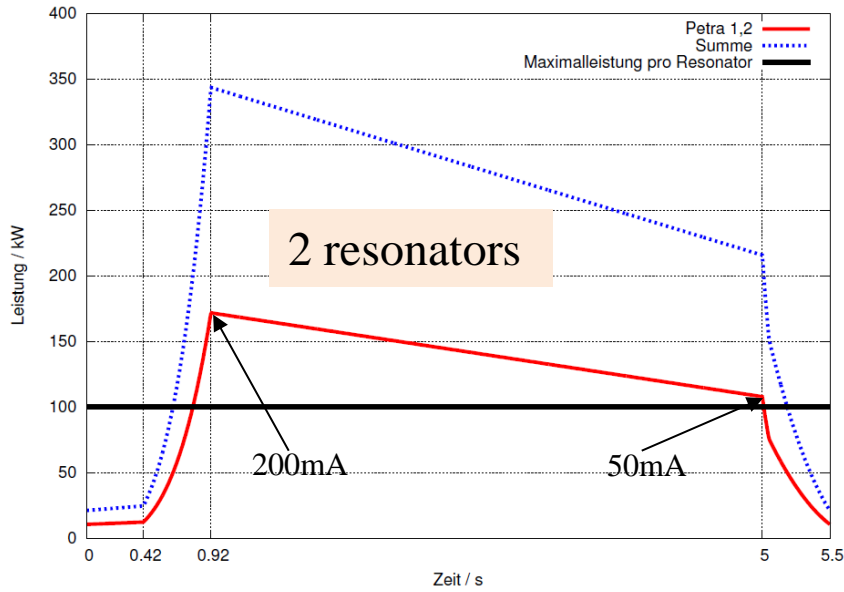
→ **ELSA shut-downs required!**



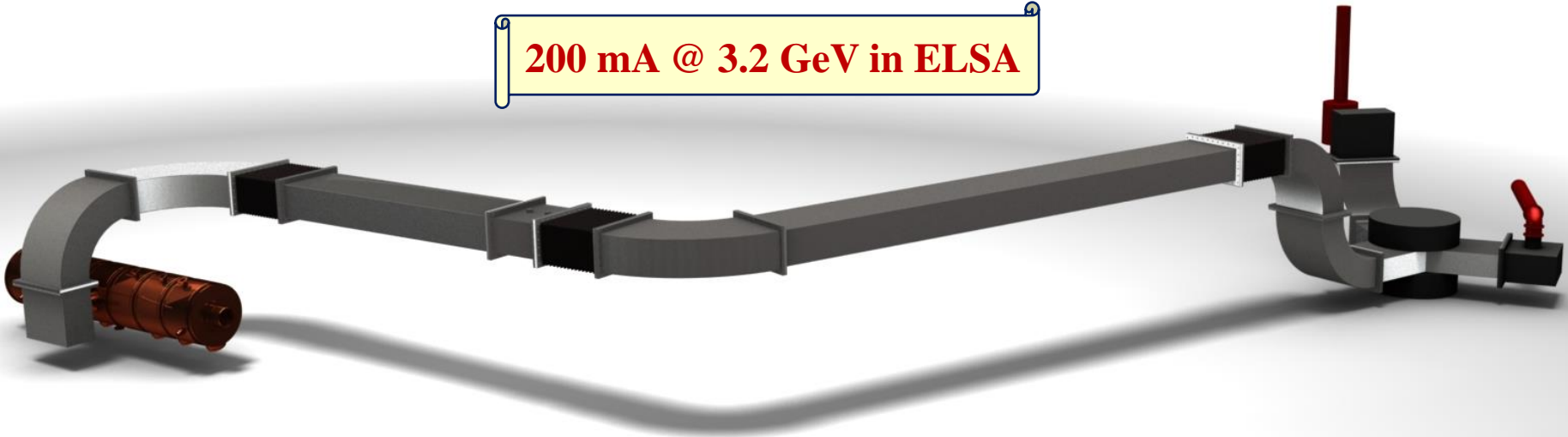
New Waveguide-System



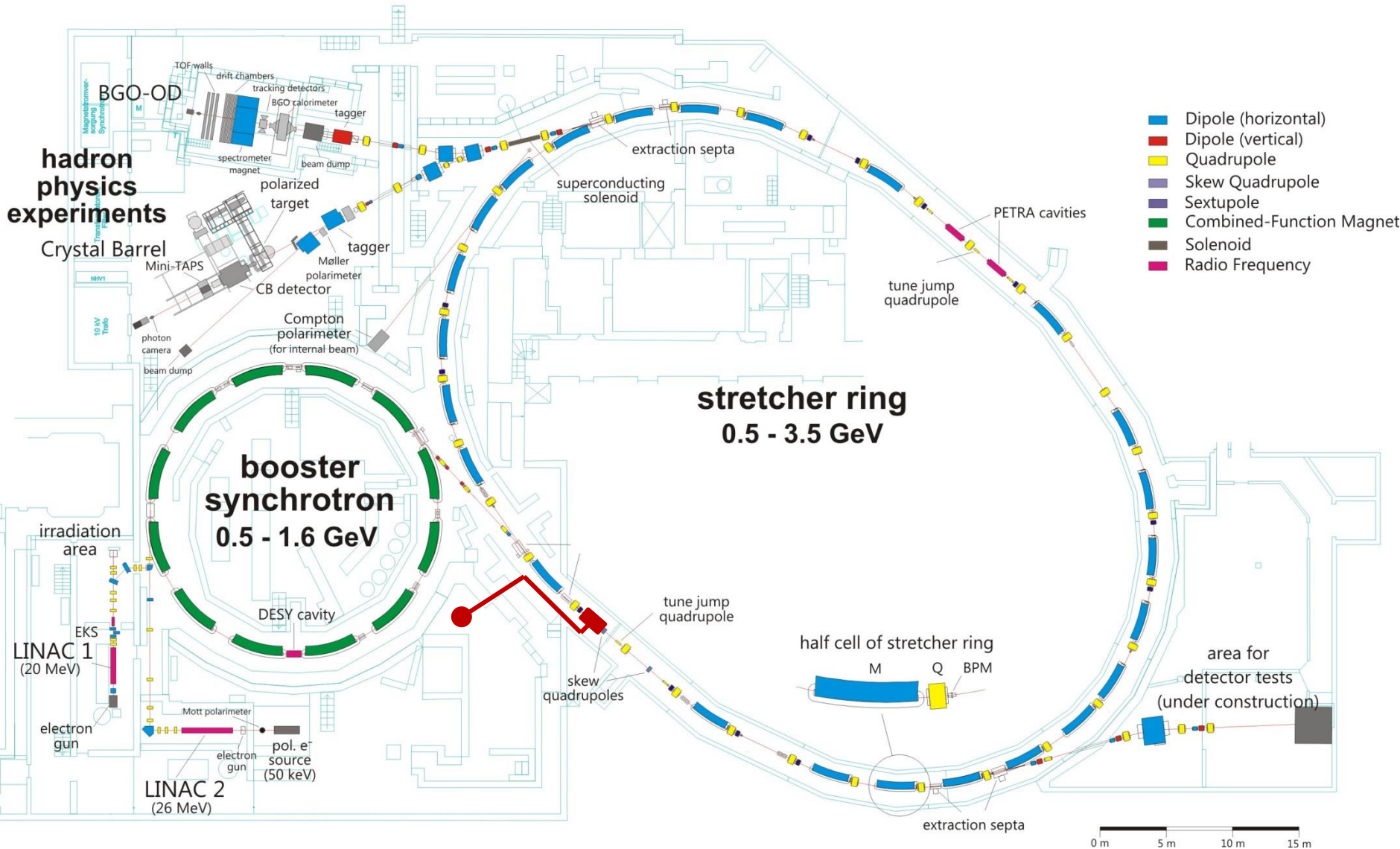
New RF System



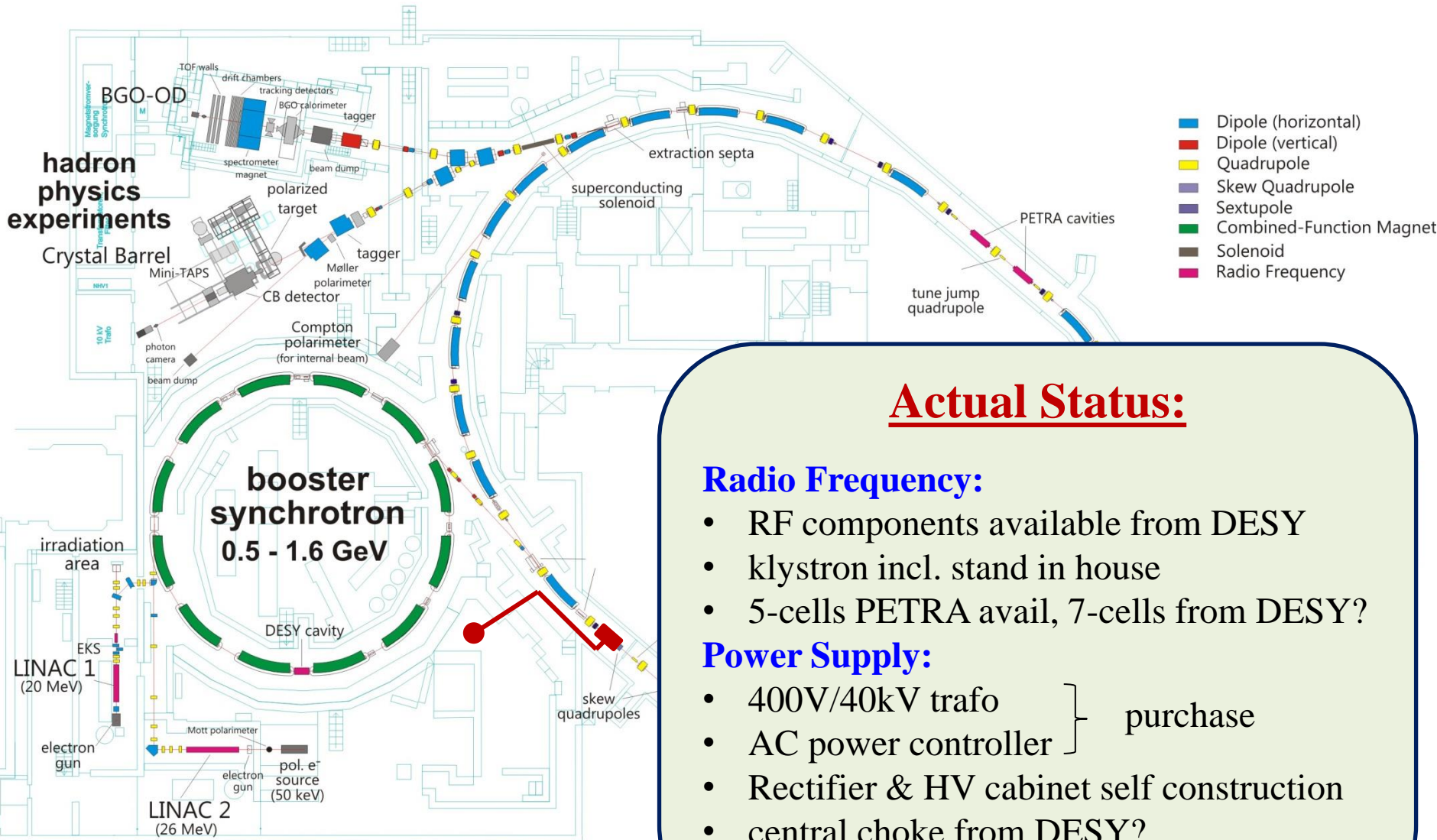
200 mA @ 3.2 GeV in ELSA



Electron Stretcher Accelerator (ELSA)



Electron Stretcher Accelerator (ELSA)



Actual Status:

Radio Frequency:

- RF components available from DESY
- klystron incl. stand in house
- 5-cells PETRA avail, 7-cells from DESY?

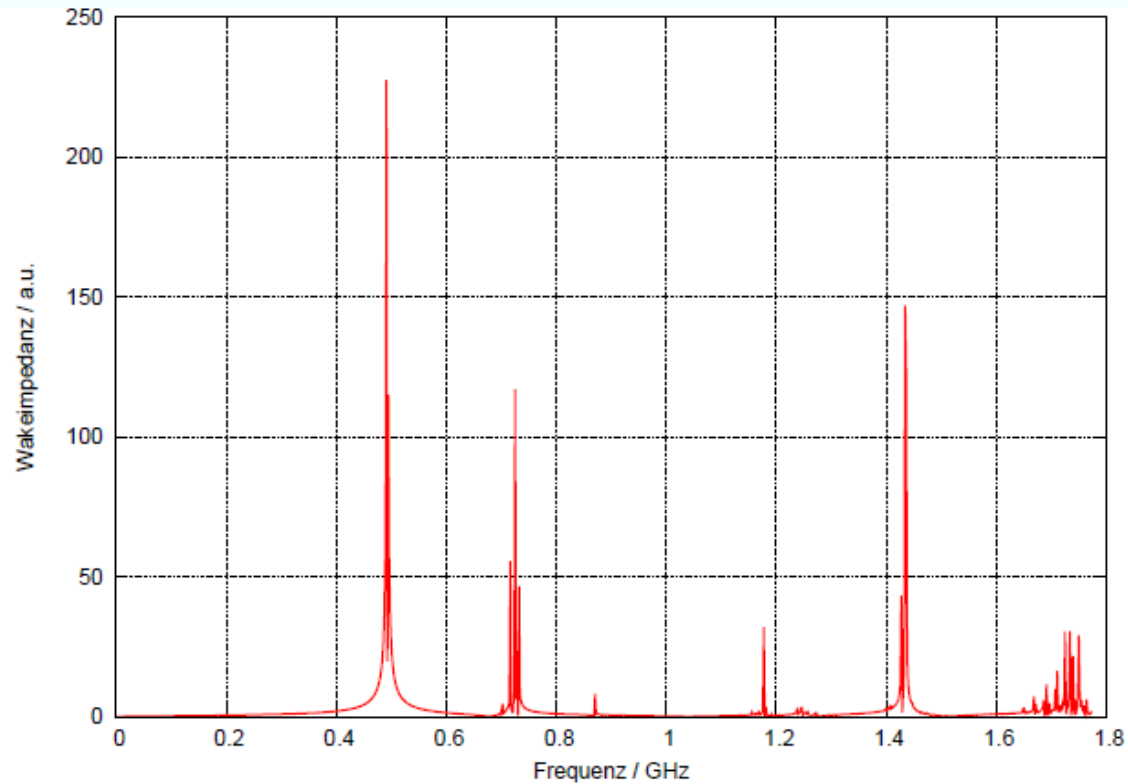
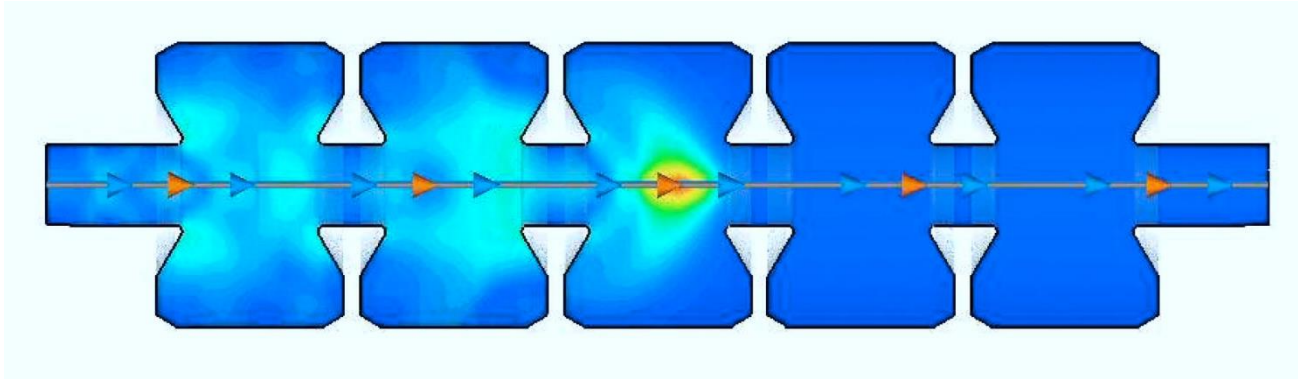
Power Supply:

- 400V/40kV trafo
- AC power controller
- Rectifier & HV cabinet self construction
- central choke from DESY?

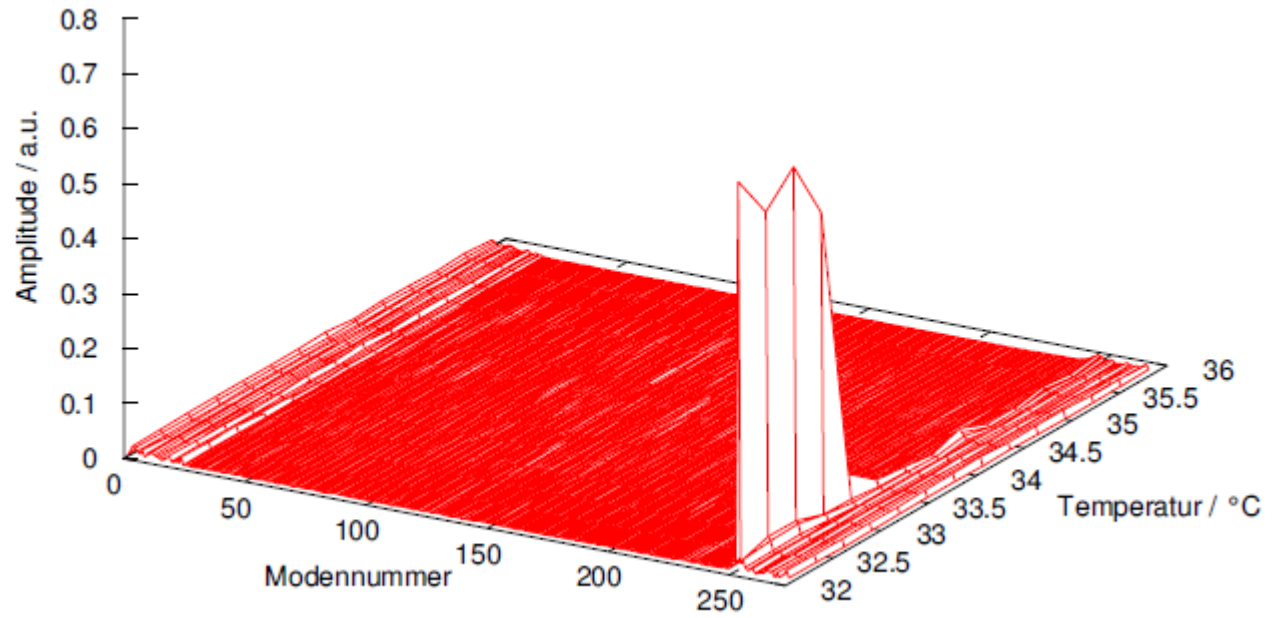
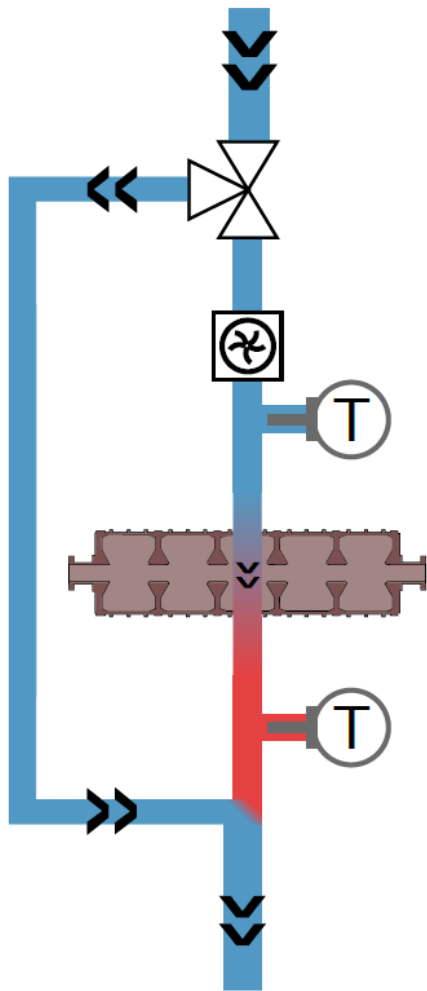
} purchase

→ **ELSA shut-down required!**

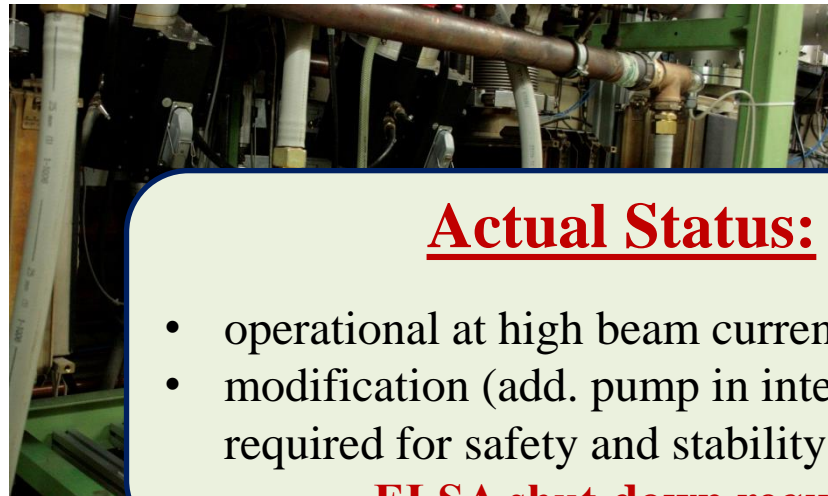
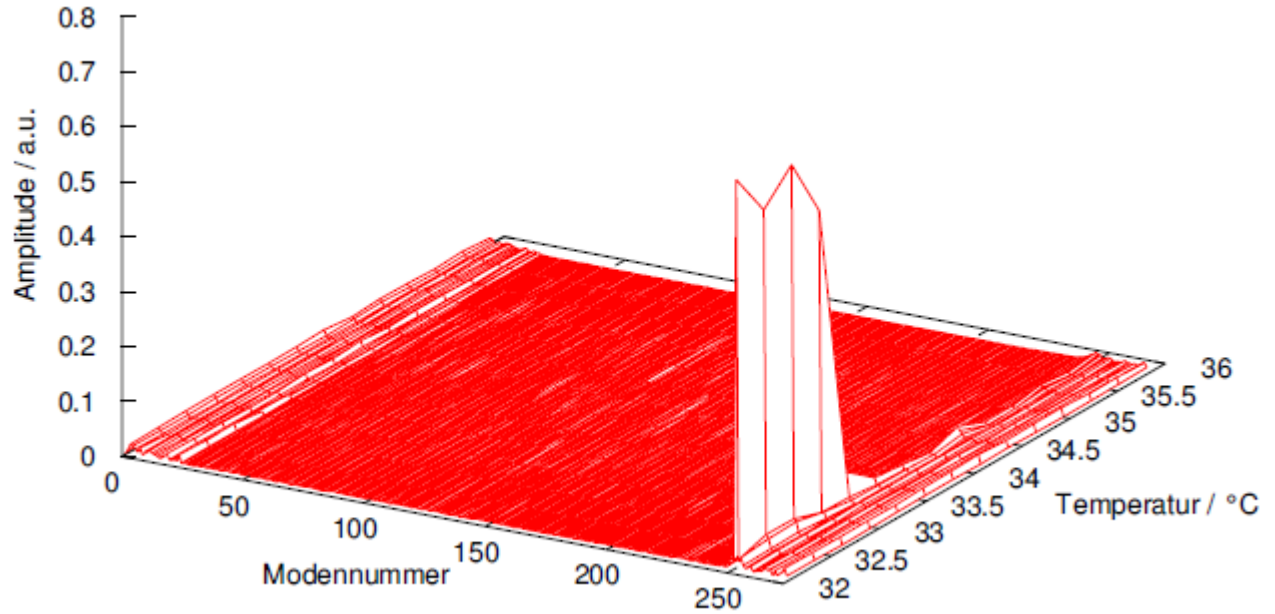
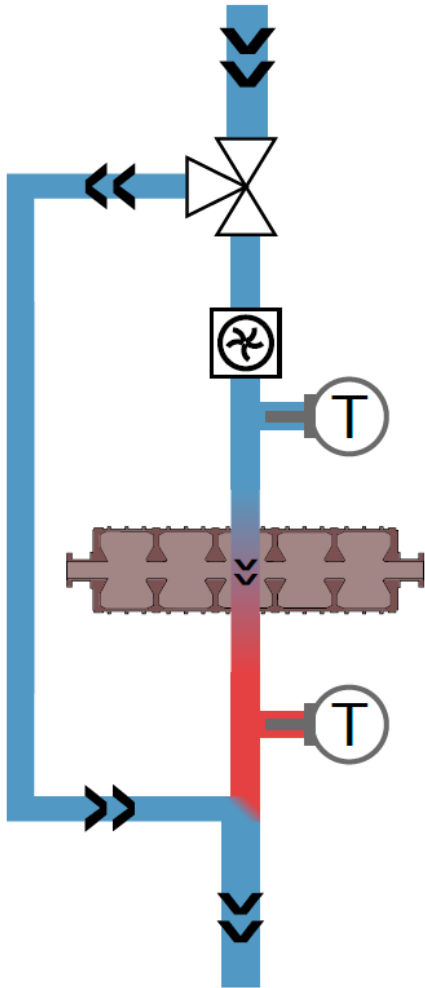
PETRA HOMs



PETRA HOMs



PETRA HOMs

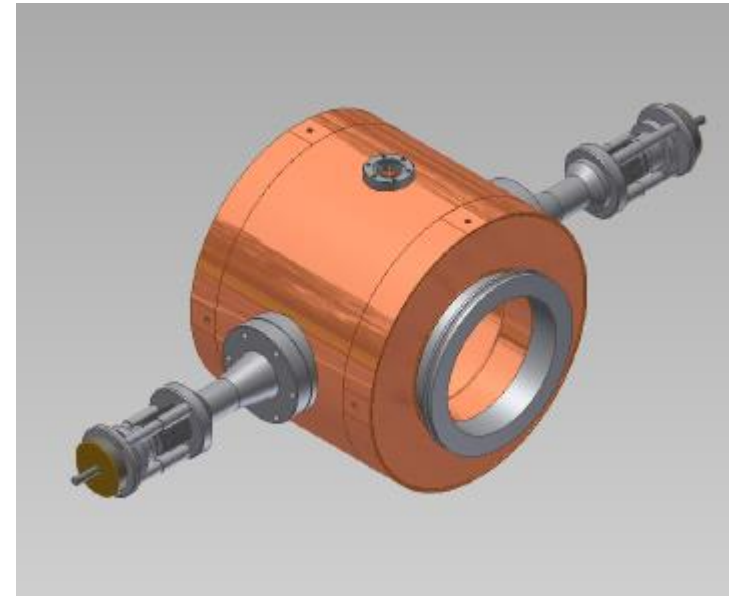
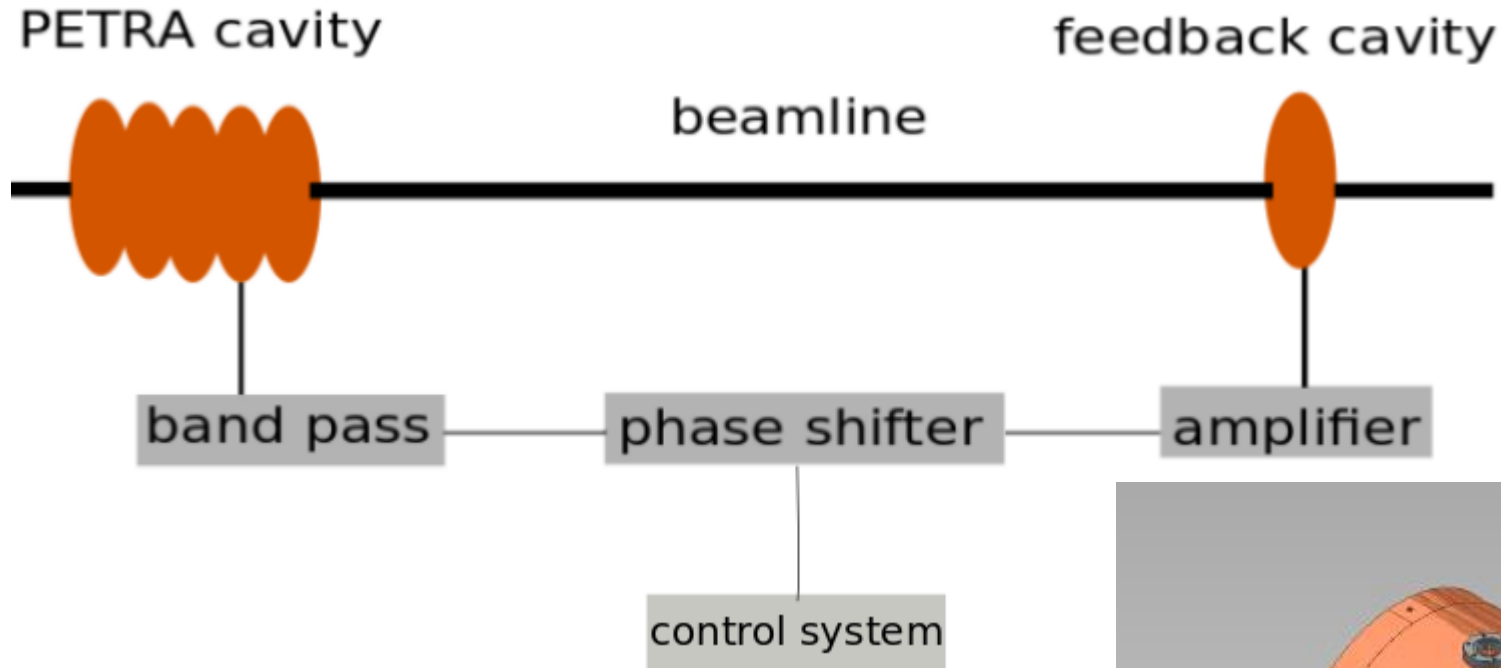


Actual Status:

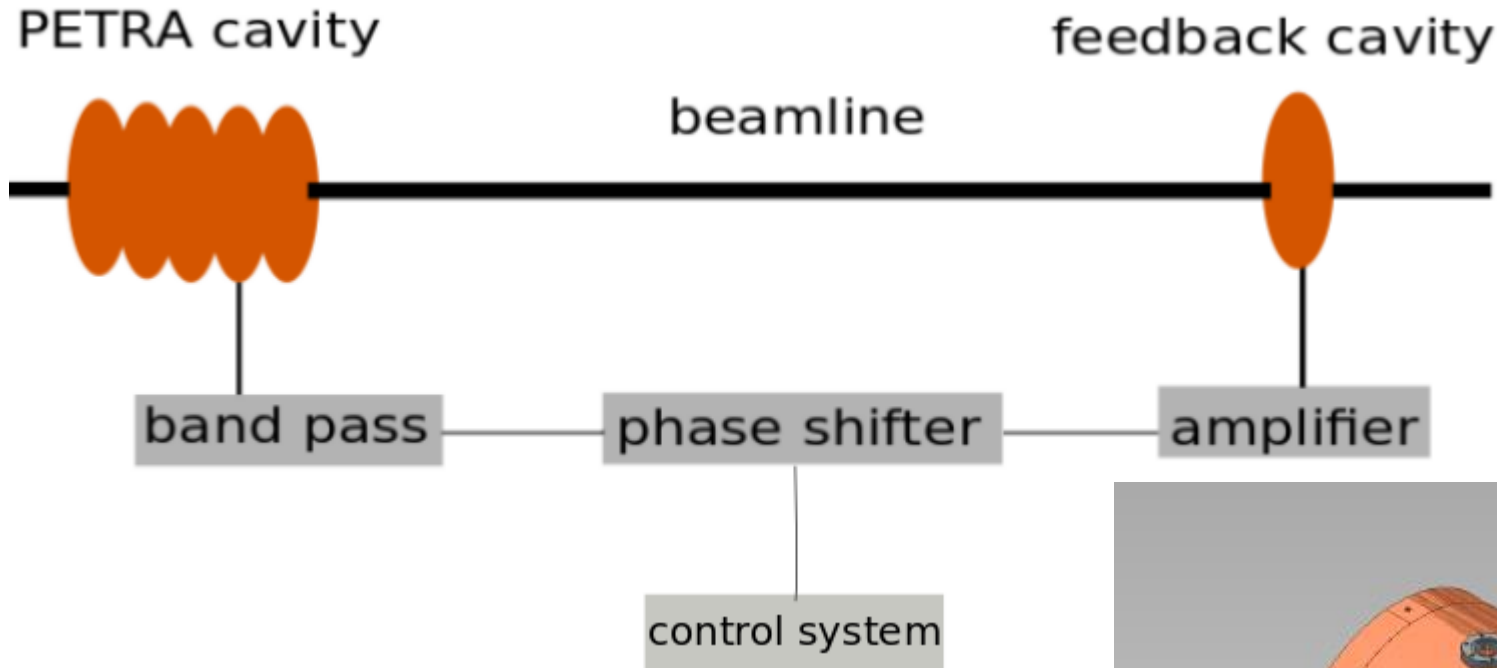
- operational at high beam currents / energy
- modification (add. pump in internal circuit) required for safety and stability reasons

→ **ELSA shut-down required!**

Narrow Band Feedback



Narrow Band Feedback

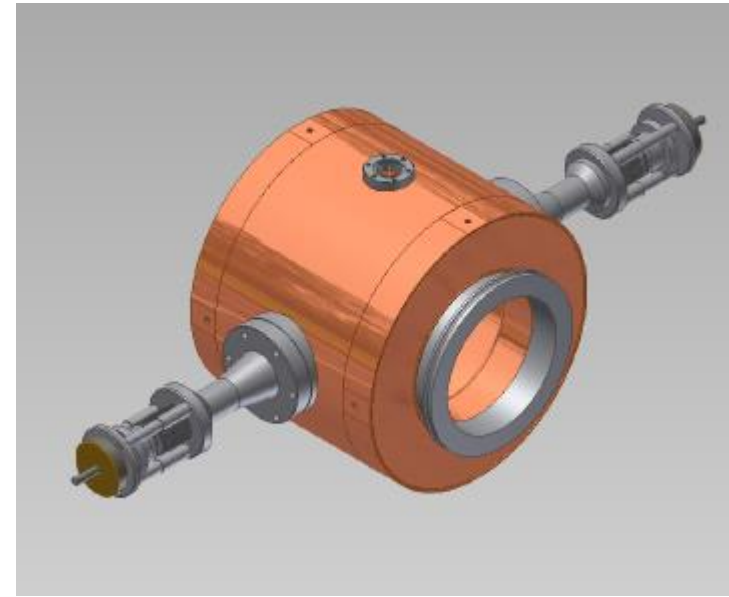


Actual Status:

- cavity under construction
- RF electronics under development

Funded by DFG within D.2 of SFB/TR 16!

→ ELSA shut-down required!



Impedance Reduction



- **installation of new IGP crosses with elliptical geometry**
- **bridging of ceramic brakes (x48) in the dipole chambers**
($\approx 1 \text{ M}\Omega$ contribution to impedance of beam pipe!)

Impedance Reduction

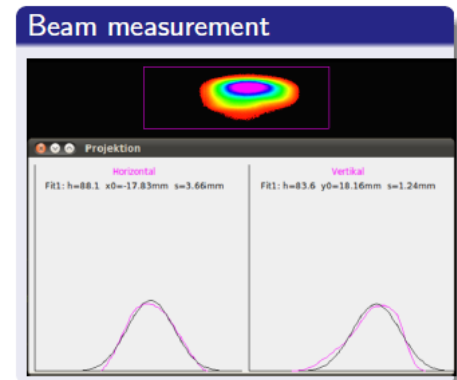
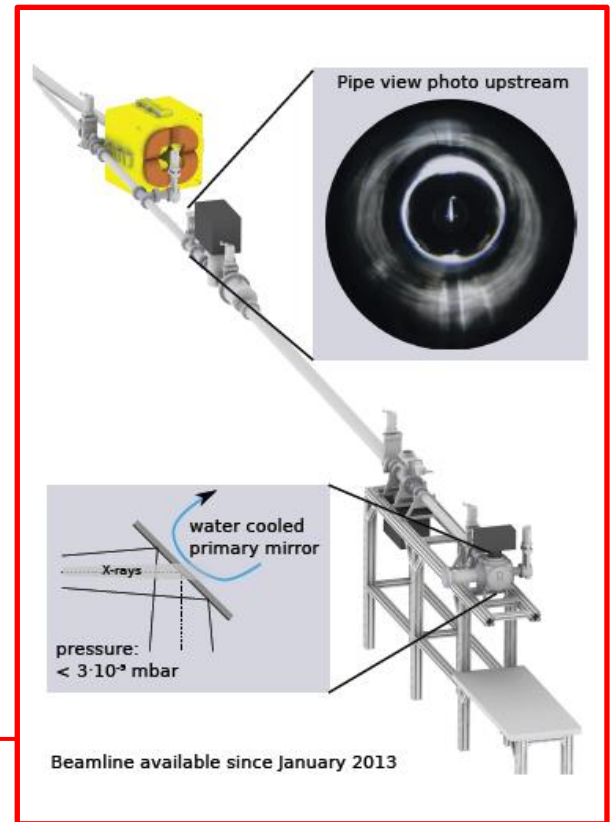
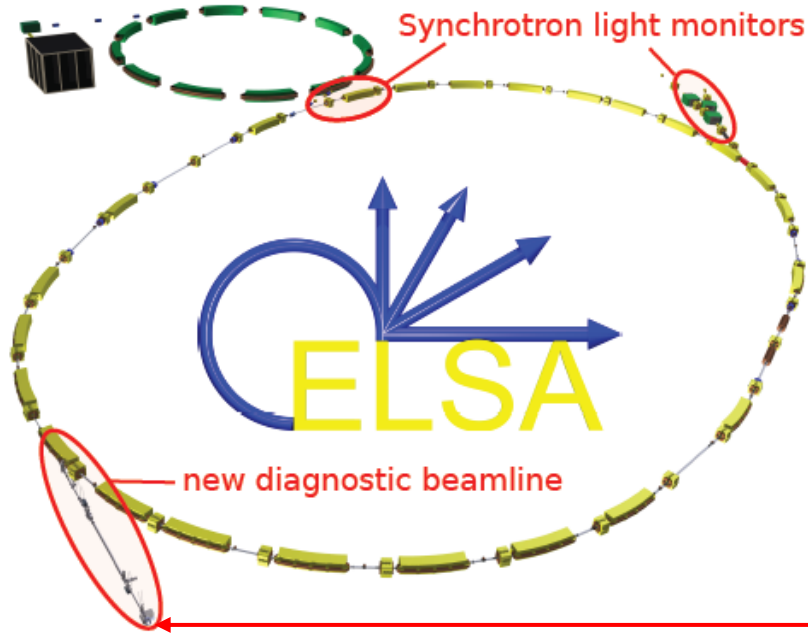


- installation of new IGP
- bridging of ceramic bra
($\approx 1 \text{ M}\Omega$ contribution to

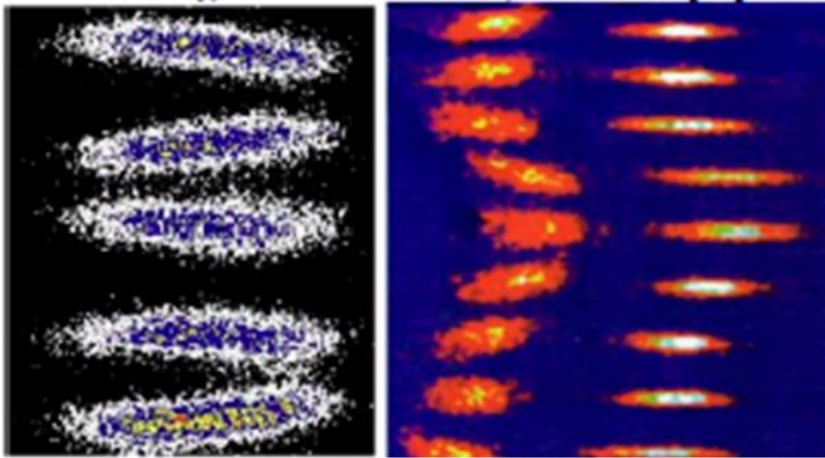
Actual Status:

- design work ongoing on dedicated components
- complete venting of ELSA required for installation!
→ longer ELSA shut-down required!

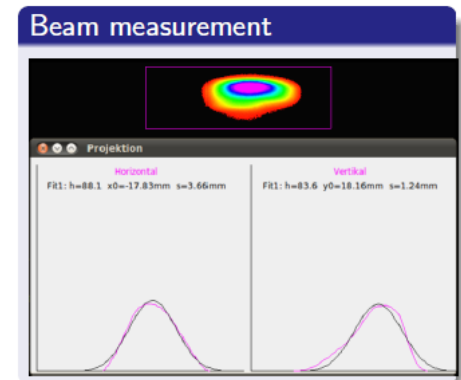
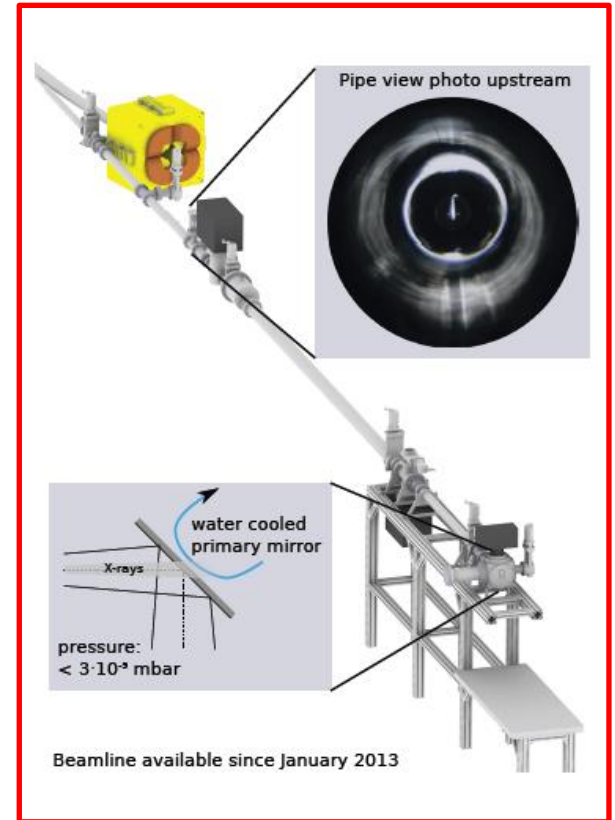
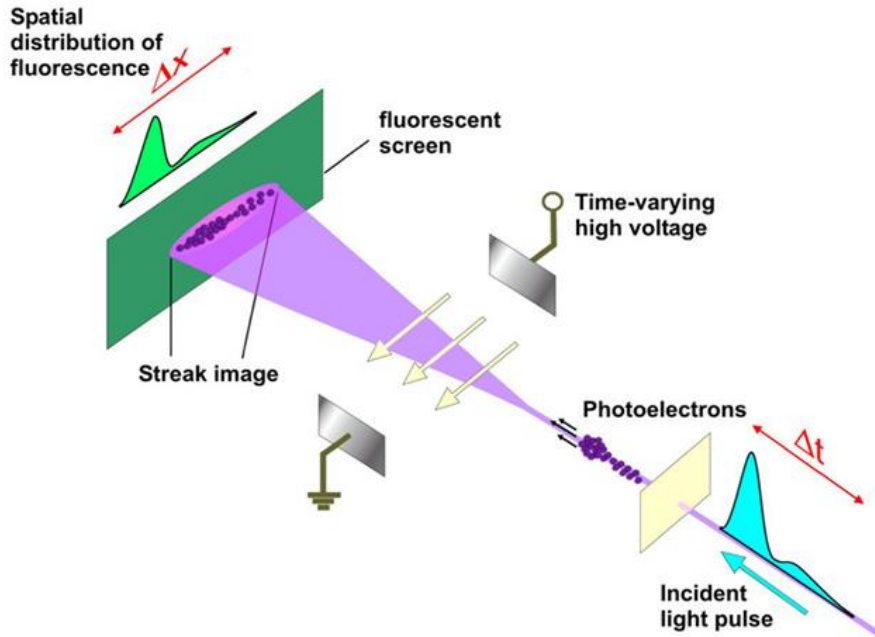
High Resolution Diagnostics



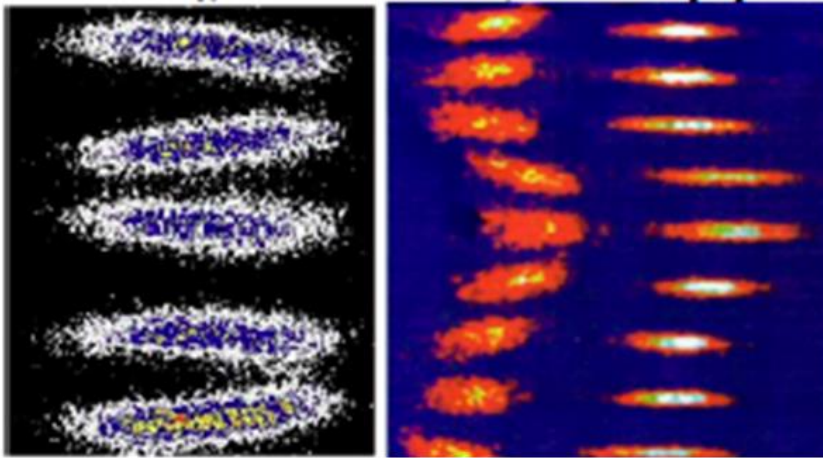
High Resolution Diagnostics



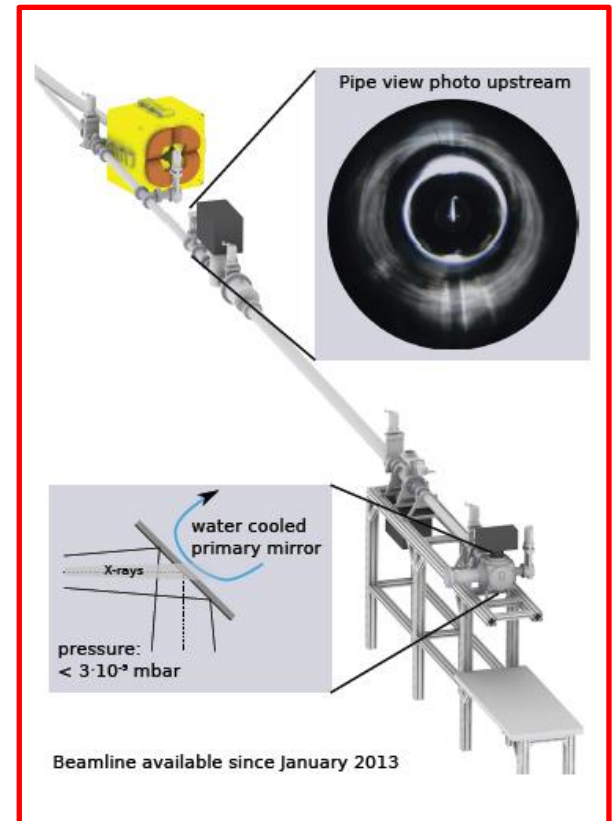
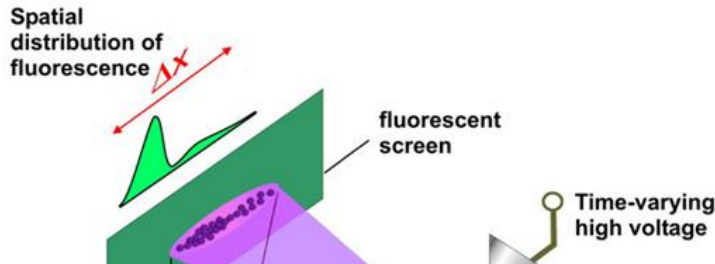
(K. Scheidt: Review of streak cameras for accelerators, Proc. EPAC 2000)



High Resolution Diagnostics

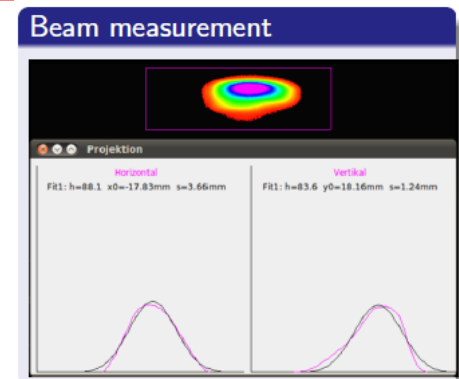


(K. Scheidt: Review of streak cameras for accelerators, Proc. EPAC 2000)

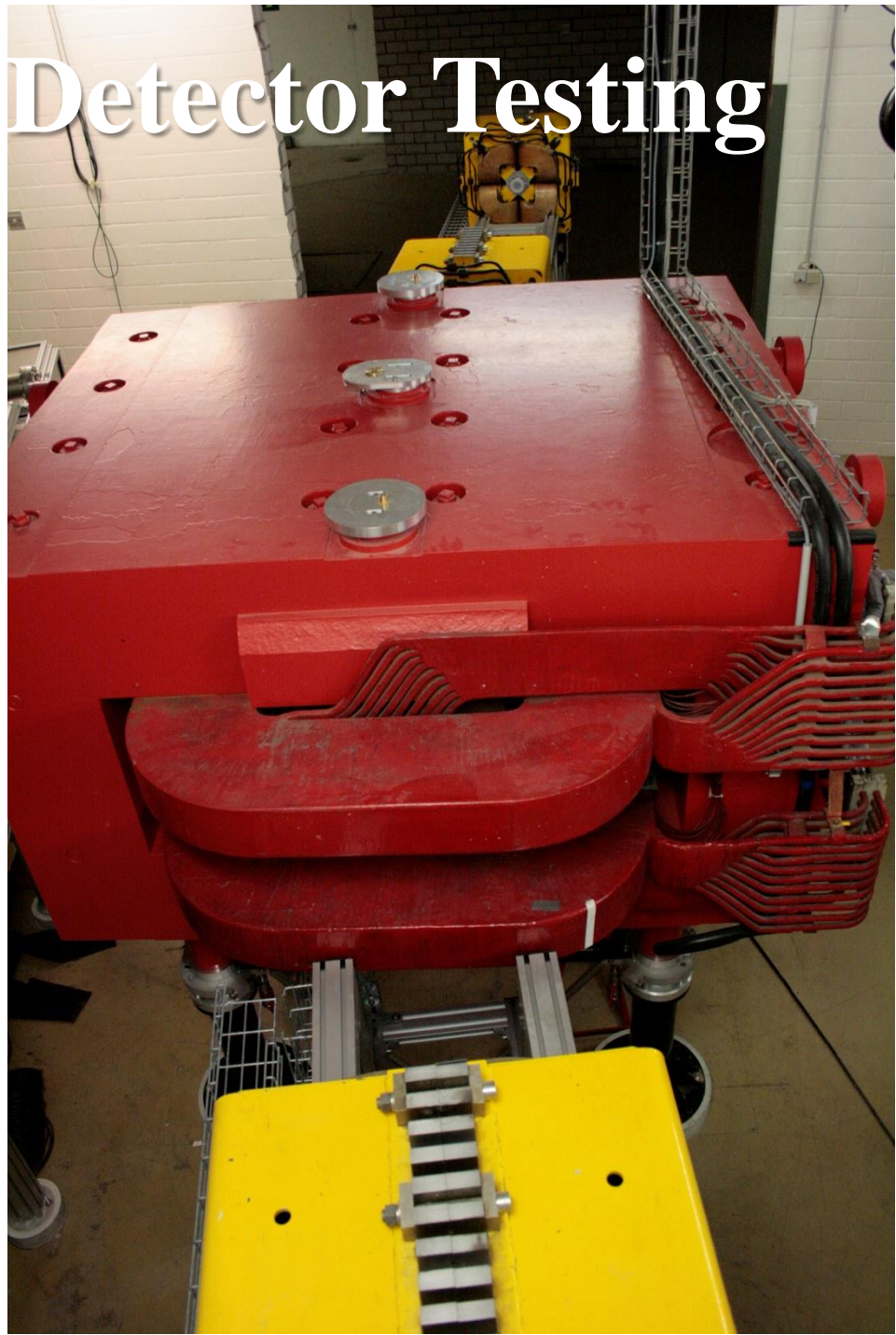
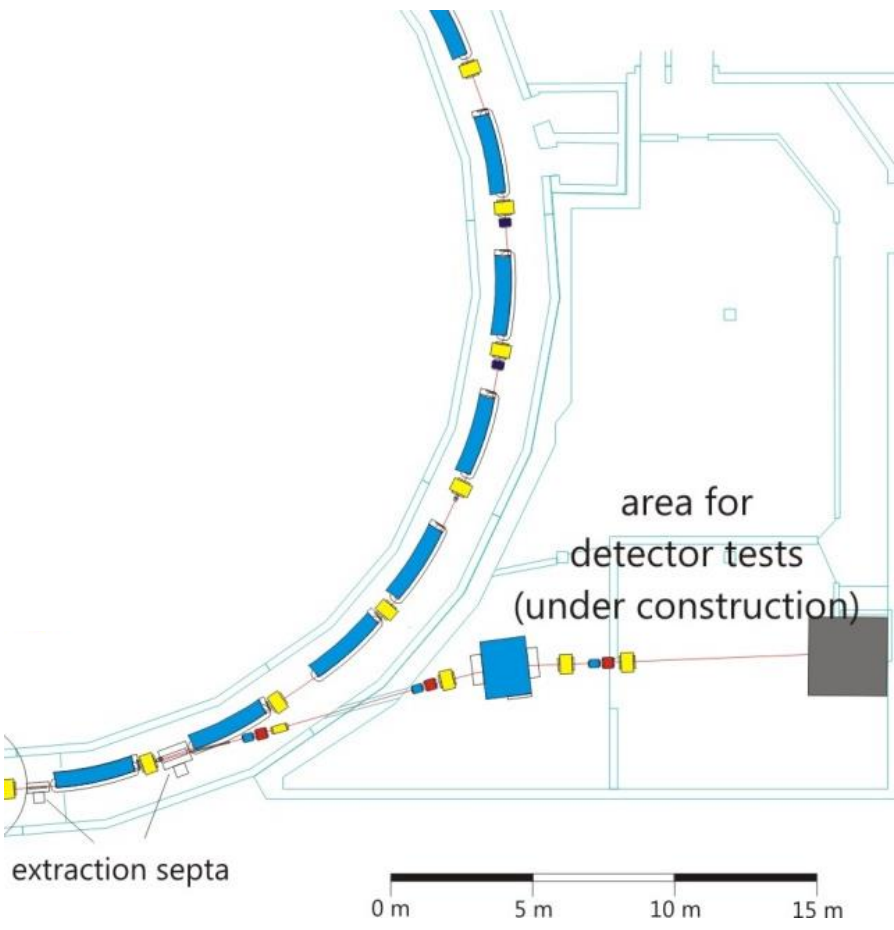


Actual Status:

- SYLI beam line operational since January
 - Streak Camera (ps-resolution) ordered
- Funded by DFG within D.2 of SFB/TR 16!*
- short beam test required end of May!!**



Beam Line for Detector Testing



Beam Line for Detector Testing



Actual Status:

Experimental Area:

- magnets and supports in place,
- power cables, water cooling, beam pipes and diagnostics ready for installation
- main PS in the area, some still missing
- problem: beam dump and emergency exit

ELSA Tunnel:

- septa, quadrupole, steerers, beam pipes, diagnostics, beam shutter, ...
- longer ELSA shut-down required!

Time Schedule

Longer shut-downs for installations / modifications
(and further savings of operating costs!) required:

- Installation of new ELSA RF system
- Modification of PETRA temperature control
- Installation of EKS / waveguide-system @ LINAC I
- Continuation of upgrade CO / Harmcorr correction system
- Set up of Compton laser beam line
- Upgrade of ELSA impedance / vacuum
- Set up of new external beam line (detector testing)

**Flexible / relaxed planning in view of
4000 operating hours / 4000 maintenance hours
per year?!**