The (upcoming) digital real-time positron lifetime measurement of EPOS

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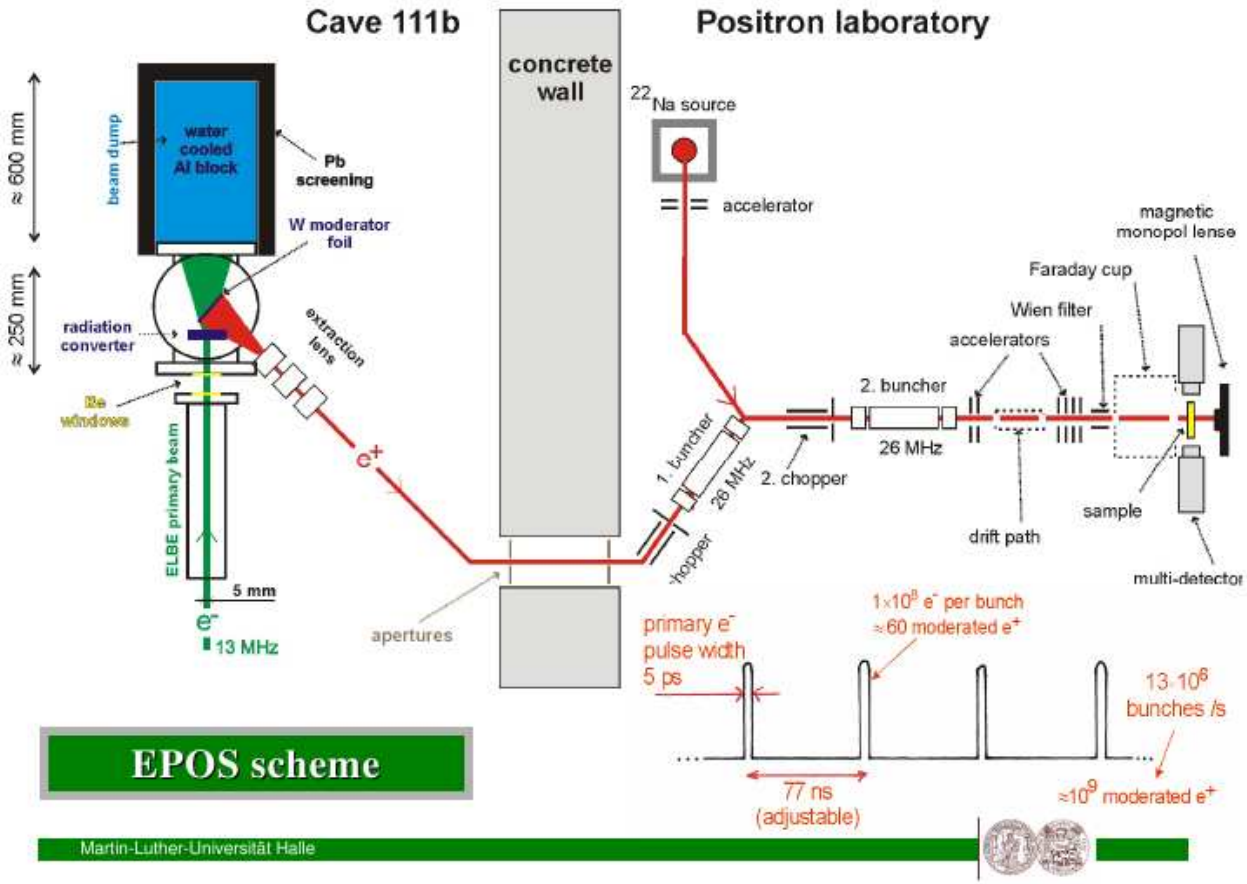
The application of high intensity positron beam techniques and digital lifetime positron spectroscopy in material science, Bergen (Netherlands) 2005

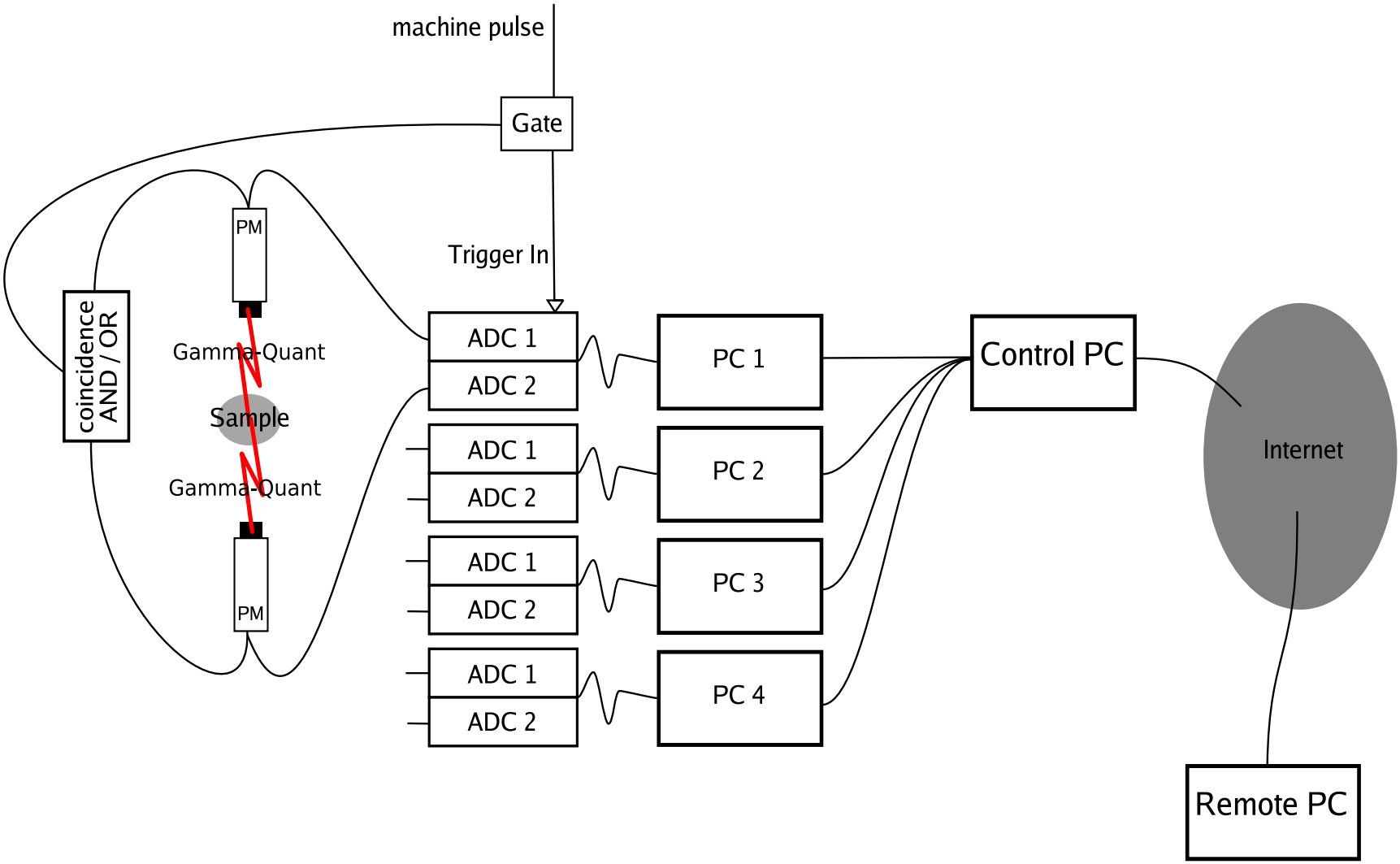
Outline

Hardware:

Starting at yesterdays talk of R. Krause-Rehberg:



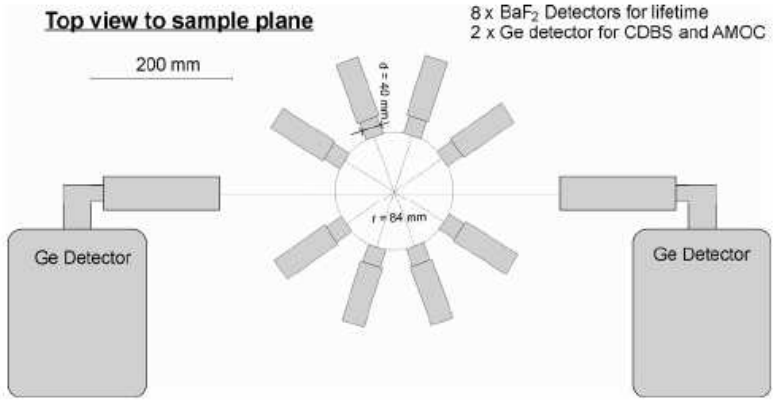
Hardware


machine pulse
Gate
Trigger In
PM
coincidence AND / OR
Gamma-Quant
Sample
Gamma-Quant
PM
ADC 1
ADC 2
ADC 1
ADC 2
ADC 1
ADC 2
ADC 1
ADC 2
PC 1
PC 2
PC 3
PC 4
Control PC
Internet
Remote PC

Hardware: Detectors

8 detectors (BaF_2-SEV + Hamamatsu PM) for lifetime measurement

- two modes of operation:
  - coincidence (AND)
    less background-noise
  - single (OR)
    faster measurement
- 2 additional Ge-detectors for Doppler-measurements



Start-signal from machine-pulse into trigger input of the digitizers (AND-coupled with coincidence).

No detection of the start-impuls → better time resolution compared to conventional systems.

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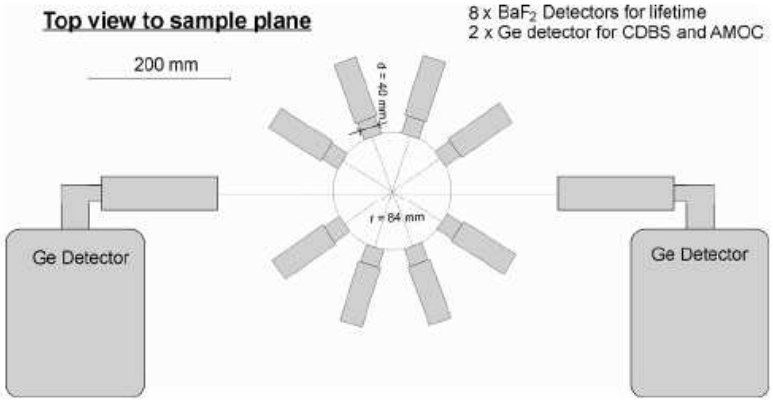

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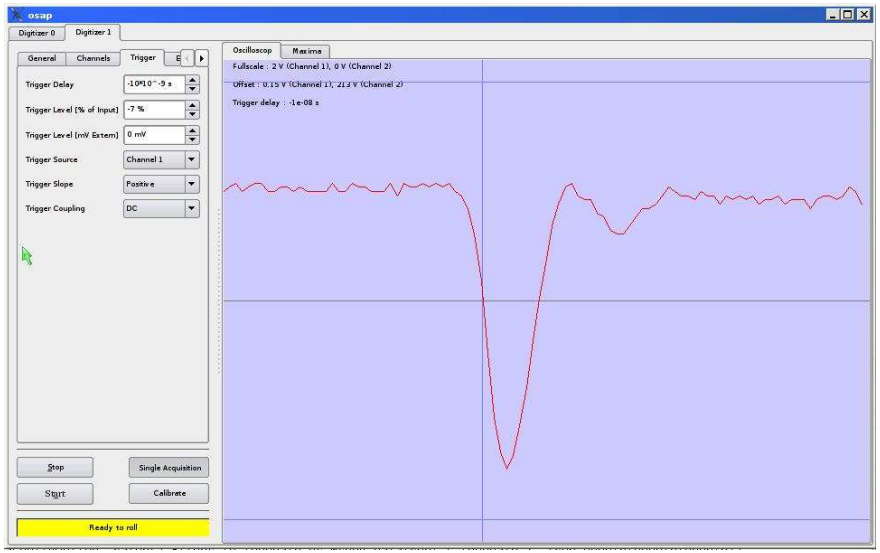
Hardware: Digitizer

- 8 digitizers: Acqiris DC211 - 4GS/s, max. 1GHz input frequency, 8bit vertical resolution
- always two coupled together in one crate to form one 2-channel digitizer

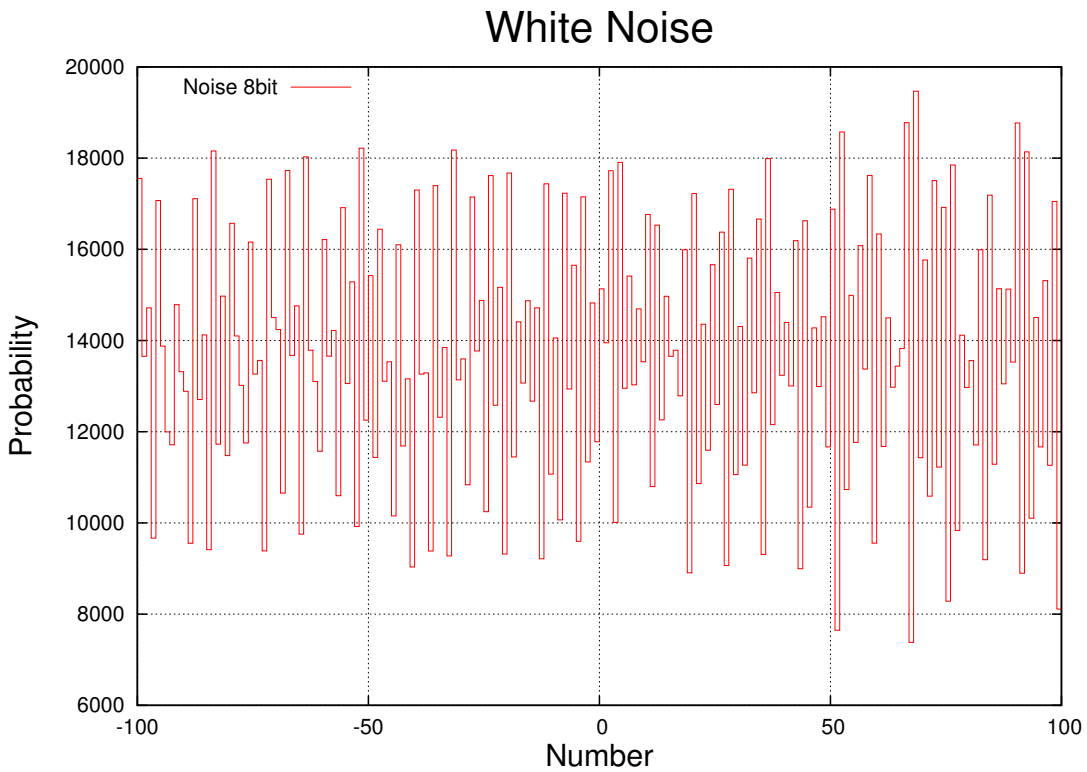
One of four digitizers



Anode-pulse of SEV + PM (of $Na^{22} - \gamma$)

Hardware: Digitizer: Problem of Noise

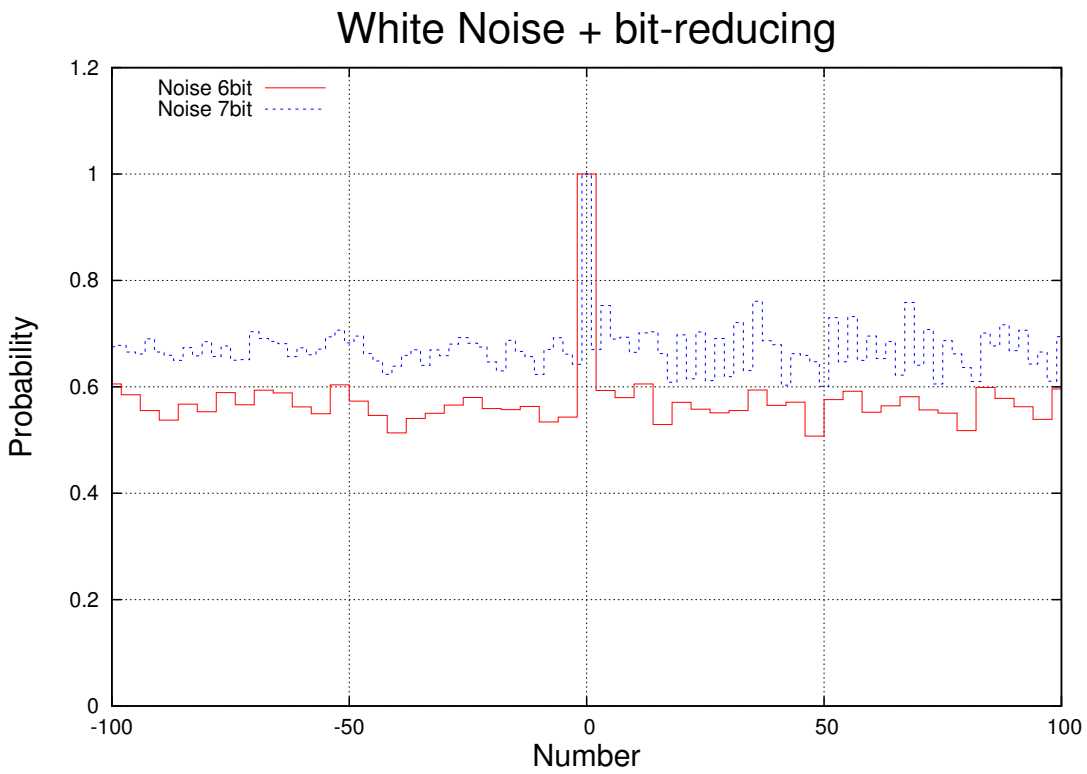
Testing the linearity of the digitizers with White Noise:



Hardware: Digitizer: Problem of Noise

The Problem of Noise

The last 2 bits are noisy but the last bit isn't randomly distributed.



Hardware: Computers

Hardware all the pc's have:

- Dual 2.8GHz Intel© Xeon™
- 4GB RAM
- Gigabit Ethernet

The clients will boot their OS over network.

- Easier system maintainance (Example: Software update)
- Less noise, heat and trouble with hardware

Special hardware of the server:

- Graphics
- 200GB HD (mirrored by RAID1 for data-integrity)

Special hardware of the clients:

- Acquiris Crade with 2 digitizers
- no HD
- no graphics at all

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Hardware: Computers: Operating System

Linux is choosen for the OS - Distribution: “Gentoo”

- The programmer knows Linux far better than Windows
- Windows had problems with hyperthreading and $>$ 2GB RAM and is less optimised
- Better suitable for booting the clients over net
- No expenses for licenses

Acquisation-Software

A homebrewn Laboratory-Software-Suite is needed.
How hard can it be?

Overall needs

- network-transparent
- highly customizable and extendible
- (in parts) accessible via internet

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Acquisation-Software

Several steps to make life easier:

1. divide the apps into server- and client-part
2. invent a simple, yet fast and sophisticated network-communications-protocol
3. use existing tools and apps where possible (mysql for the database and apache+PHP for the webinterface)
4. think about standardized interfaces to replace parts easily

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Acquisation-Software: Clients

Tasks:

- Fetching the data from the digitizers
- Evaluating the data (through exchangable plugins)
- Sending the results over the network to the server

Just simple needs?

- some advanced concepts for plugins
  (more on the analyzer-plugins later on)
- need for total network-transparency
  to remote-control the systems

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Acquisation-Software: Server

Tasks:

- controlling the clients
  - state (on/off, measuring/pausing, etc.)
  - analyzers / filters
  - parameters
- controlling the laboratory
  - vacuum
  - temperature
  - magnetic fields
  - beam
- controlling the measurement
  - sequence / loops / conditions

Acquisation-Software

Fulfilling these tasks gets easier by using complicated plugin-concepts.

Plugins will be used for: Analyzers, Filters, Modifiers, data acquisation, data-display and -export, etc...

Acquisation-Software: Analyzers

What is the aim of the analyzer-plugin-concept?

- An interface to plug different methods of analysation into the chain of data-acquisation.
- and to replug them without recompiling the apps
- ...and even without restarting the apps
- analyzers can also make use of filters

Acquisation-Software: Analyzers

Currently planned analyzer-plugins:

- Lifetime - Implementing constant fraction or integral constant fraction to measure positron-lifetime
  (as described by [Poggi, 2003] or [Becvar, 2004])
- Doppler - To measure the doppler-broadening
- other debugging analyzers like:
  - noise
  - oscilloscope
  - first sample
  - etc...

Conclusion

Contact us if you are interested in joining the development.
arnold.krille@gmail.com or a.krille@fz-rossendorf.de

Get the slides at http://positron.physik.uni-halle.de/

Literature

F. Becvar, J. Cizek, I.Prochazka, J. Janotova
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NIM A 539 (2005) 372-385

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