The EPOS positron facility

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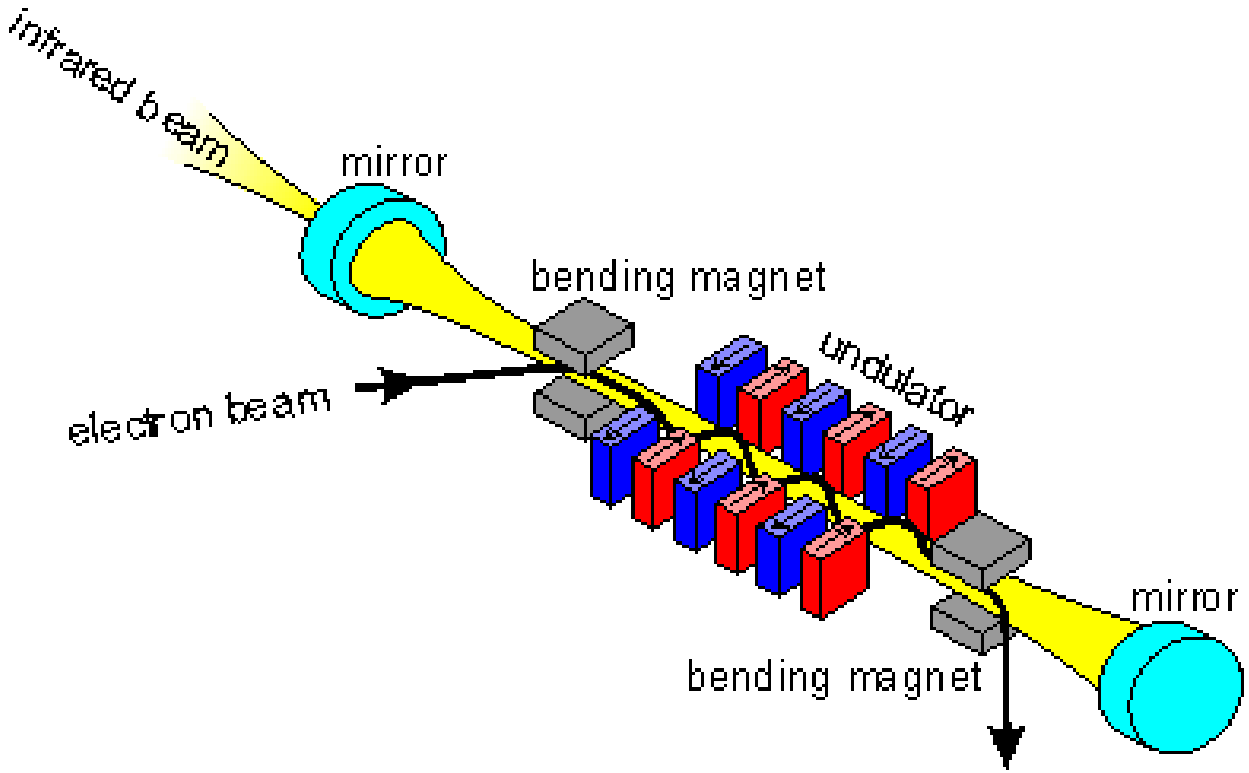
- Introduction
- The ELBE radiation source at Research Center Rossendorf
- EPOS = ELBE Positron Source

Positrons for Materials Science

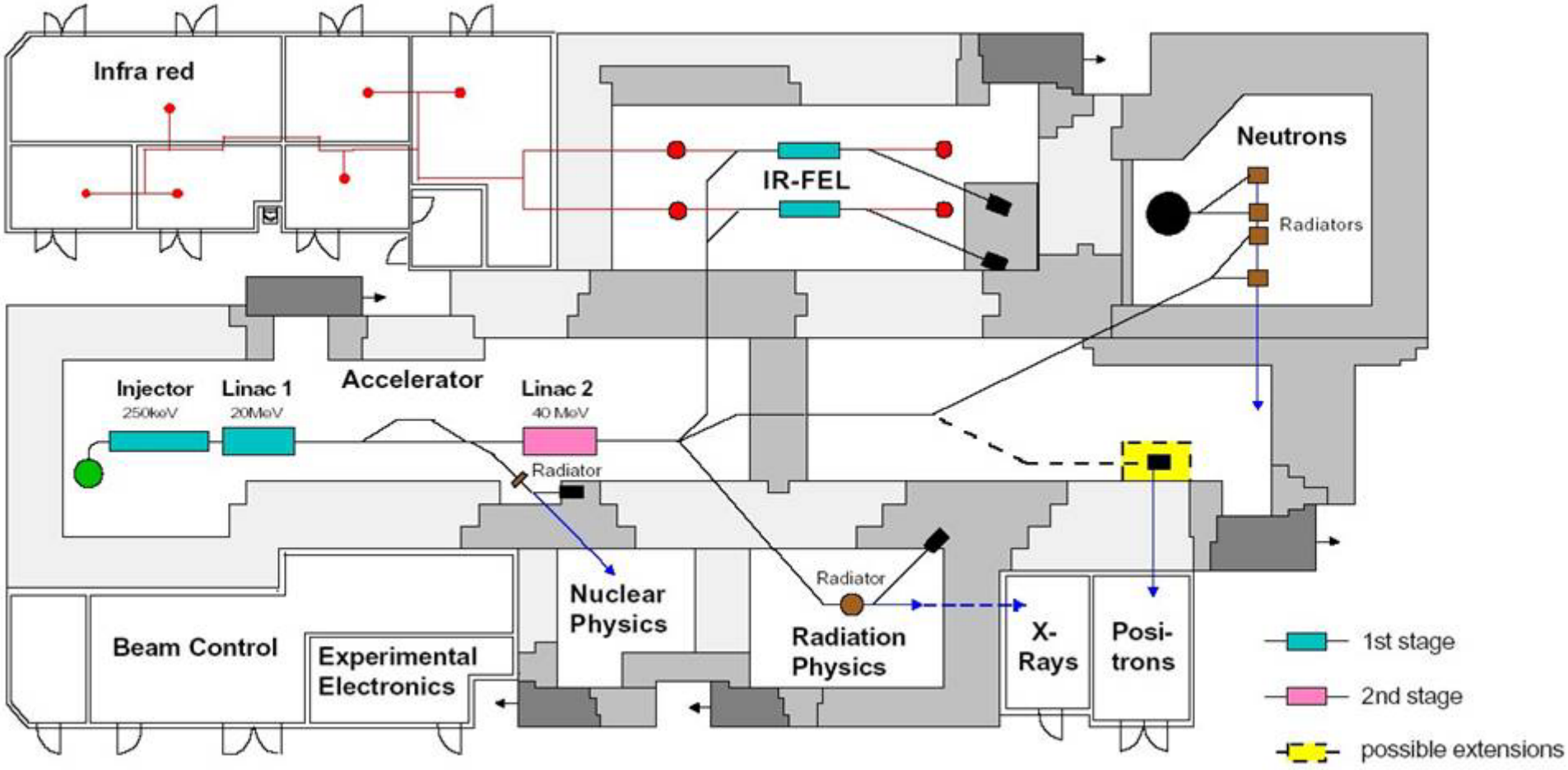
- Positron Annihilation is well established method
- well suited for nanoscopic defects: vacancies, vacancy clusters
- laboratory sources: about 10^5 e^+/s (22-Na; see our poster)
- time / spectrum 10^3 ... 10^5 s
- intense positron sources needed
- freely accessible in user-dedicated facilities
- e^+ generation by pair production
- γ-radiation of a reactor (Delft, Garching)
- electron LINAC's with E > 10 MeV (LLNL, Tsukuba, EPOS, ...)
- EPOS = **E**LBE **PO**sitron **S**ource
- planned as external facility of Center of Materials Science in Rossendorf
- free for external users

Research Center Rossendorf

- Research Center Rossendorf is near Dresden
- 600 people
- main experiment: Radiation source ELBE
- ELBE = **E**lectron **L**inac with high **B**rilliance and low **E**mittance
- superconducting cavities (from TESLA)
- 40 MeV, 1 mA (40 kW)
- main goal: IR Free-electron Laser

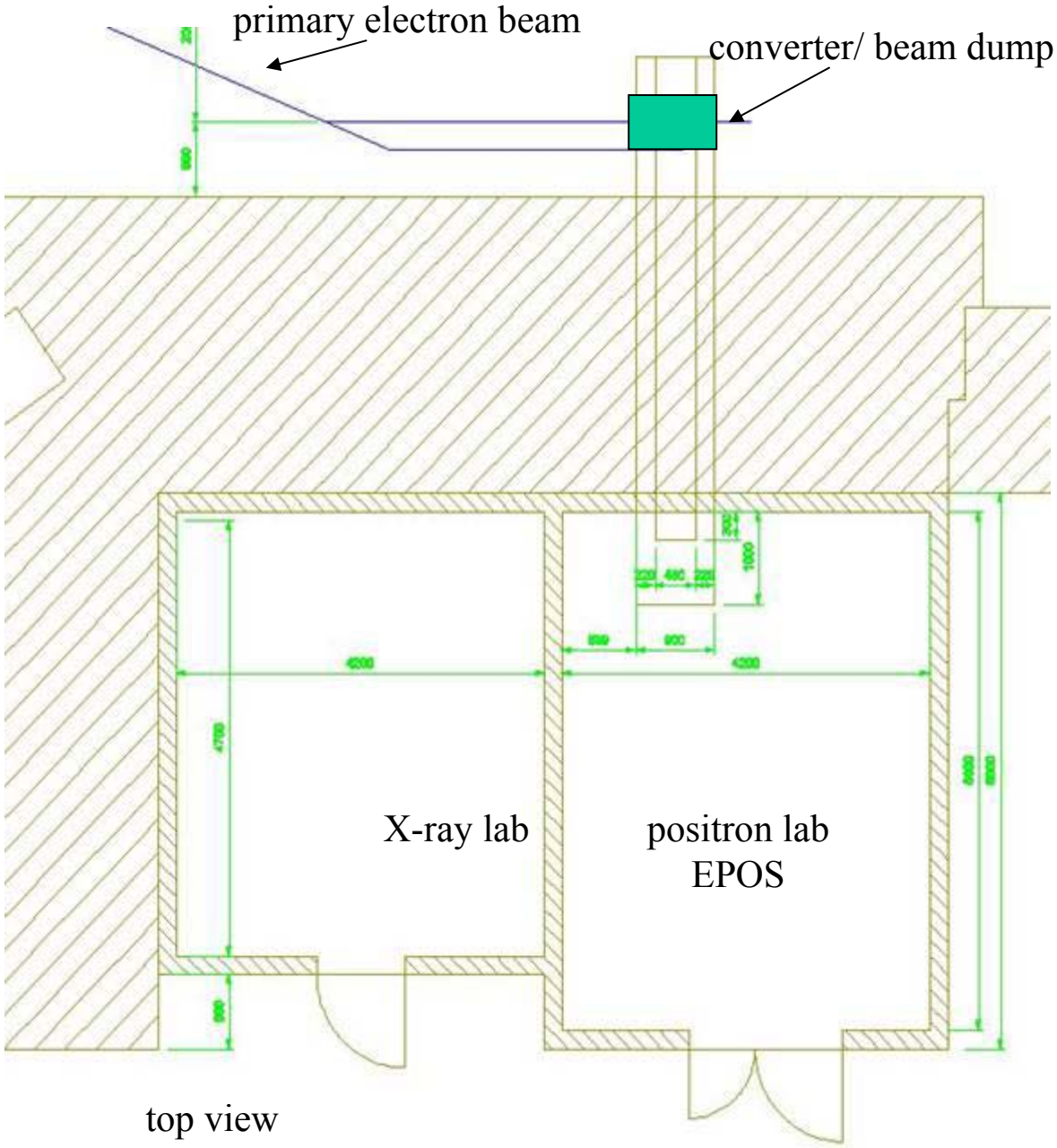


Ground plan of the ELBE hall



Ground plan of positron lab

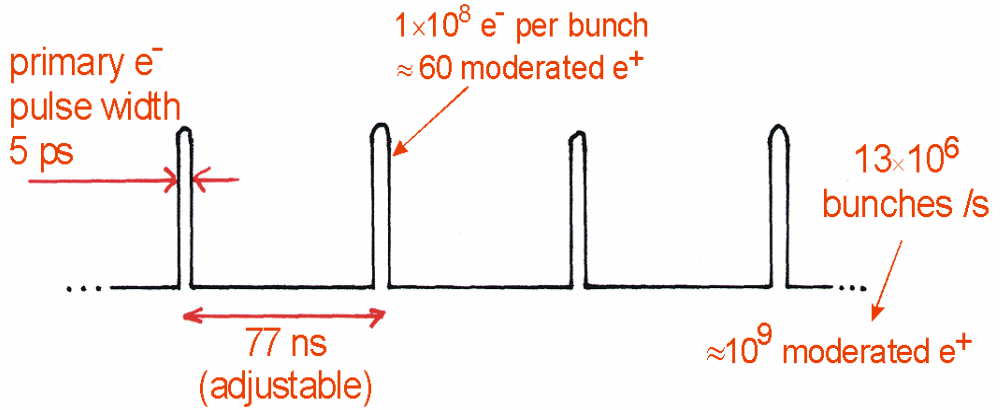
- Planning for both labs finished
- Construction work started
- Financing ...



top view

EPOS – ELBE Positron Source

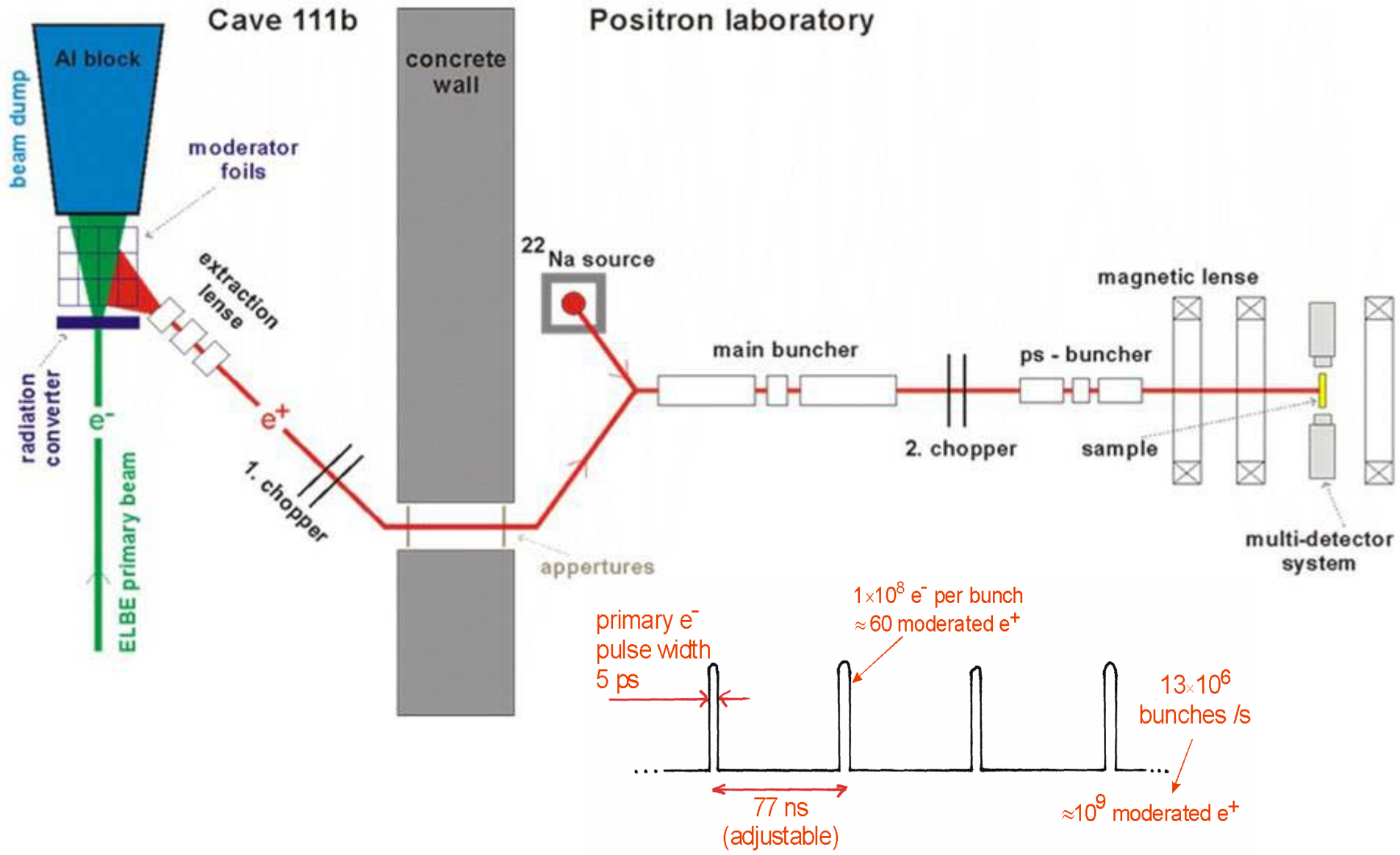
- electron beam at ELBE FEL is bunched
- bunch length: few ps, repetition time: 77 ns, CW-mode
- up to 10^8 e^-/bunch, 10^7 bunches/s
- FEL-system in Rossendorf under construction (ELBE)
- primary electron beam already available



electron bunches

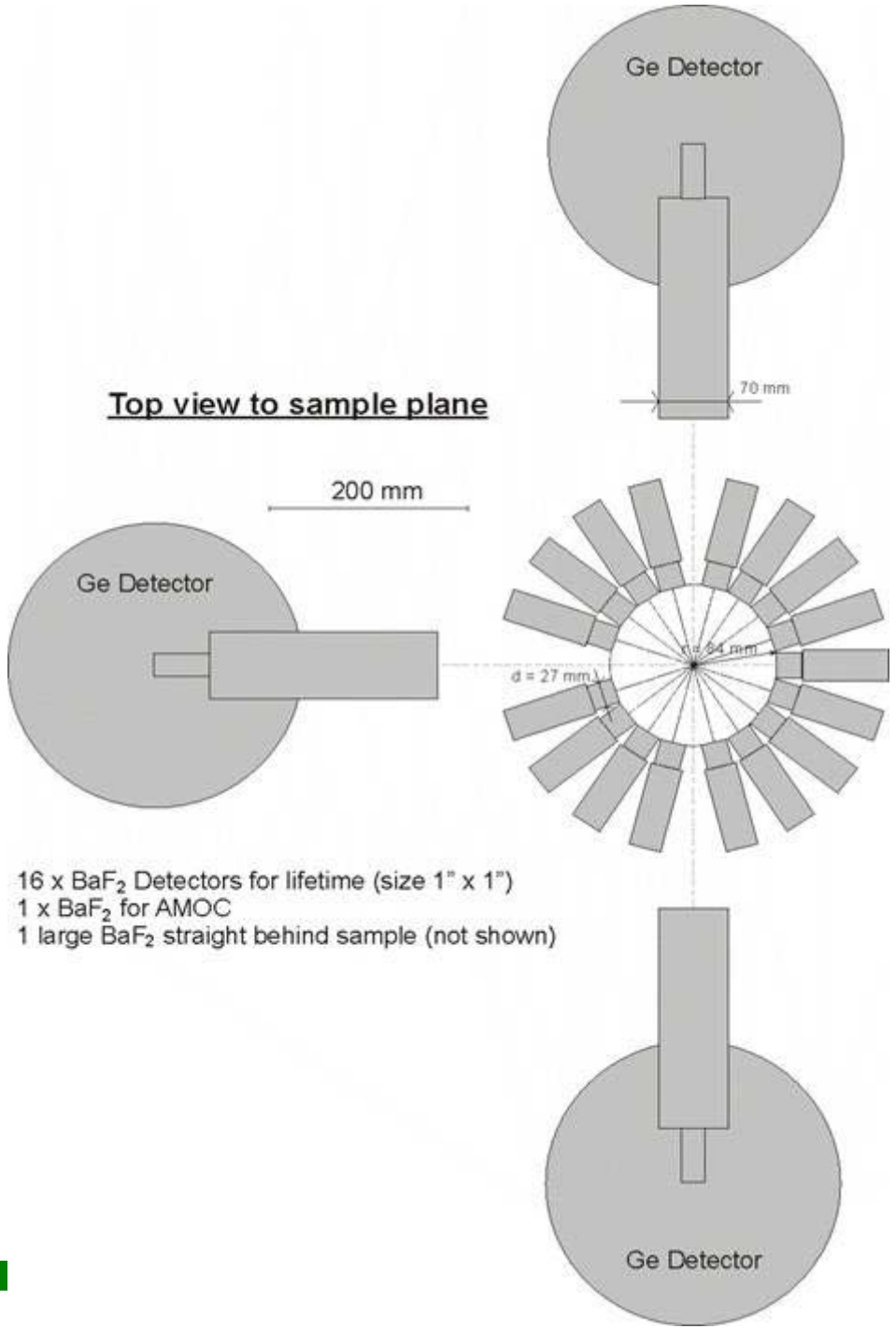
- direct positron lifetime measurement using time structure of e^- beam possible
- however: due to moderation and beam transport -> re-bunching necessary
- about 1 x 10^9 slow e^+/s; multi-detector system for high counting rate
- digital lifetime measurement
- combination with Doppler-coincidence spectroscopy and Age-momentum correlation (AMOC)

EPOS (ELBE Positron Source)

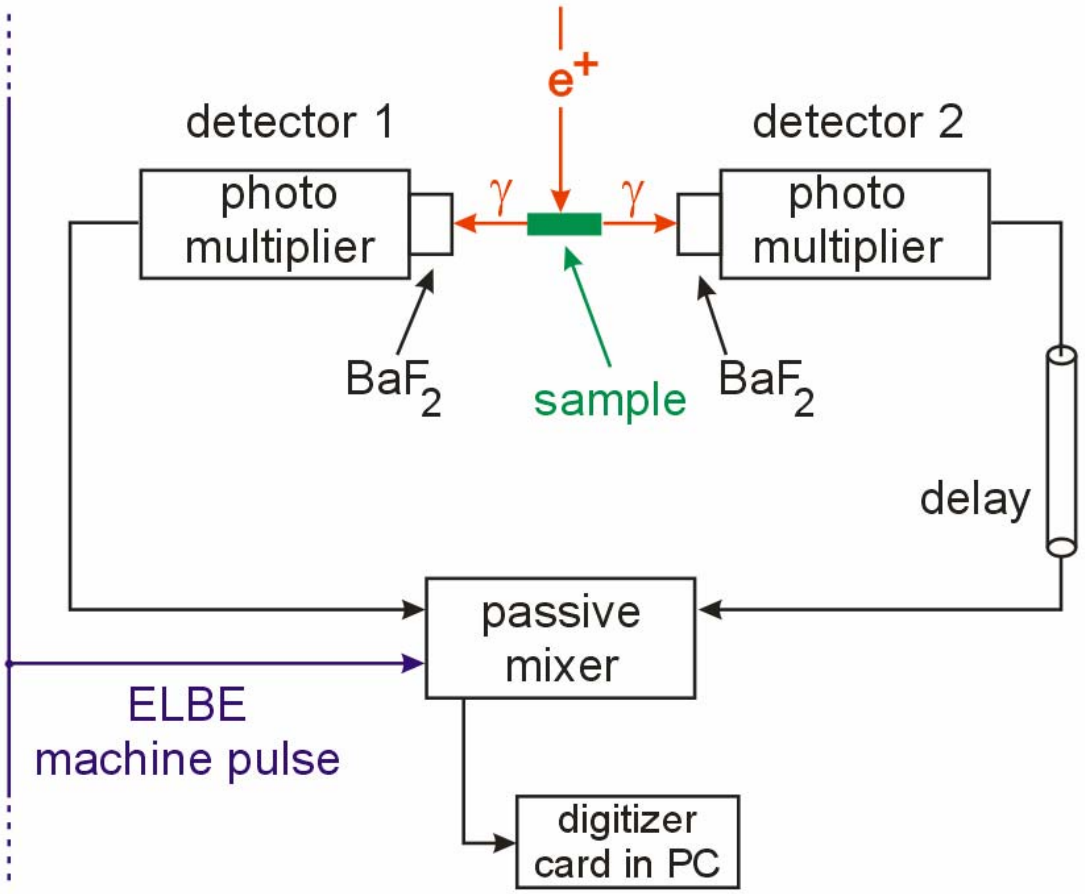


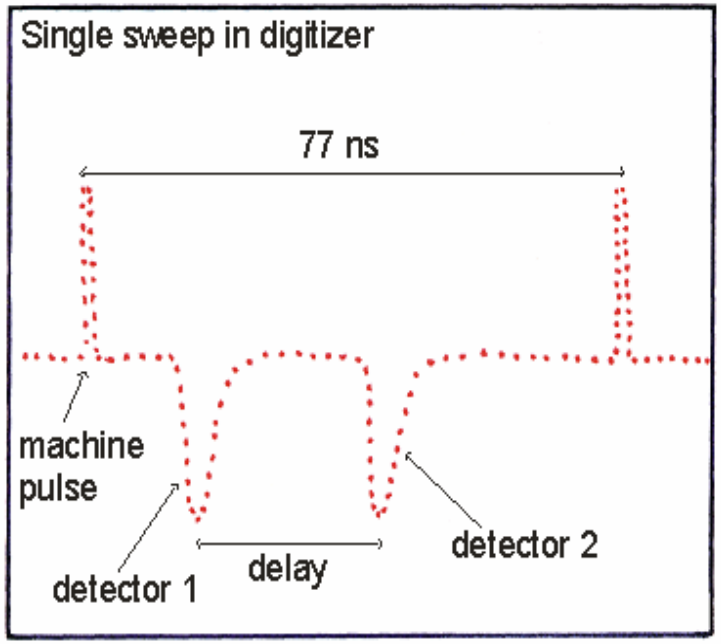
Detector system

- **3 experiments**: lifetime spectroscopy (16 BaF_2 detectors); Doppler coincidence (2 Ge detectors), and AMOC (1 Ge and 1 BaF_2 detector)
- arrangement of all detectors in a plane
- one **large extra BaF_2** behind the sample for detection with high counting rate (no coincidence possible)
- advantages of **digital detection system**:
  - 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
- disadvantage: large number of data



Digital Lifetime Spectroscopy

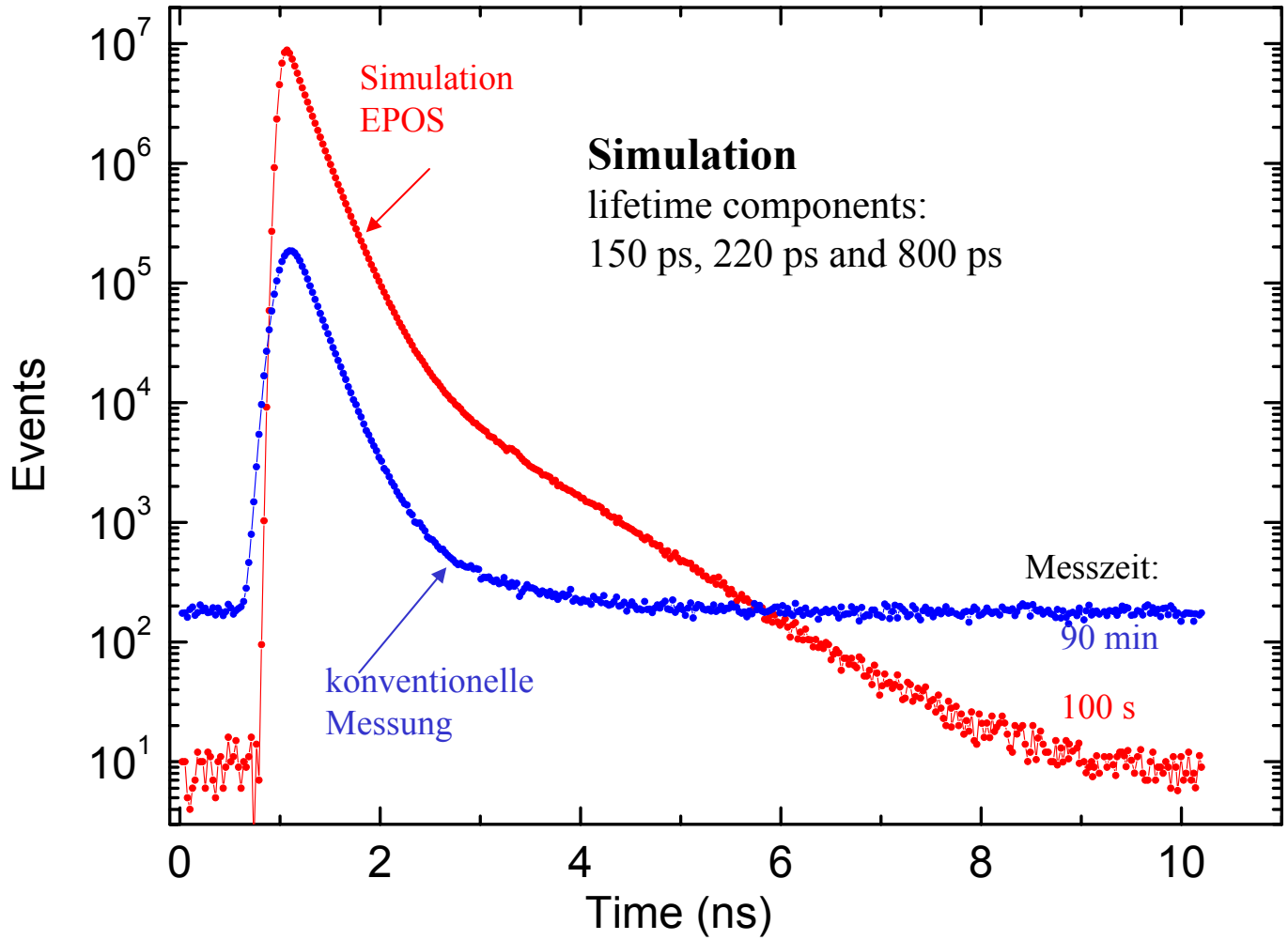




Digitizer:

- > 1 GHz analog band width
- Sample-Rate 2...5 GS/s

- due to coincident lifetime measurement: quality of spectra will be improved



Time Schedule

	1. Year	2. Year	3. Year
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 transport system			
Detector system and software			
Automation			
Software lifetime / Doppler spectra			
Optimization of time resolution			

Conclusions

- Positron annihilation spectroscopy is useful toll for materials science
- intense positron sources needed (> 10^8 e^+/s at sample)
- ELBE Positron Source (EPOS) will combine most positron techniques
- 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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