STT front-end electronics

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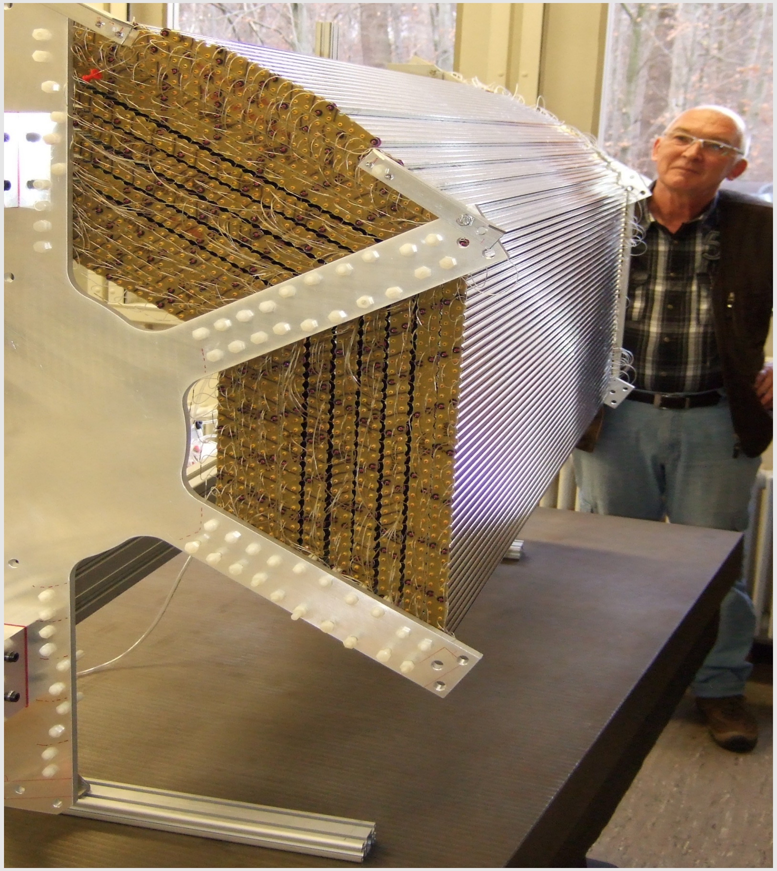

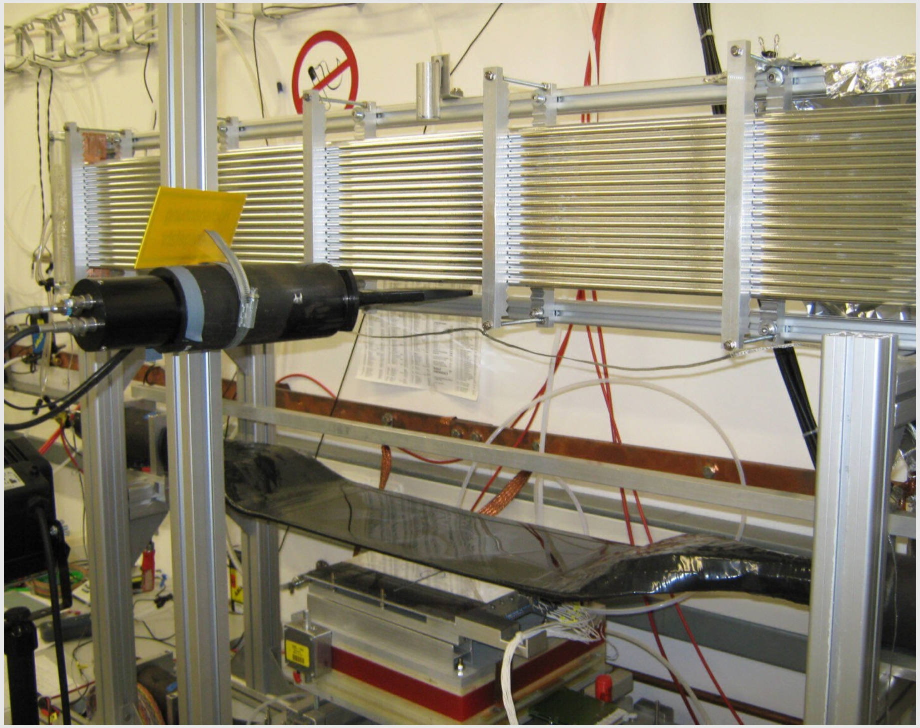

STT Activities

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Overview

- Introduction
- STT - design, requirements
- *Particle identification dE/dx method*
- Work plan
- Test setup detectors / electronics
- Achievements
- Summary
- Outlook (planed tasks)

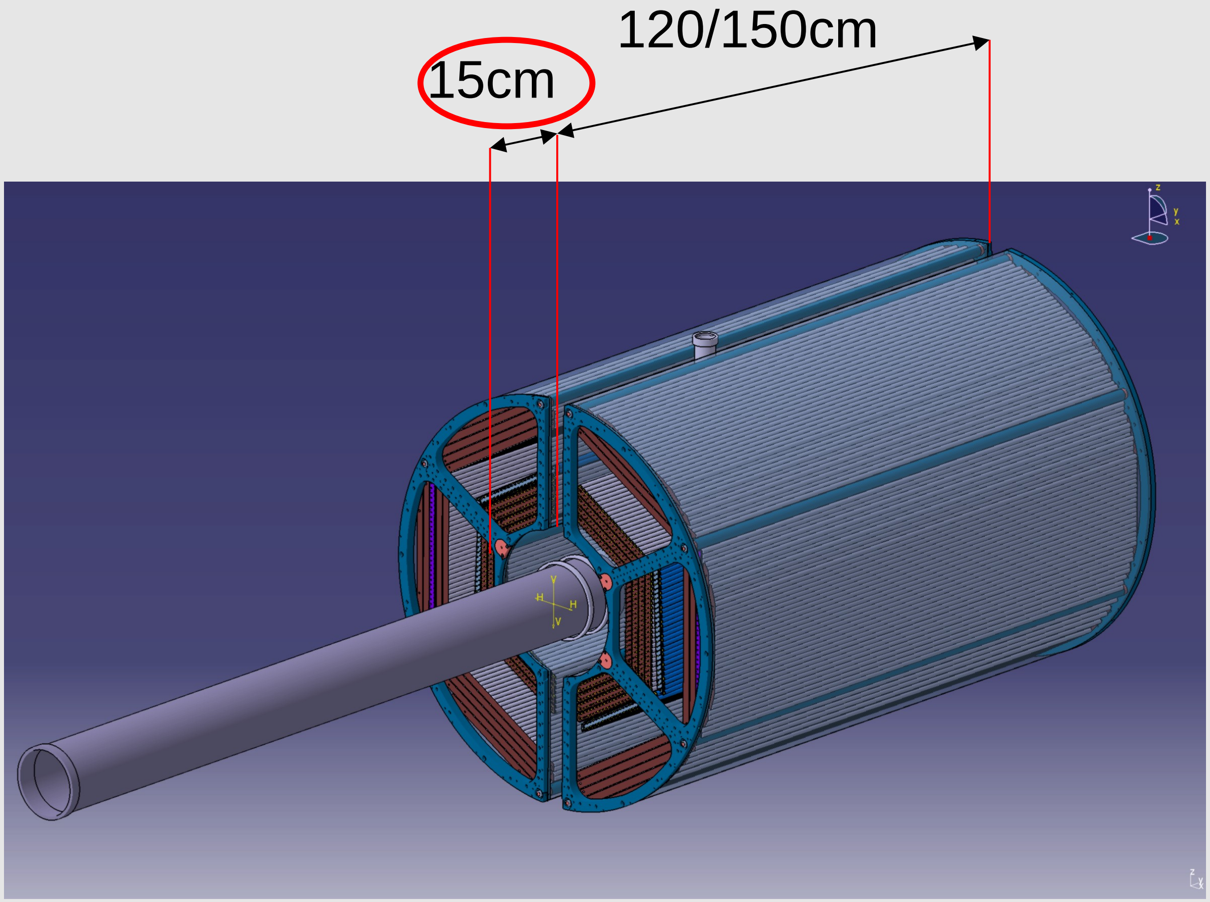
STT Design

2 semi-barrels around beam-target cross-pipe

- **light-weight frame structure (Dario)**
- **self-supporting straw layers**

Supply & readout

- **15cm longitud. space for**
- **electric straw contacting**
- **gas manifolds/ supply**
- **cable routing**
- **readout boards ???**



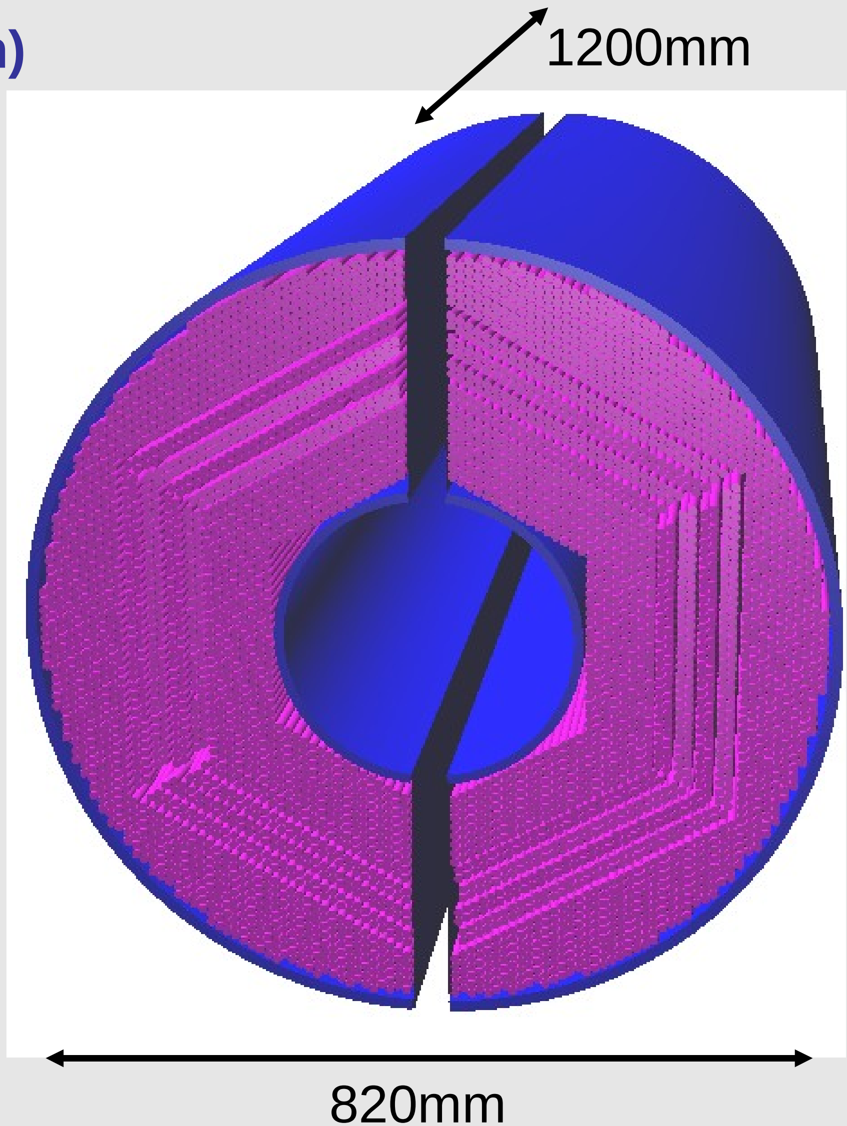
Drawings and design by Dario (INFN Frascati)

STT Design

4200 straws

- **20-26 planar layers in 6 sectors (hexagon)**
- **8 skewed layers (±3°) for 3d-reco**
- **~80% (85)% active volume**
- **Ar/CO_2 at p ~ 2 bar**
- **high efficiency**
- **dE/dx capability -particle identification**

  $\sigma_{r\varphi}$ ~ 150 µm
- **σ_z ~ 2.9 mm**
- **X/X_0 ~ 1%**



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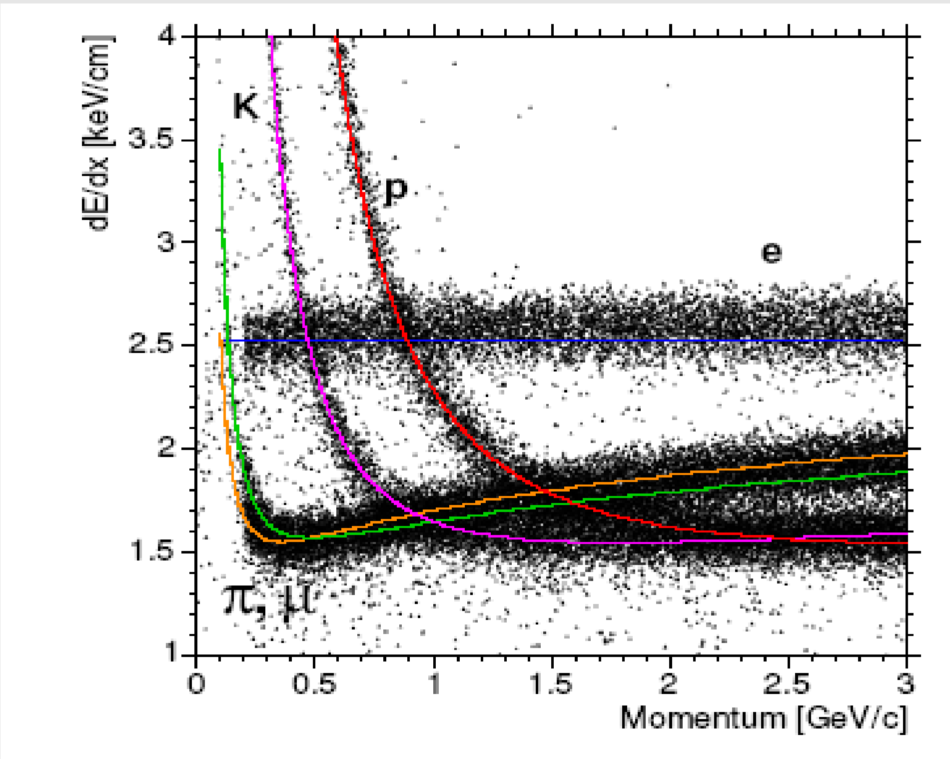
dE/dx

dE/dx(p) identification curves.



Energies and path length must be measured precisely

Main task of SST is a precise determination of the tracks → fast response, short time signal

On the other side: energy measurement requires longer charge collection time and signal processing

Can both requirements be fulfilled at the same time ?
What information from signals are needed ?

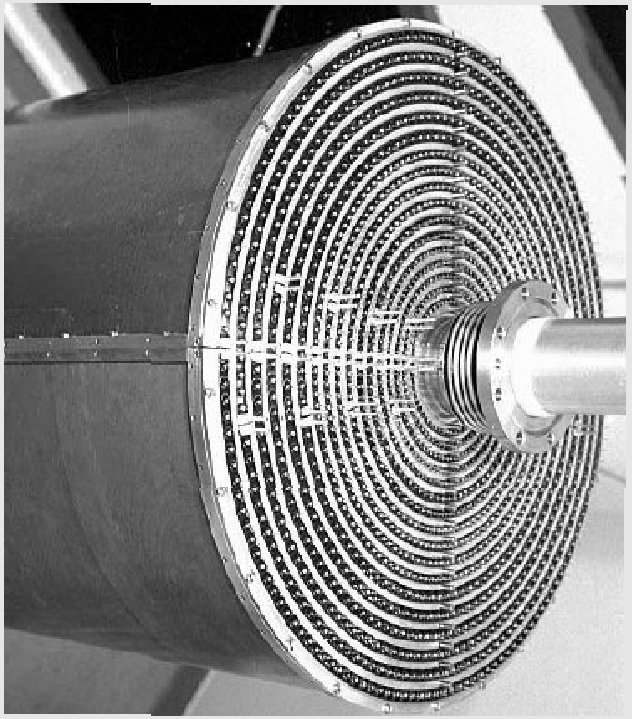
- > requirements for front-end electronics

What we have to do

- Experimental check of energy resolution
- Provide correlated data for simulations
  - Offline signal analysis - > front-end requirement
  - Track reconstructions, calibration method...
- Tests of “environmental” conditions
  - cabels, coupling, HV, gas mixture, gas pressure, stability, rate behaviour
- Test with COSY beam
  - Readout options (n-XYTER, MSGCROC ....)

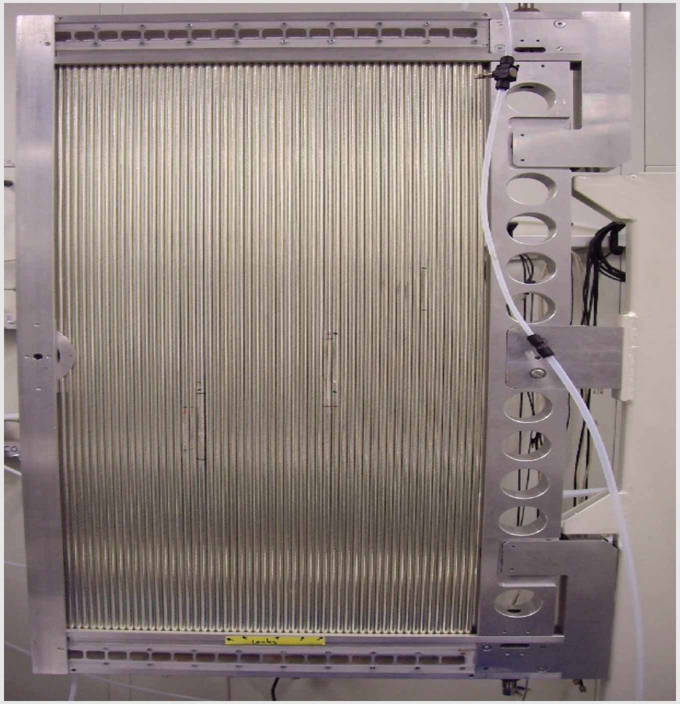
WASA trackers

MDC



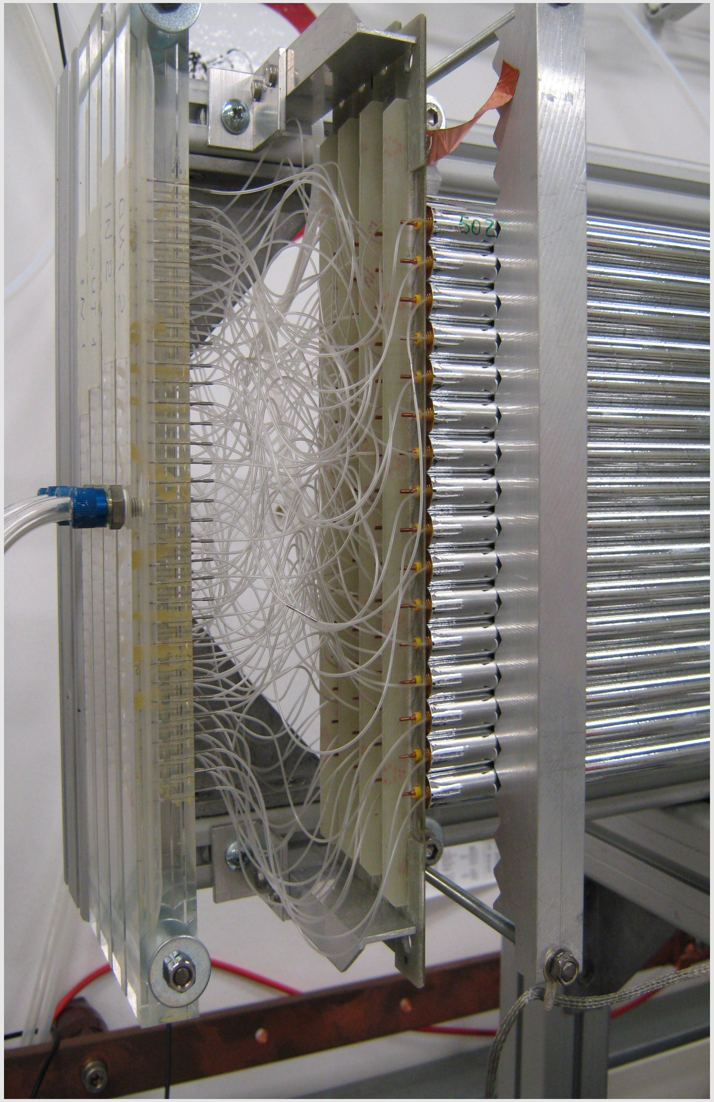
- ~17 layers
- ~ 2000 channels
- Coax cables: signals(HV)

FPC



- 8 modules
- 4 layers per module
- ~ 2000 tubes in total

Test setup – detectors

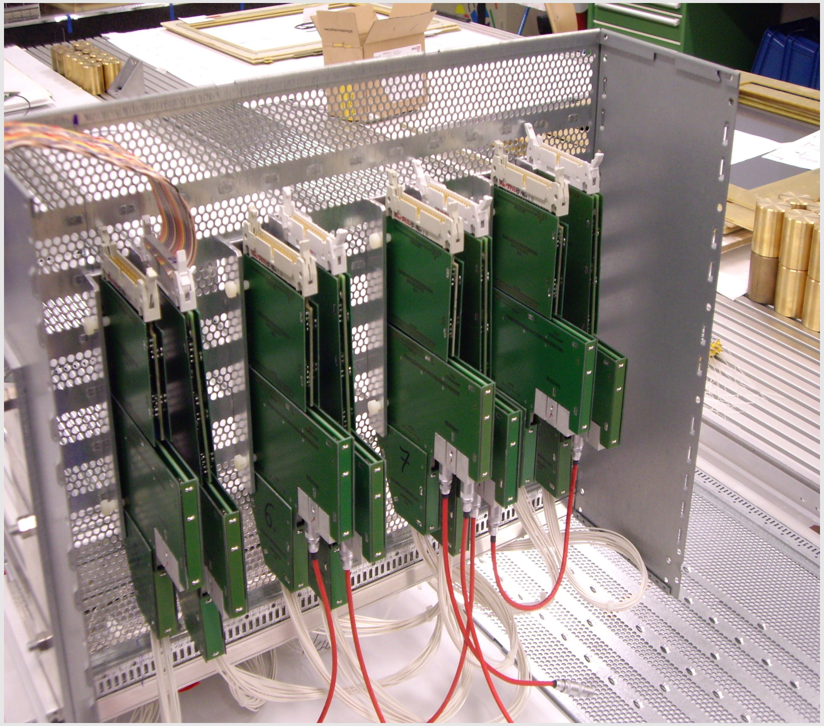


1.5 m long Φ 10 mm

30 μm wall thickness

20 μm anode wire

overpressure (1 bar)



Ar/CO2 (90/10), Ar/C2H6 (80/20)

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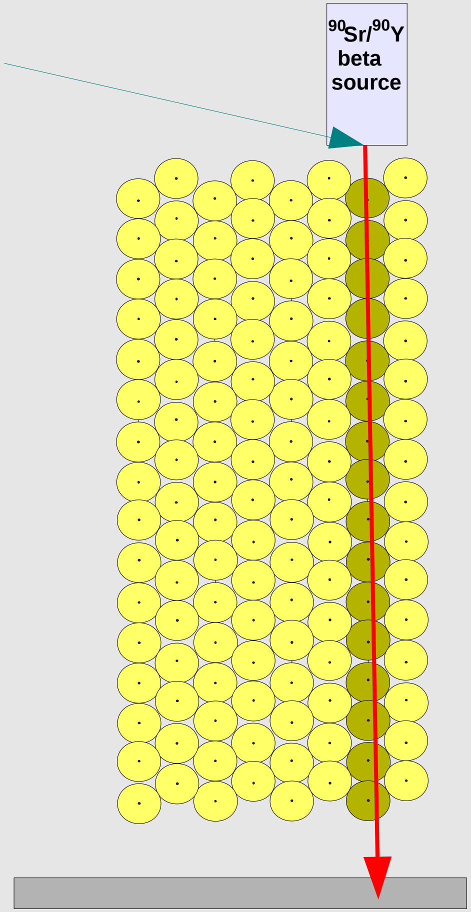
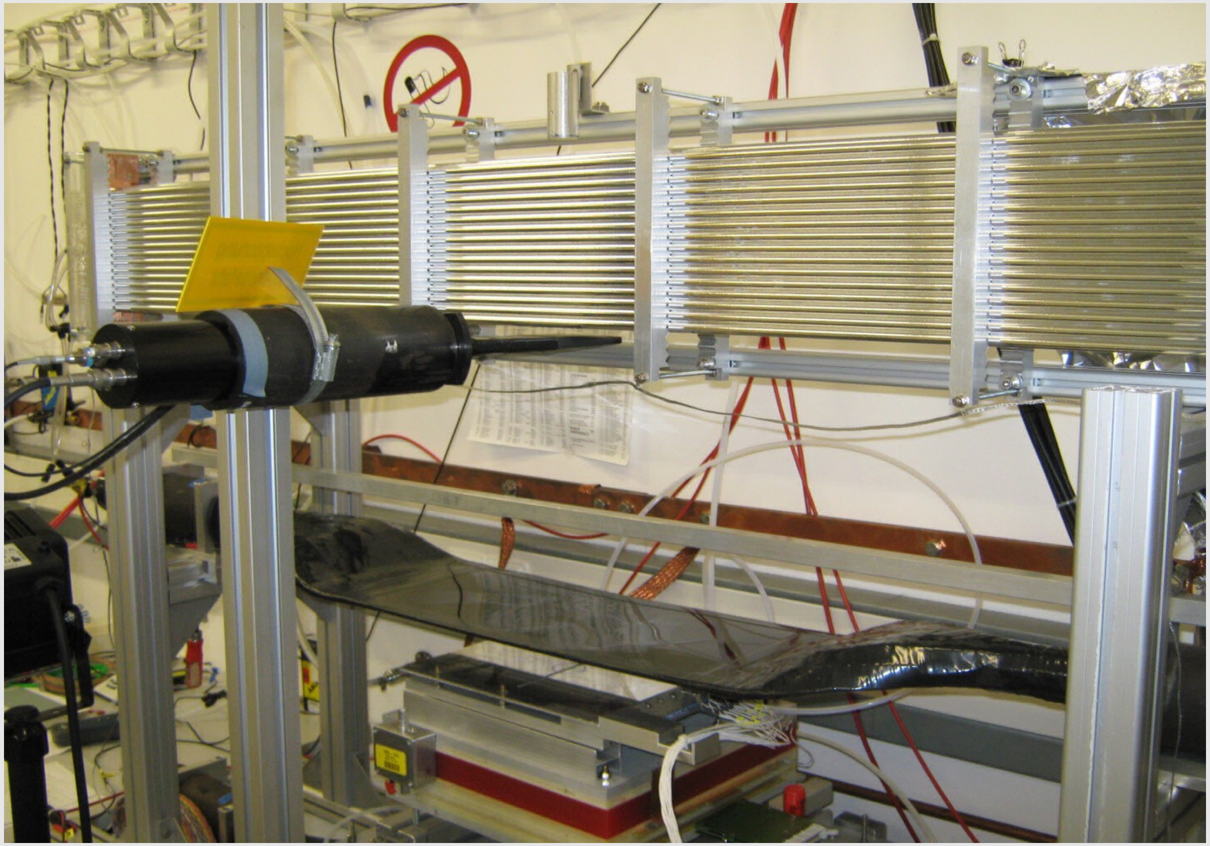
Test setup – detectors



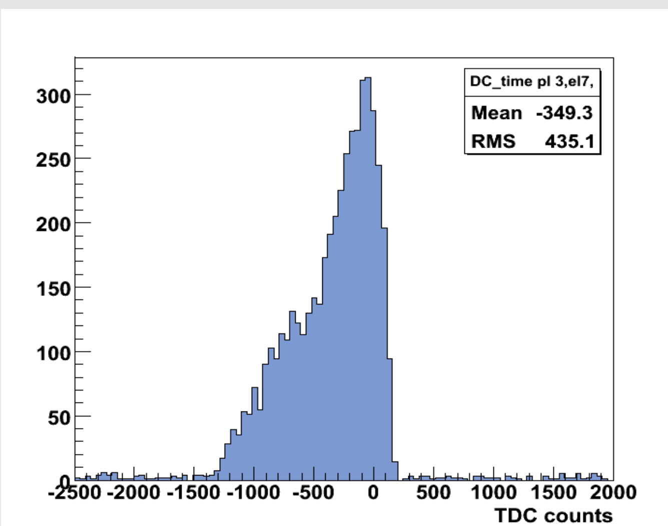


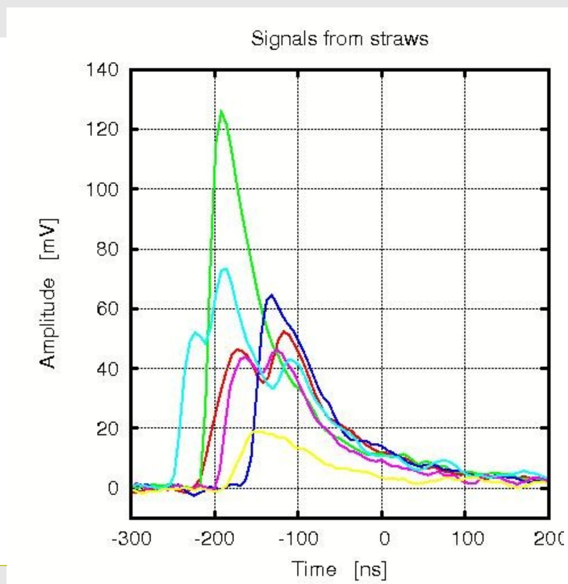
Test setup electronics

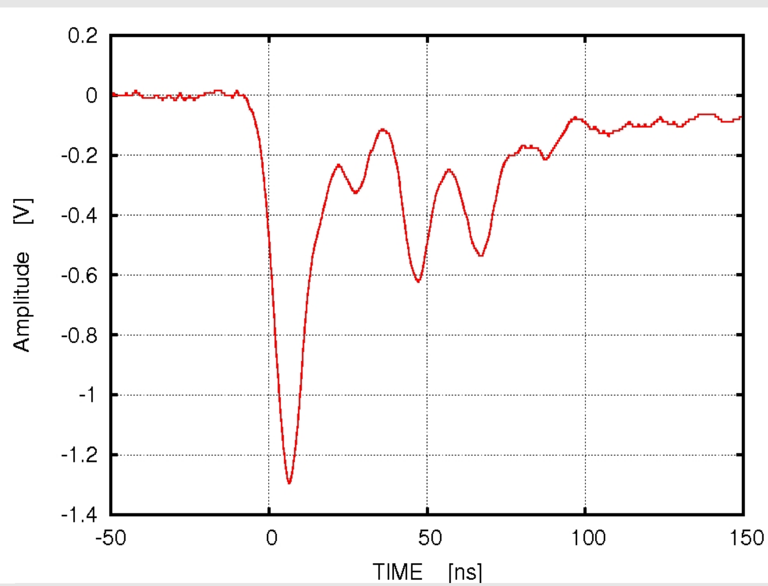
- Time measurements

  CMP16 (amp.,disc. 1-2 ns) (CMS) + F1 TDC (120ps /bin)
- Energy measurements

  amp. + “QDC” (160 MHz flash ADC) from WASA
- Scope







P.Kulessa STT front-end electronics...

CMP16

- CMP16 – ampl/discr chip
  - 16 channels per chip
  - Wide threshold range
  - Time resolution ~1-2ns
  - In use at ANKE and WASA (COSY) for drift chambers

TDC

- F1
  - 64 channels per board
  - Time binning ~120ps
  - In use at ANKE / WASA for drift chambers

Amplifier

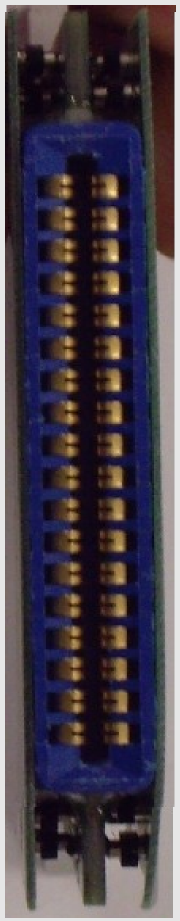
- 16 channels per board
- Rise time 6ns
- Develop for detector tests at WASA
- Compatible with CMP16 and F1/QDC system
    - Same connectors, power supply ..

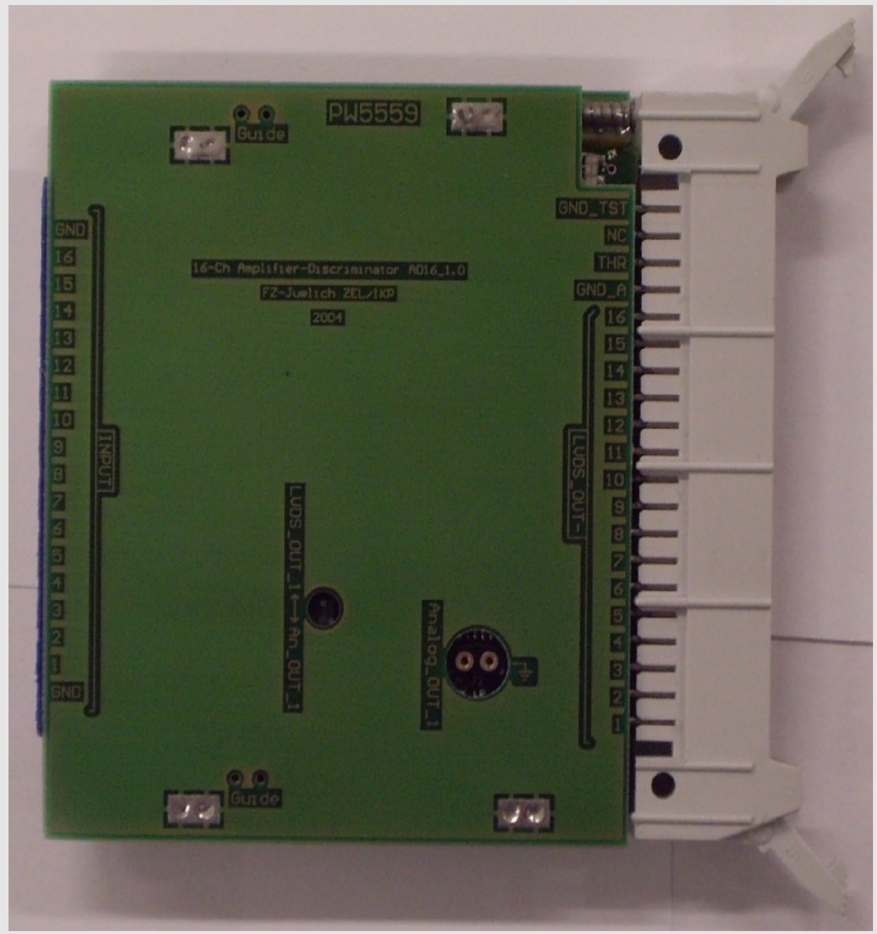
“QDC” - flash ADC

- 160 MHz   (WASA),   240 MHz version in test phase
- ADC MAX1213, 12bit resolution (+/- 0,4V)
- 16 channels per board
- FPGA – signal analysis, data reduction, in/out,
- Trigger
  - external (module (NIM) or crate controller – LVD bus)
  - Internal from pulse analysis — self triggering
  - Output for other modules possible
- Raw data (window size and offset 6 μs) – scope mode
- Analysis data: signal time, amplitude, integral (fixed, float), mean, time over threshold …)
- Possibility to provide continuously data to other module e.g. trigger decision

CMP16

DETECTOR

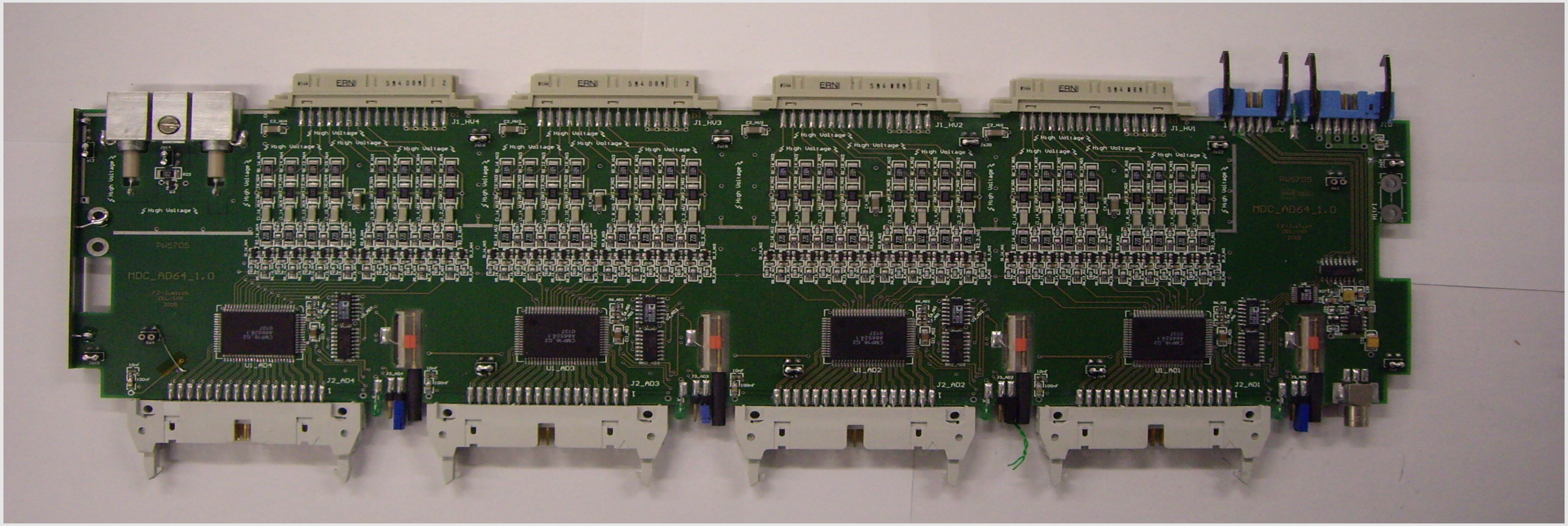




LV
THR
TEST
LVDS

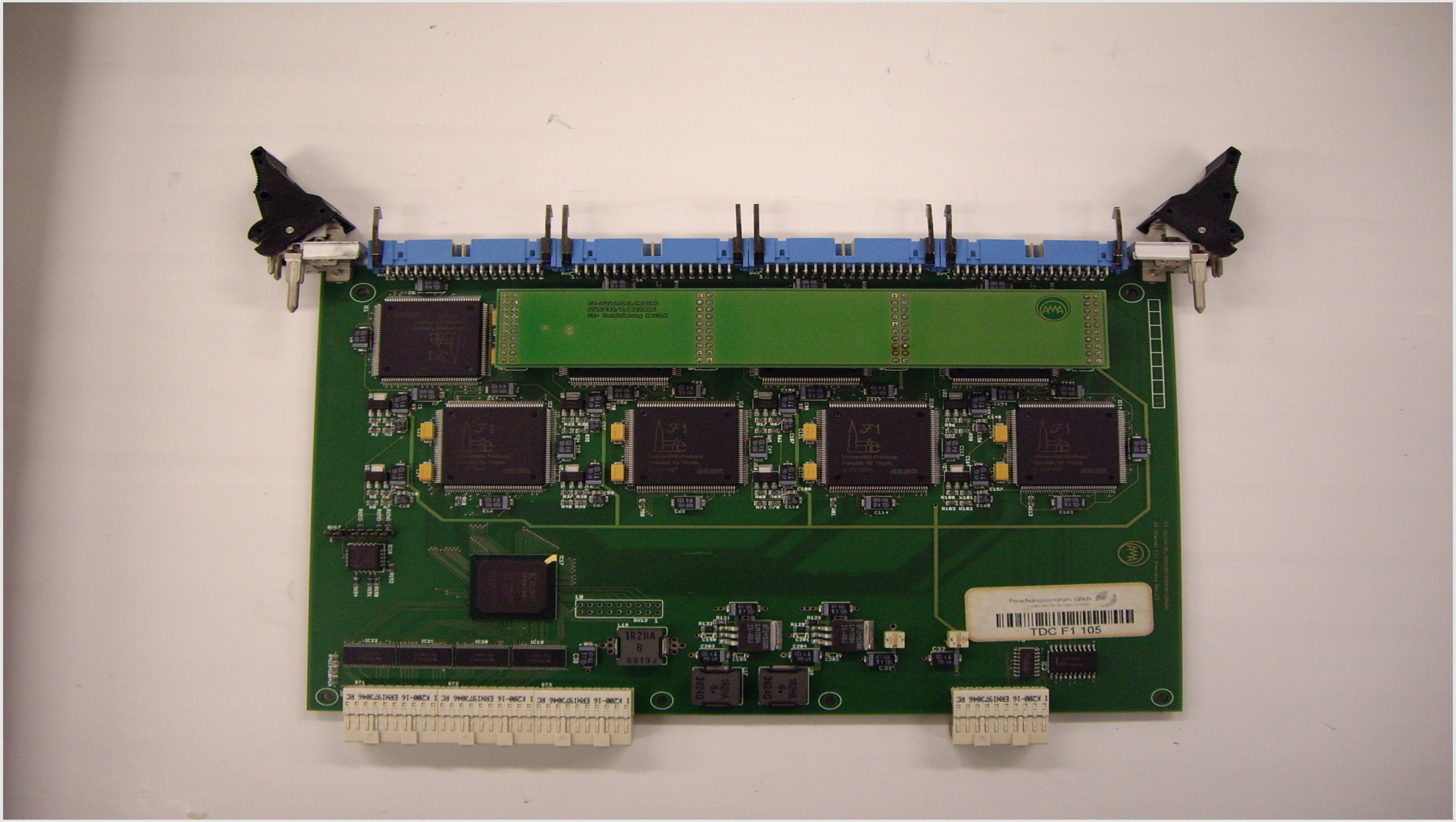
16 channels - ANKE

CMP16



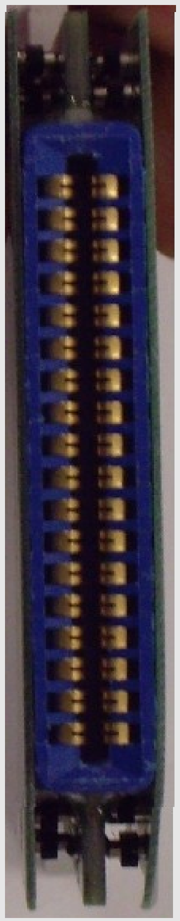
4x16 channels with HV decoupling WASA

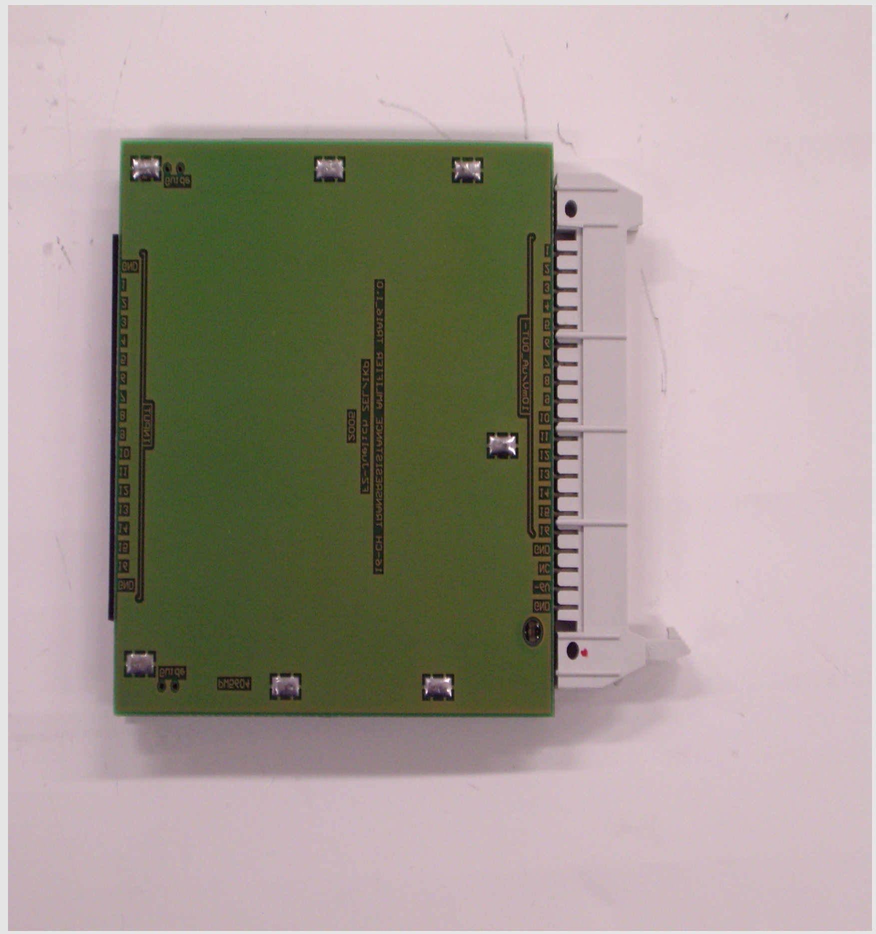
F1



Amplifier

DETECTOR

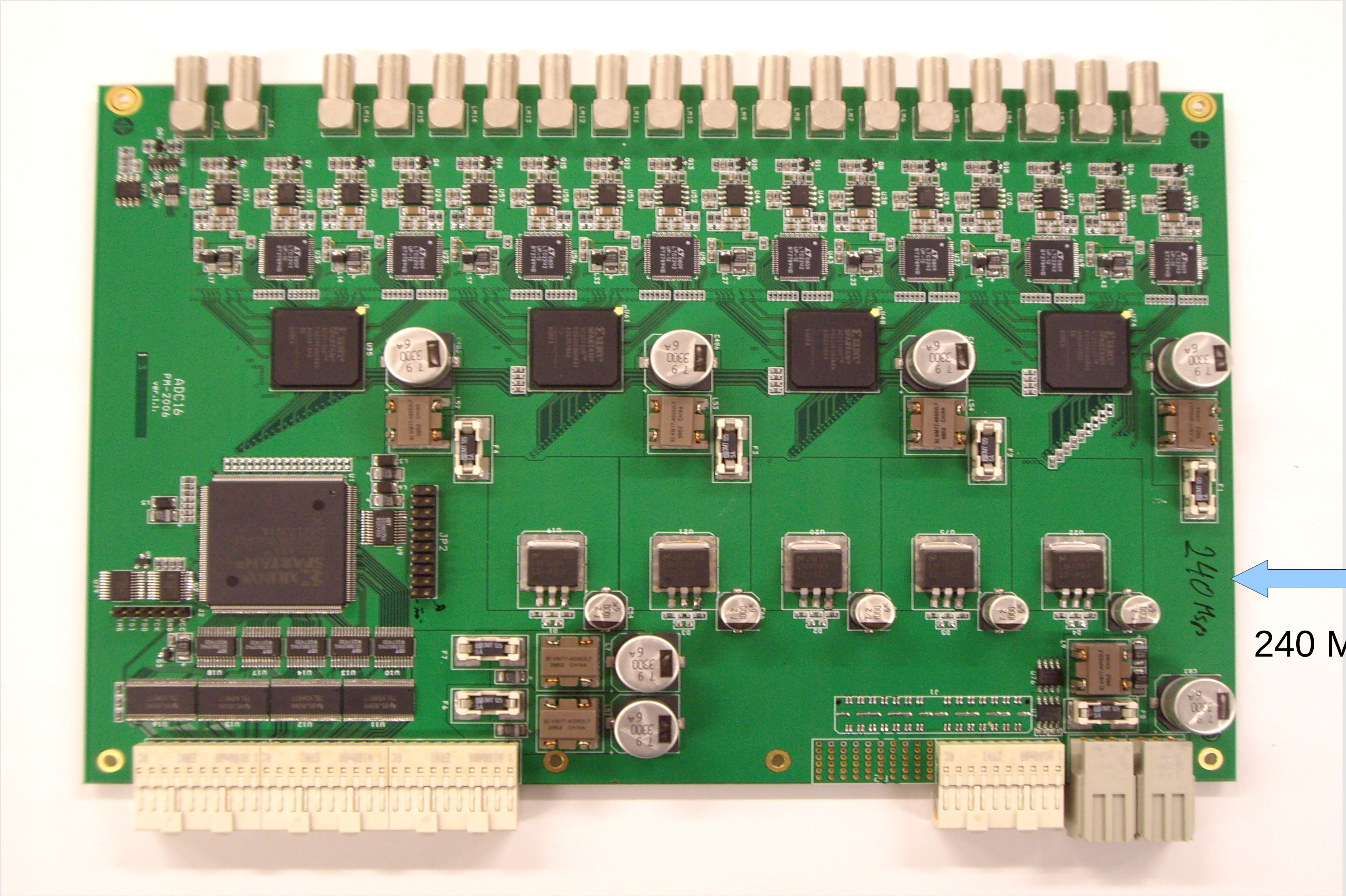




LV
Sign.

16 channels

“QDC”



240 MHz

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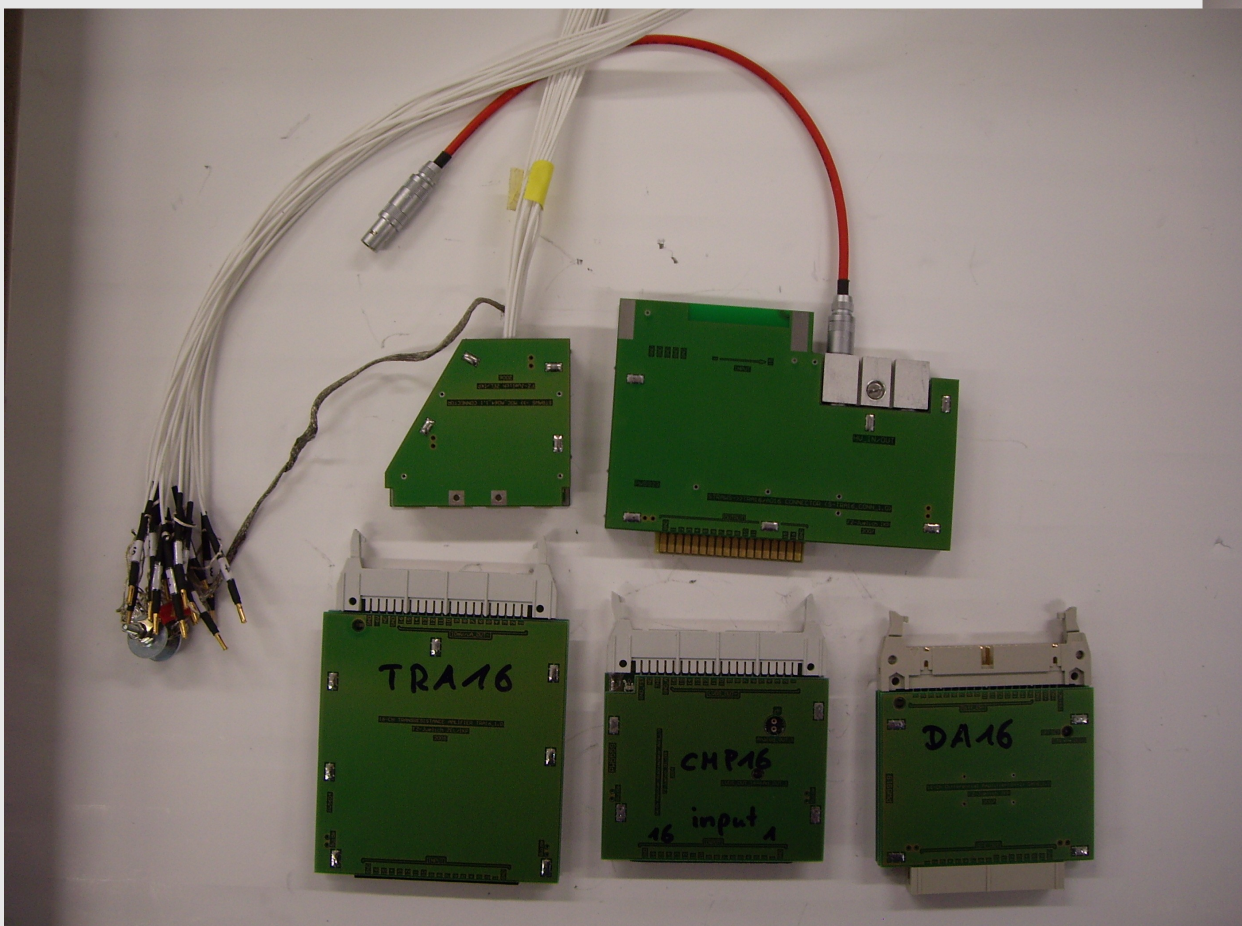
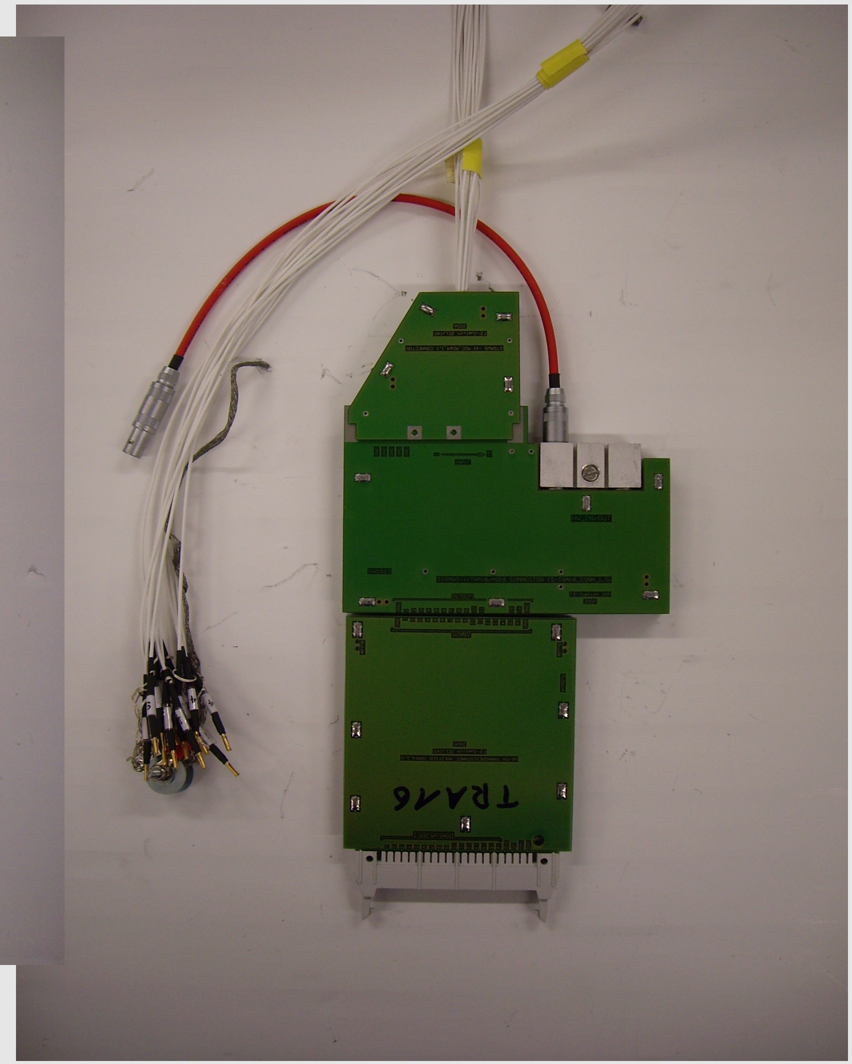
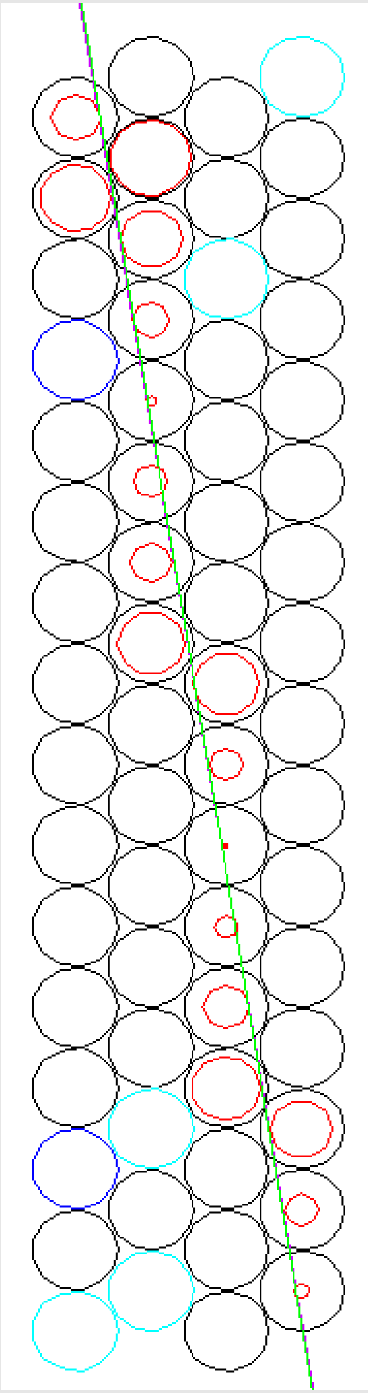
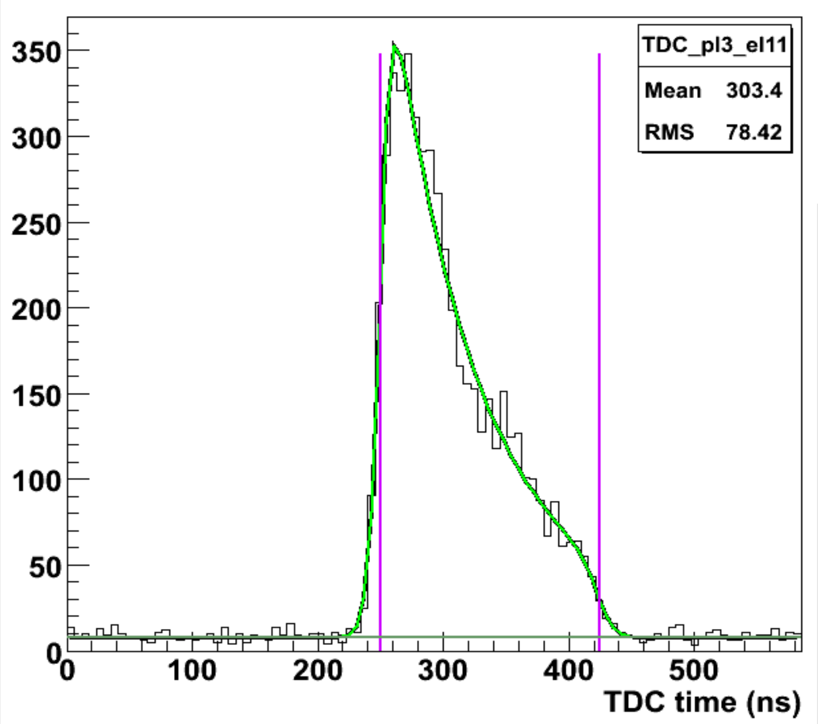
Modular Setup - our toys

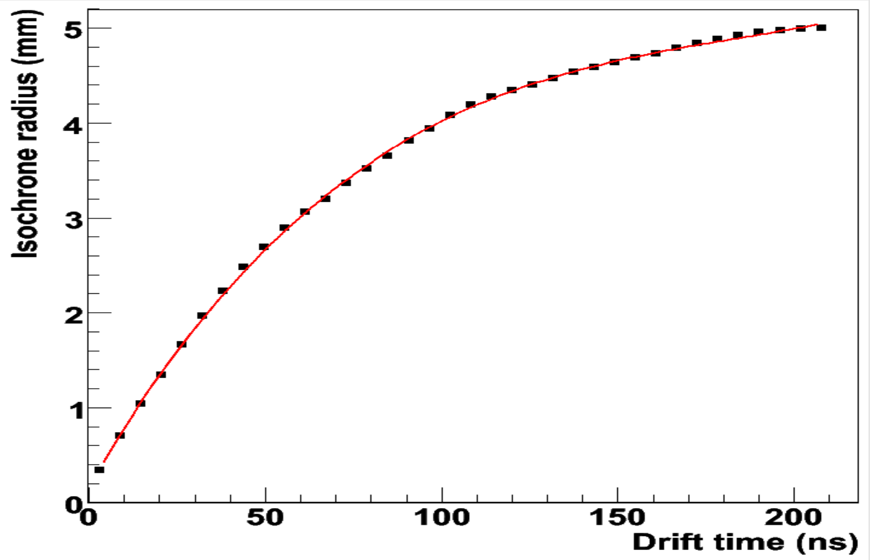


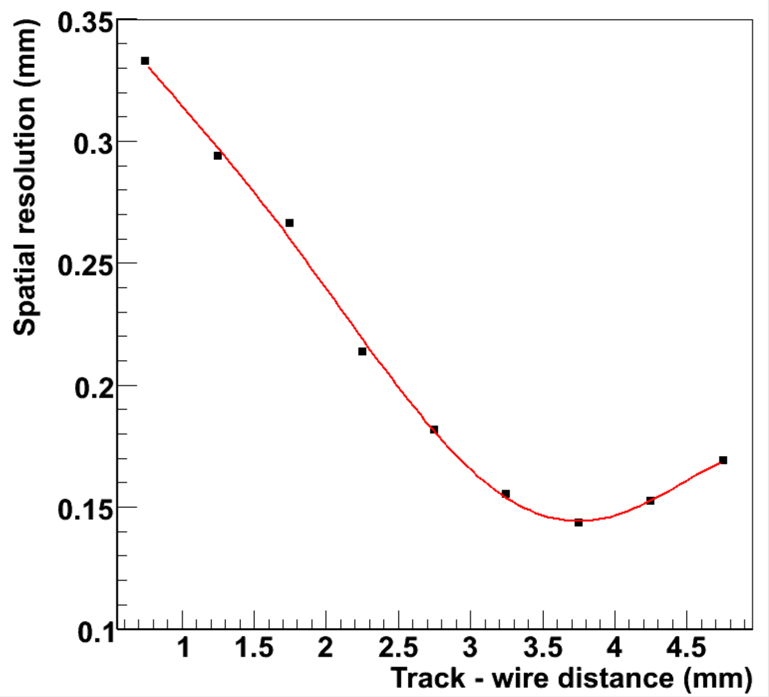


“TDC tracking”









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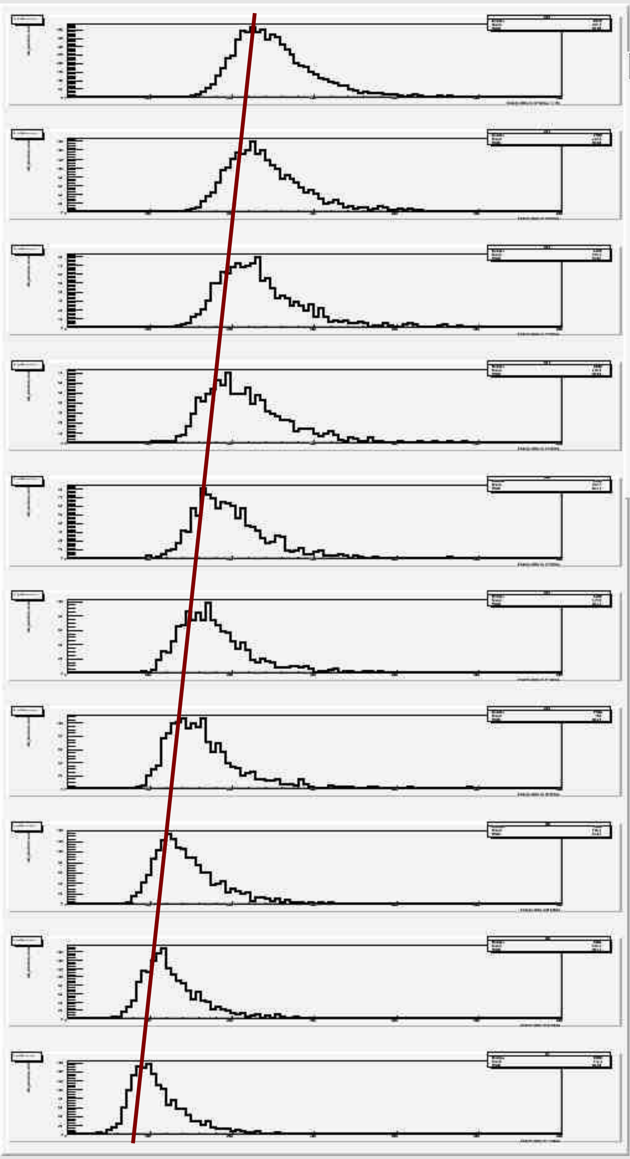
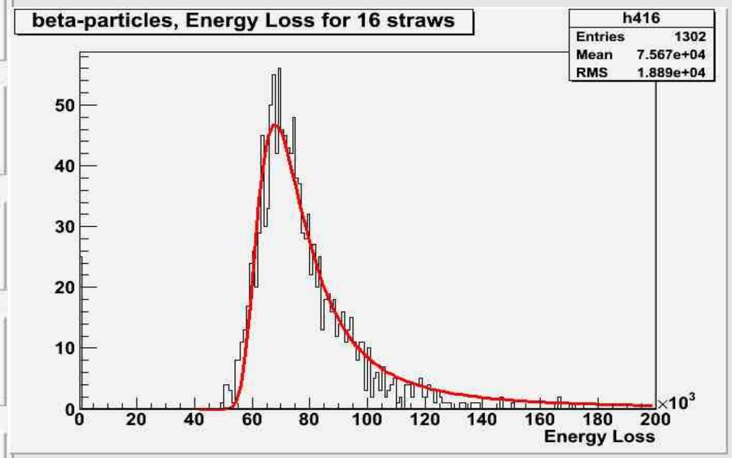
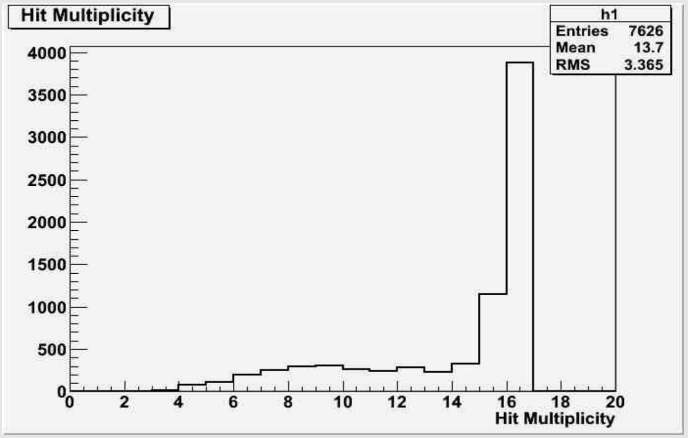
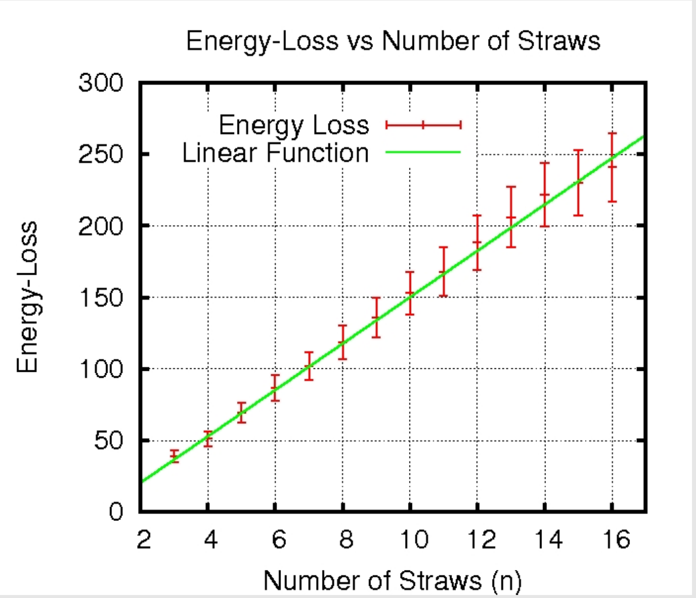
DE with "QDC"









P.Kulessa STT front-end electronics...

Summary

- Straws ready for tests (Peter Wintz)
- First test measurements of energy loss done (minimum-ionizing beta particles from 90(Sr/Y) source
- Preparation of 128 straw setup ready
- CMP16/F1 available, 240 MHz “QDC” in test phase
- Both side readout will be possible – comparison TDC/”QDC”
- First path length reconstruction (Susanna Costanza)
- First test of particle “identification power“ with different methods: time over threshold, cluster counting, truncation, signal integration … (Krzysztof Pysz)
- “QDC” data for simulation available

Outlook

- Test of the detector and electronics setup
- Different configuration test (readout, discriminators, amplifier,coupling ...)
- Preparation for tests with COSY beam
- Tests with MSGCROC in preparation (needed for WASA MDC studies)
  - Developed for Micro-Strip Gas Chambers , 32 channel with variable gain, both signal polarity, self triggering, 2ns time stamps, amplitude readout, up to 900kHz per channel
  - PCB design ready, prototype production, HV decoupling almost ready, slow control available - ZEL FZJ
- Data taking with different settings (gas, HV, energy) for algorithms, simulation and electronics development.
- Final goal:
  - Particle identification with STT
  - Definition of requirements for STT front-end electronics and DAQ
  - Integration in common PANDA DAQ