EPOS - ELBE Positron Source
Positron Annihilation Multifacility Project in Dresden

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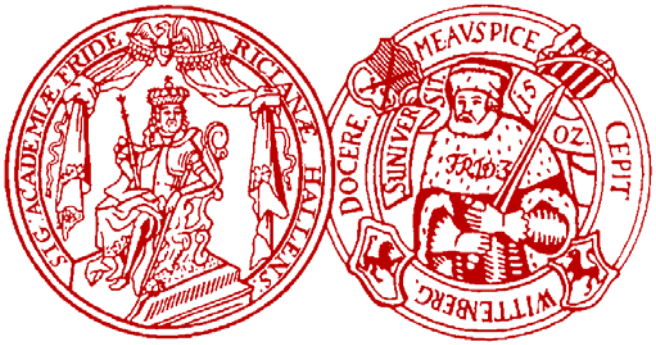
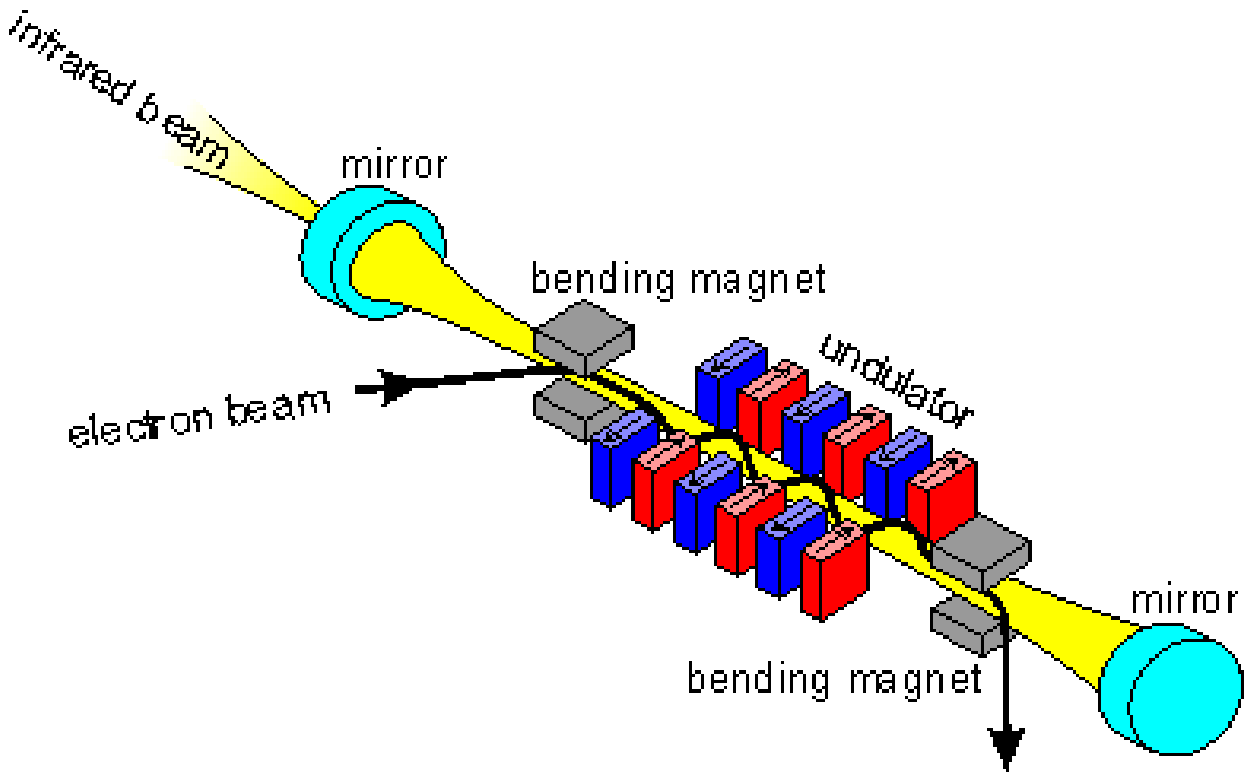


Martin-Luther-Universität
Halle-Wittenberg

1. The ELBE Radiation Source in Dresden
2. Concept of EPOS

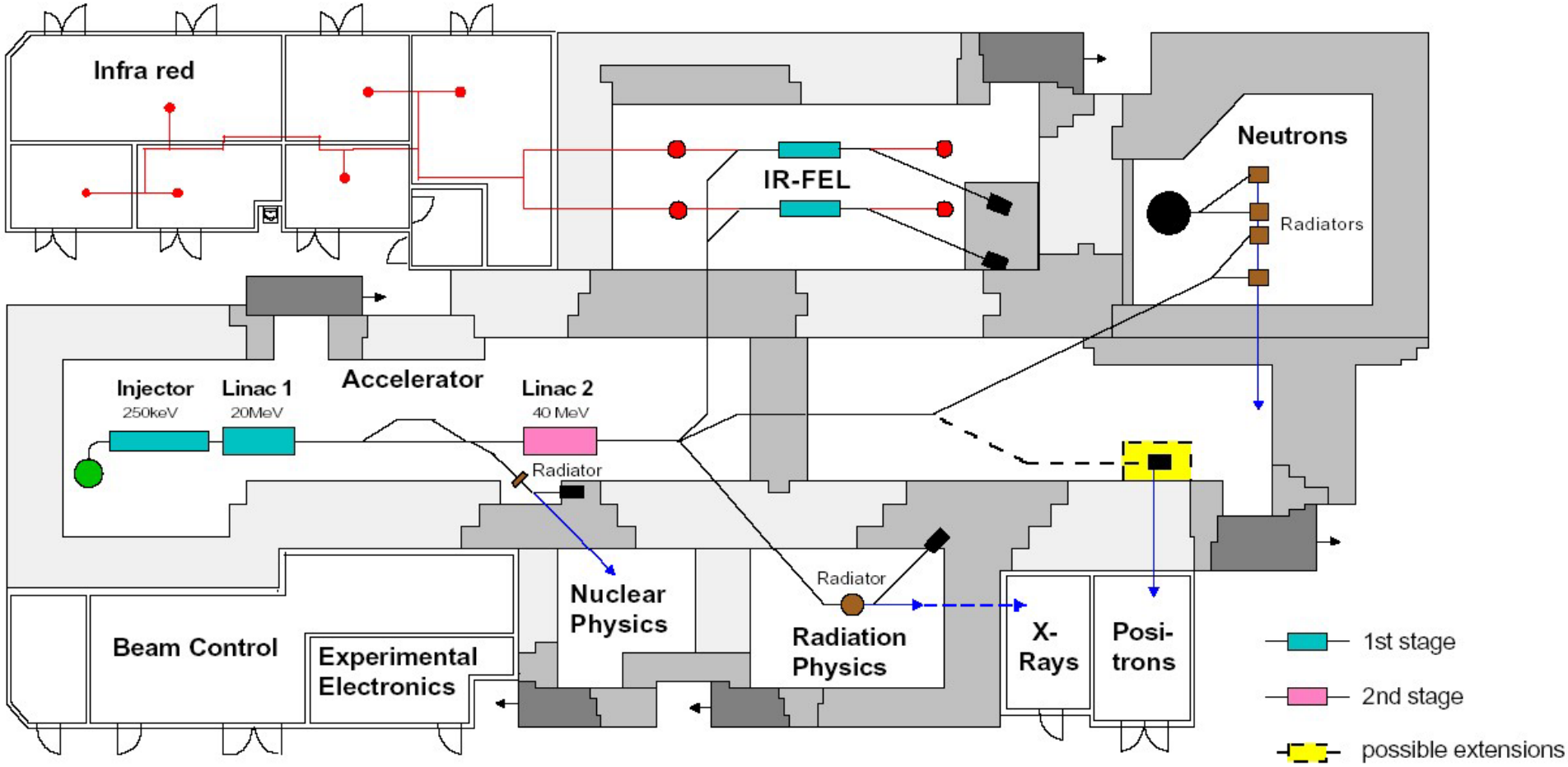
Radiation Source ELBE at Research Center Rossendorf

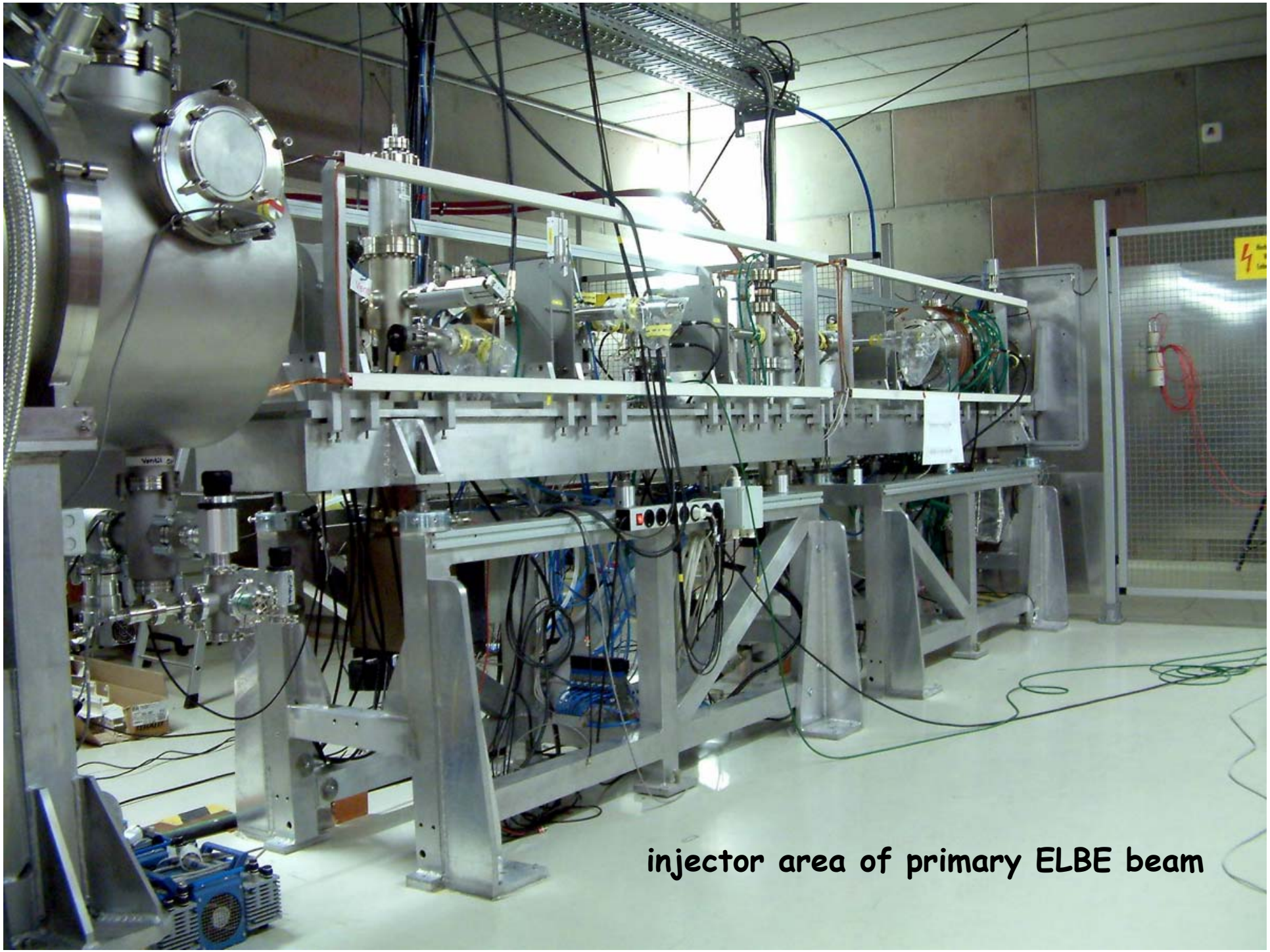
- Where is Rossendorf?
- 600 employees
- main experiment: Radiation Source ELBE
- ELBE = **E**lectron **L**inac with high **B**rilliance and low **E**mittance
- superconducting cavities (from TESLA, DESY Hamburg)
- 40 MeV, 1 mA
- main goal: IR Free-electron Laser



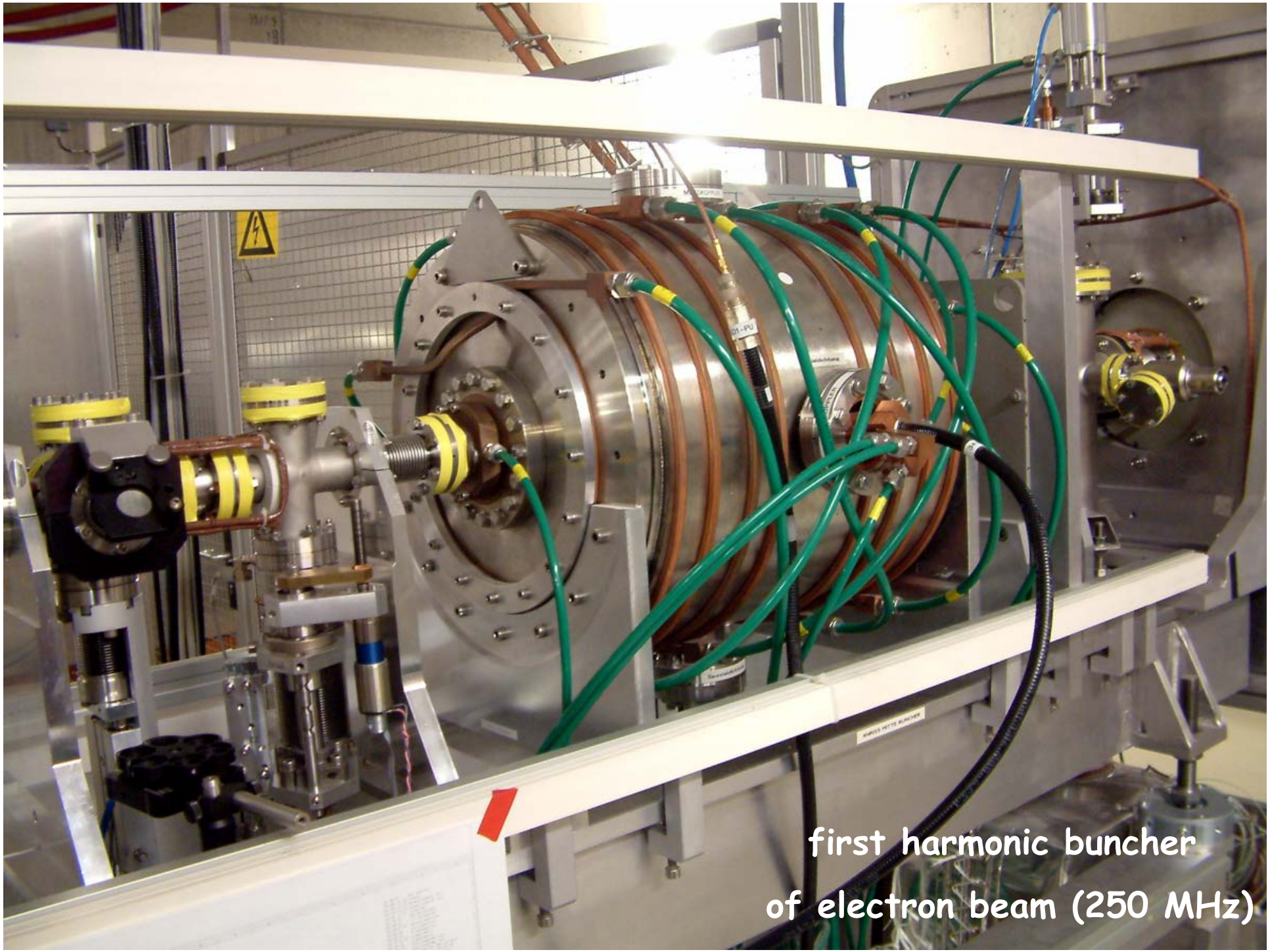
- additional experiments: nuclear physics, radiation physics, neutron lab, and positron lab -> EPOS (**E**LBE **PO**sitron **S**ource)

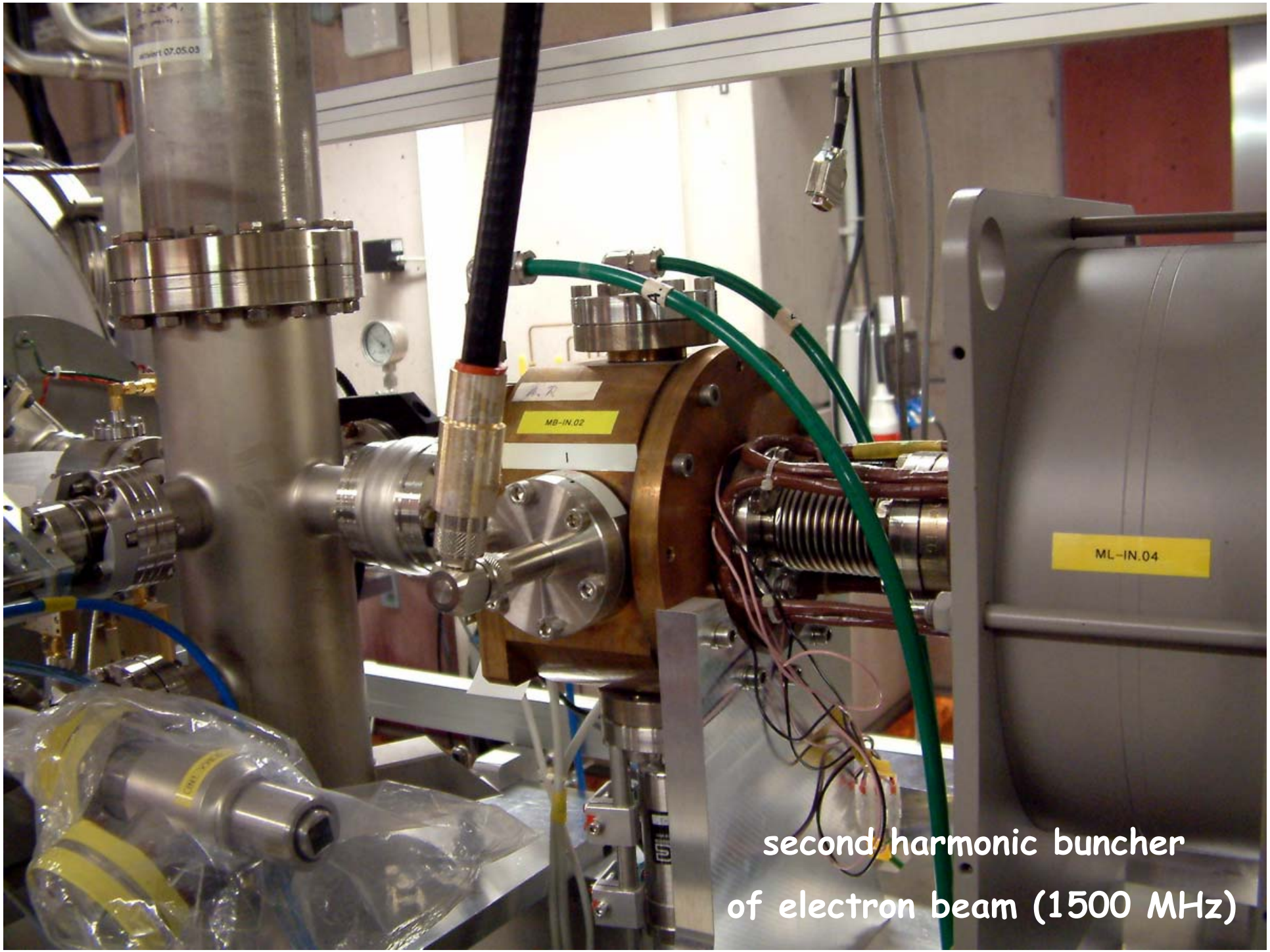
Ground plan of the ELBE hall





injector area of primary ELBE beam

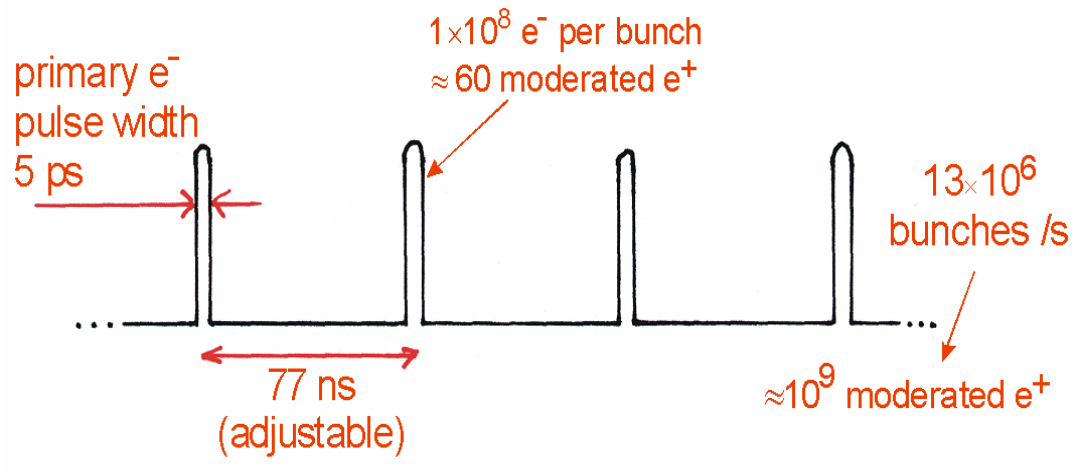

first harmonic buncher
of electron beam (250 MHz)



second harmonic buncher
of electron beam (1500 MHz)

Time structure of primary electron beam

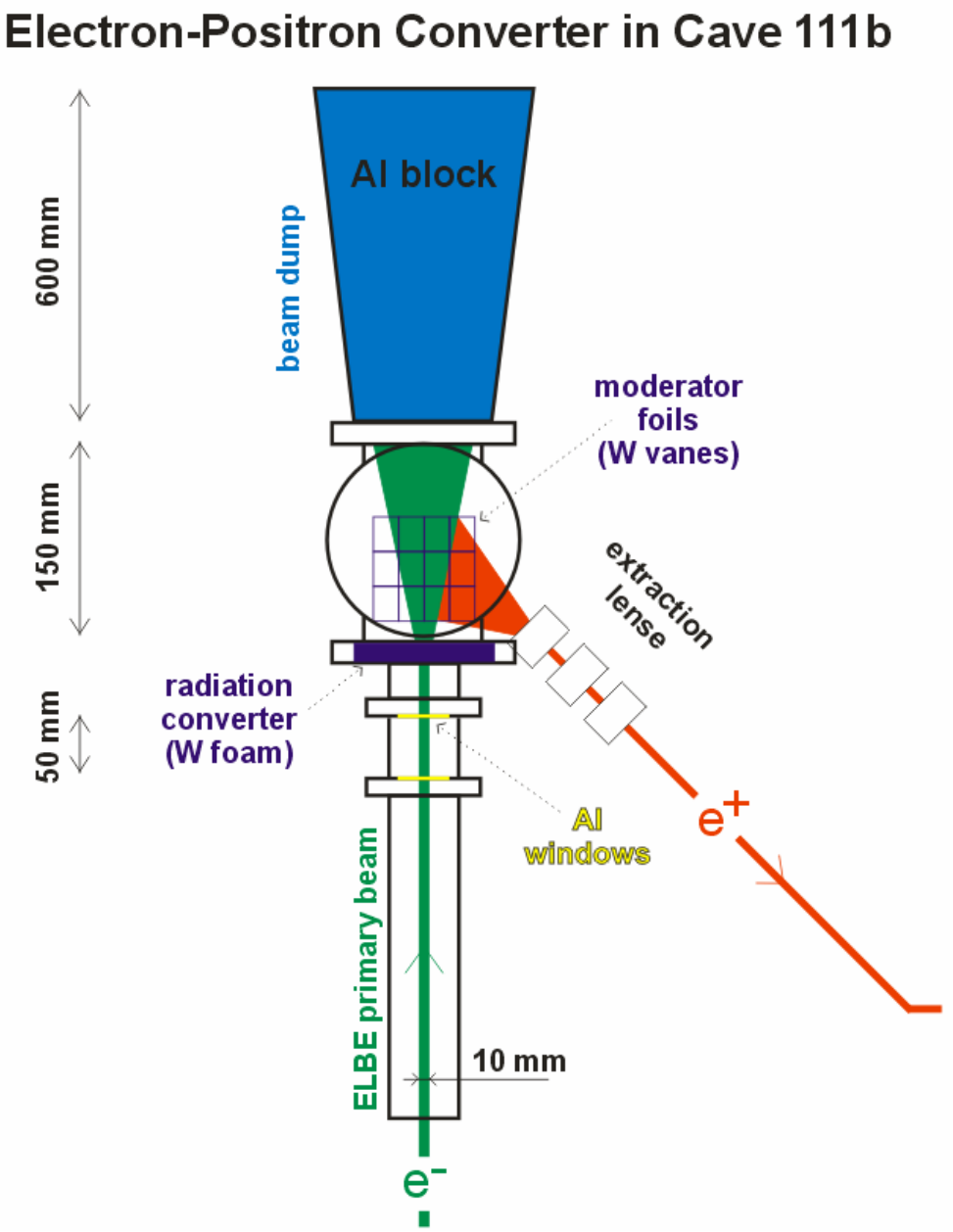
- primary electron beam (40 MeV x 1 mA = 40 kW)
- very interesting time structure: cw-mode of short bunches
- bunches very short (< 5 ps); bunch separation adjustable (e.g. 77 ns = 13 MHz)
- "normal" LINACs often have a repetition frequency of ≈ 1 kHz only
- positrons are obtained by pair production from electron beam hitting a tungsten target



electron bunches

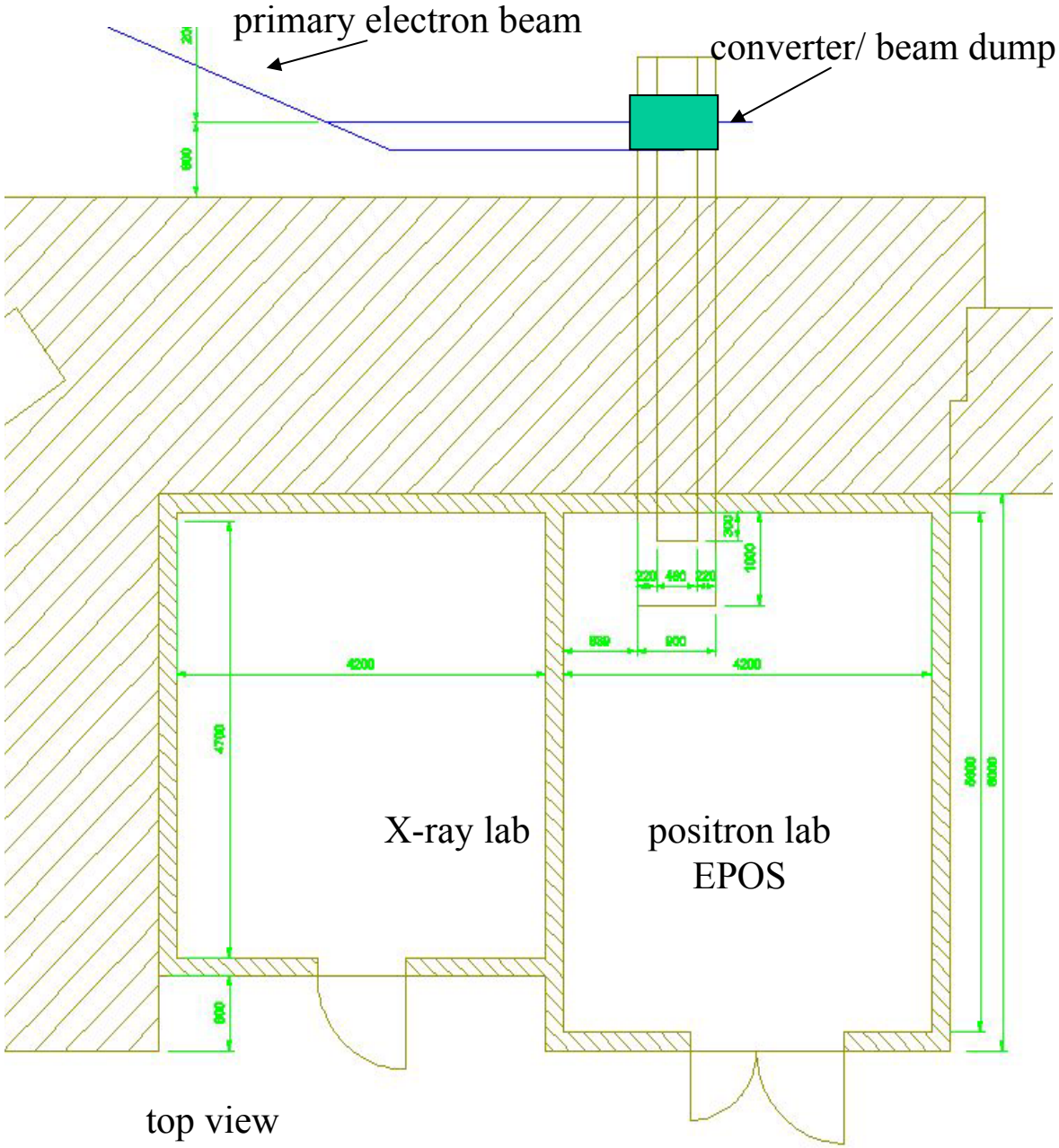
EPOS = ELBE Positron Source

- intensive beam of slow, mono-energetic positrons
- all relevant positron techniques for materials research (positron lifetime, Coincidence Doppler broadening, AMOC)
- EPOS is external facility of Martin-Luther-University Halle at Research center Rossendorf
- in close collaboration with FZR
- user-dedicated facility
- complete remote control via web interface



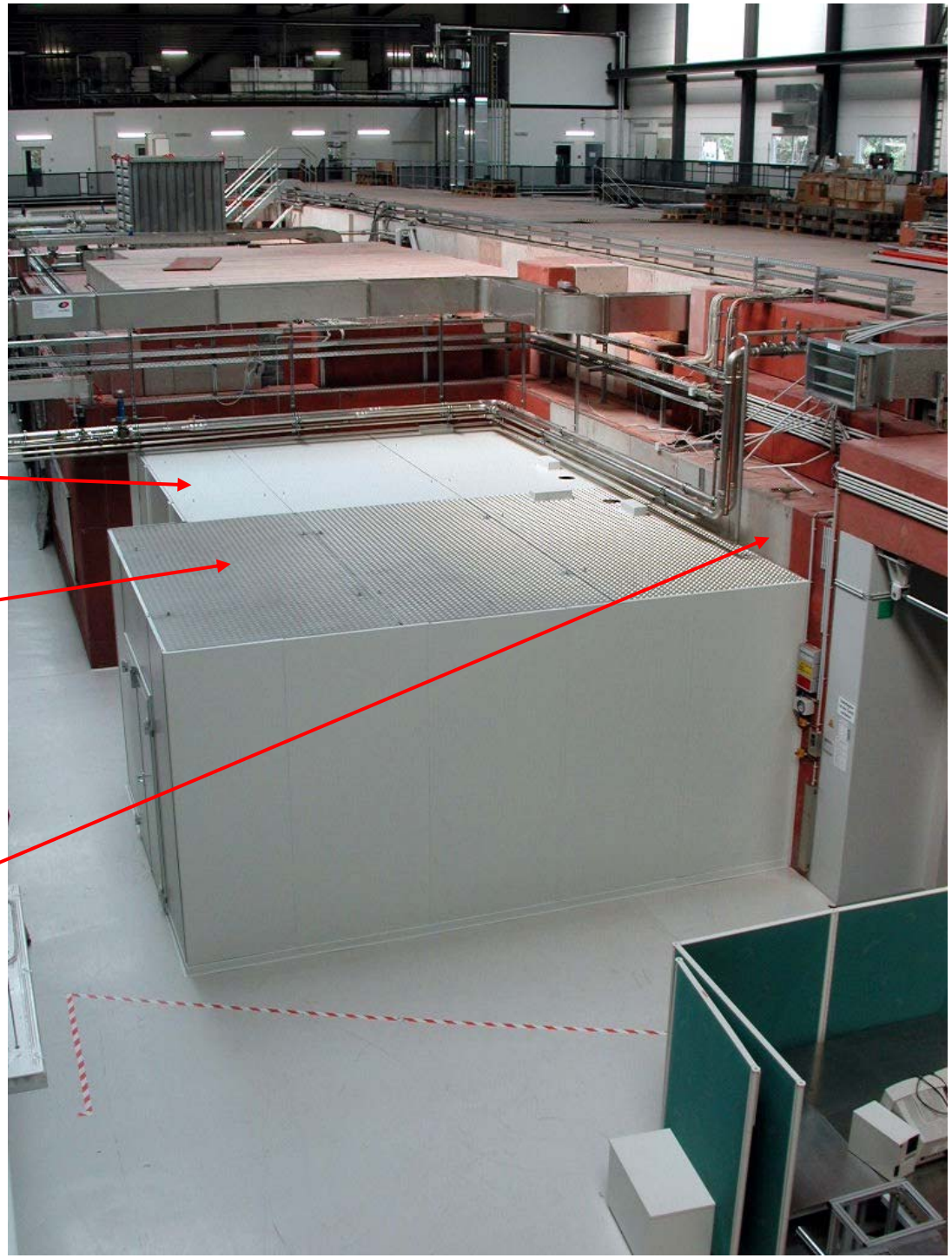
Ground plan of positron lab

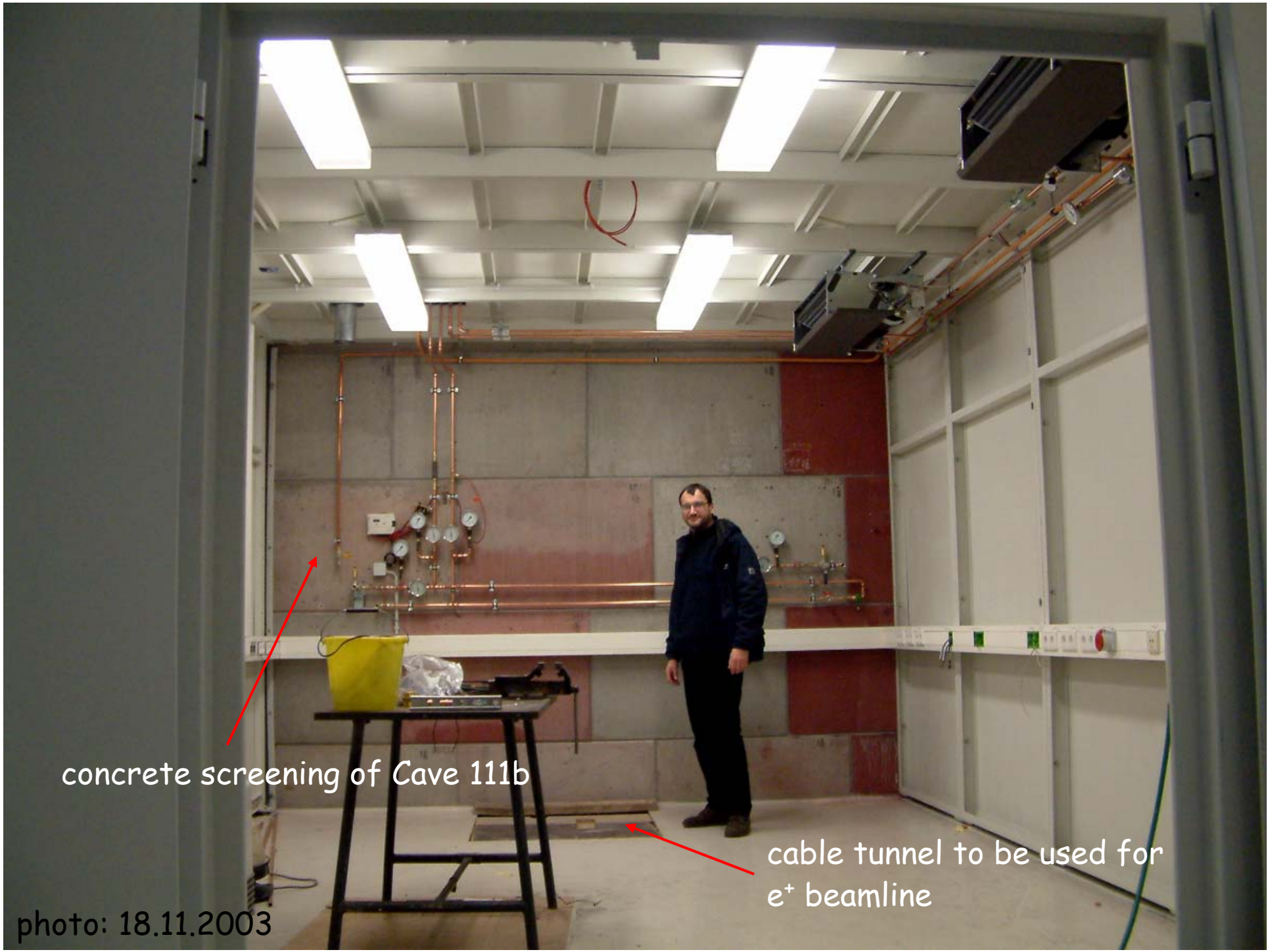
- Construction work started
- Lab itself ready for use
- Basic financing by University Halle, federal state of Sachsen-Anhalt and EC



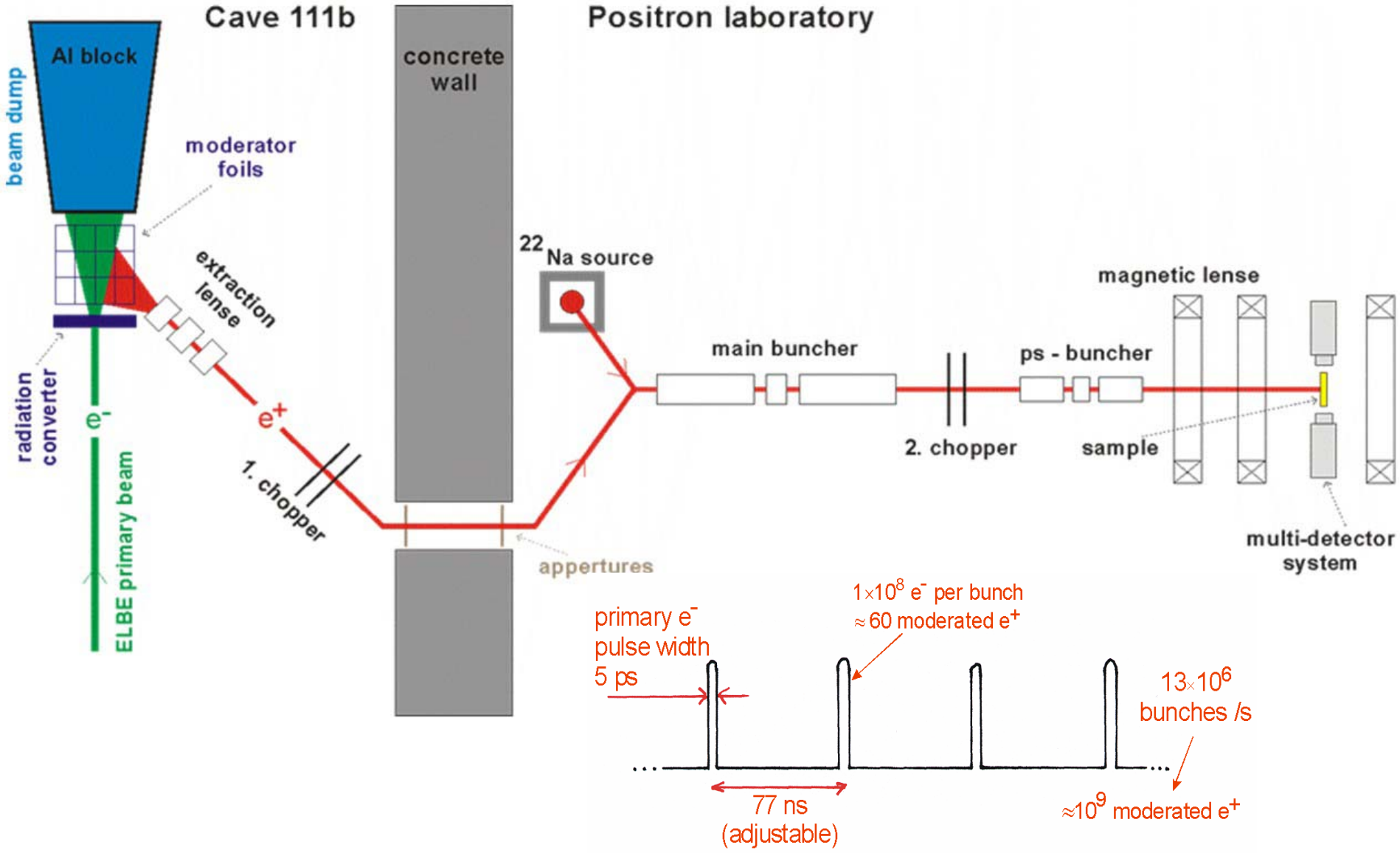
Positron Lab

- positron lab in ELBE hall



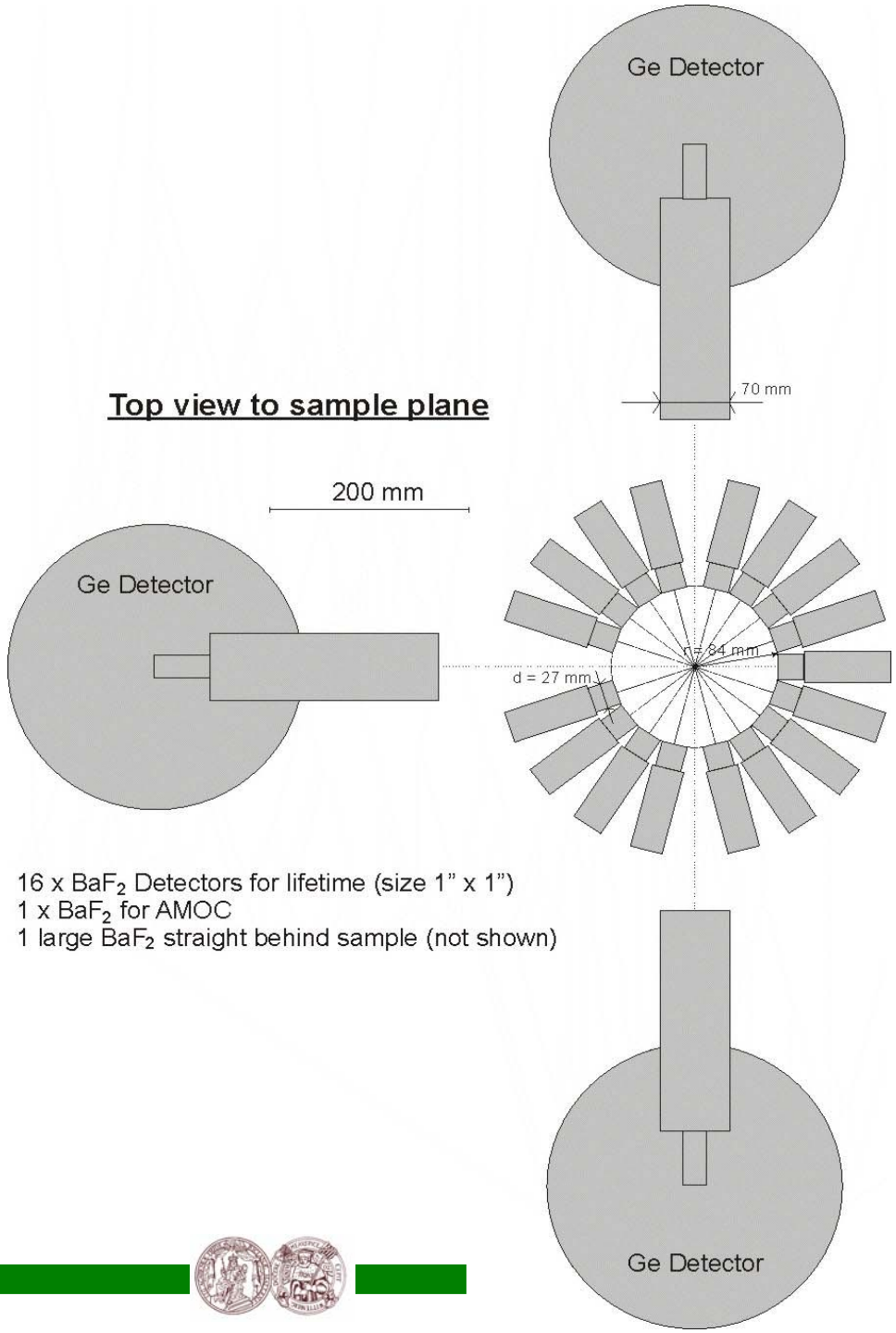

concrete screening of Cave 111b
cable tunnel to be used for
e+ beamline
photo: 18.11.2003

Beam Schematics of EPOS

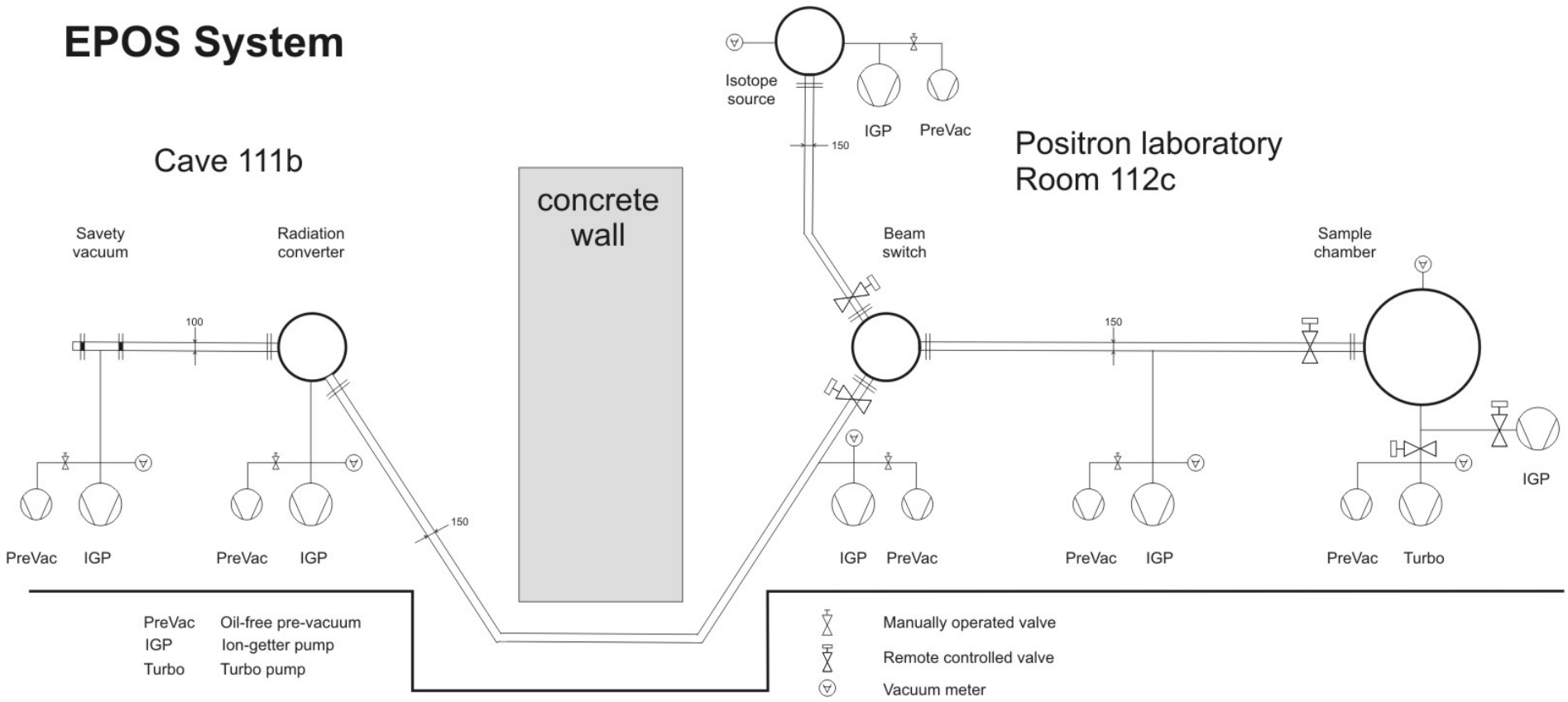


Detector system

- **3 experiments**:
  - lifetime spectroscopy (16 BaF_2 detectors), single mode and coincidence mode
  - Coincidence Doppler (2 Ge detectors)
  - AMOC (1 Ge and 1 BaF_2 detector)
- **digital detection system**:
  - direct digital measurement of detector pulses
  - lifetime: almost nothing to adjust; time scale exactly the same for all detectors; easy realization of coincidence
  - Doppler: better energy resolution and pile-up rejection expected



Vacuum System



- whole system is remote controlled via web interface (pumps, valves and vacuum meters)

Time Schedule

	2004	2005	2006
Laboratory			
Simulation e^+ converter			
Simulation beam			
Converter chamber and vacuum system in tunnel			
Screening of converter chamber			
First chopper / buncher			
Test converter / beam transport			
Vacuum system completion			
Conventional source chamber			
2. Chopper / buncher			
Sample chamber			
Completion of beam electronics			
Test of transport system			
Detector system and software			
Automation			
Software lifetime / Doppler spectra			
Optimization of time resolution			

Main features and applications of EPOS

main features:

- **ultra-high intensity** bunched positron beam (E_+=1…30 keV)
- very **good time resolution** by using the unique primary time structure of ELBE
- **high quality spectra** by lifetime and Doppler spectroscopy in coincidence mode
- **fast lifetime mode** (single detector mode) for kinetic investigations
- **conventional source included** for Doppler measurements (when primary beam is not available)
- fully **remote control** via Internet by user

Variety of applications in all field of materials science:

- defect-depth profiles due to surface modifications and ion implantation
- tribology (mechanical damage of surfaces)
- polymer physics (pores; interdiffusion; …)
- porous materials (layers and bulk)
- defects in semiconductors, ceramics and metals
- epitaxial layers (growth defects, misfit defects at interface, …)
- fast kinetics (e.g. precipitation processes in Al alloys; defect annealing; diffusion; …)
- radiation resistance (e.g. space materials)
- many more …

Conclusions

- ELBE Positron Source (EPOS) will combine most positron techniques
- very intense positron source for high-quality positron spectroscopy
- will be user-dedicated facility of University Halle at Research Center Rossendorf

This presentation can be found as pdf-file on our Website:
http://positron.physik.uni-halle.de

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