
First beam test of dE/dx resolution in STT

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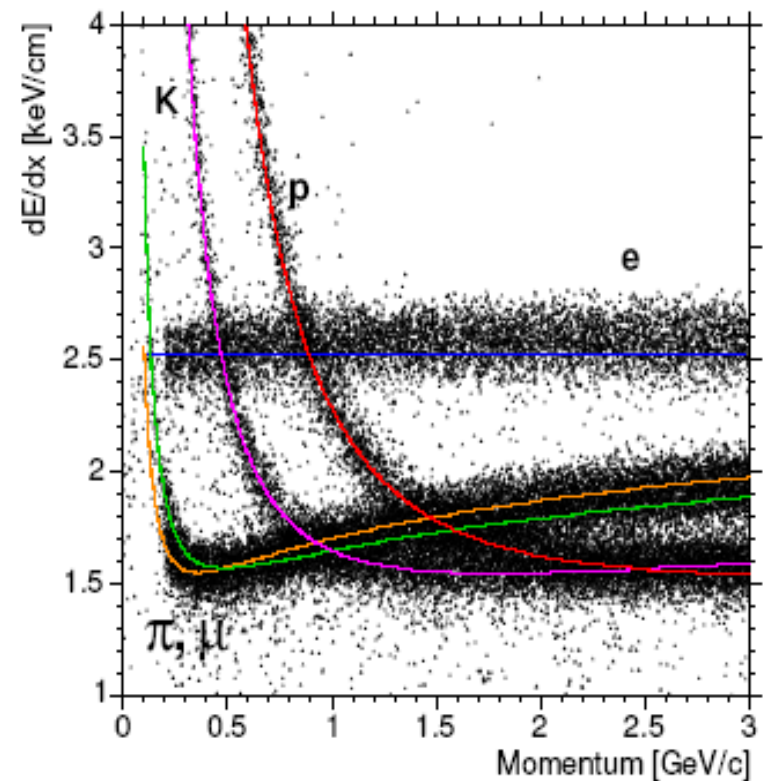
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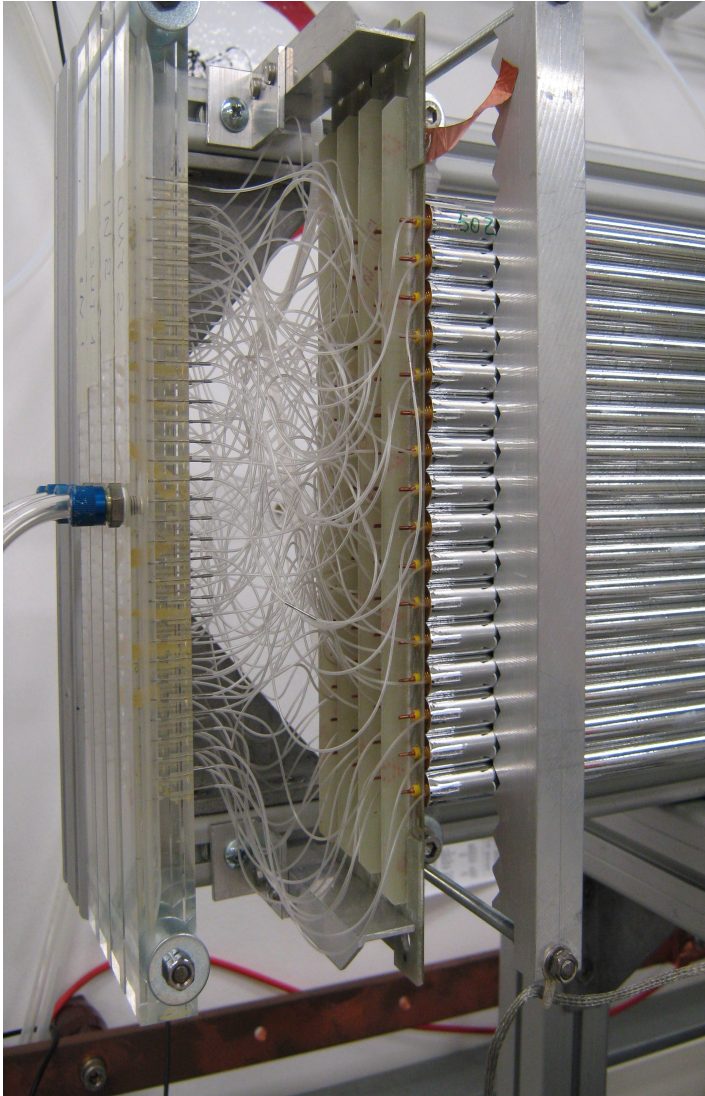
reminder - AIMS

Aims:

- experimental check of the achievable energy-loss resolution in the Straw Tube Tracker,
- optimization of the detector working conditions, read-out electronics and data treatment in order to apply the particle identification method based on dE/dx .



reminder – STT test setup



8 layers with 16 tubes each

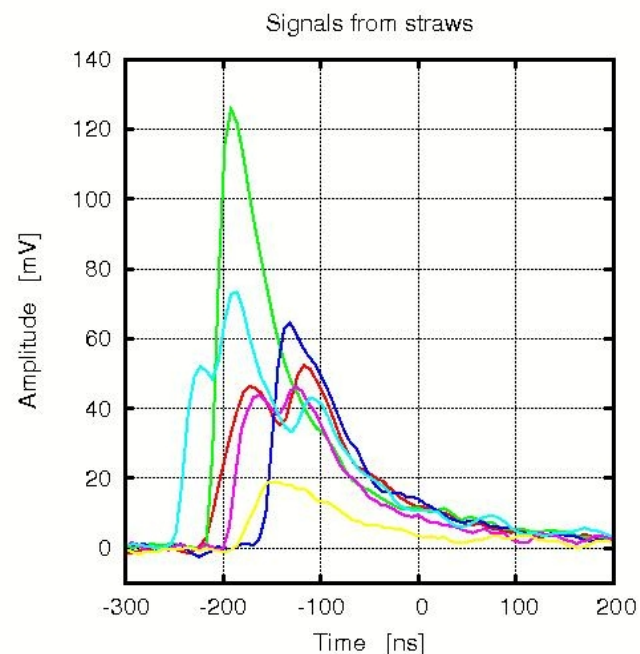
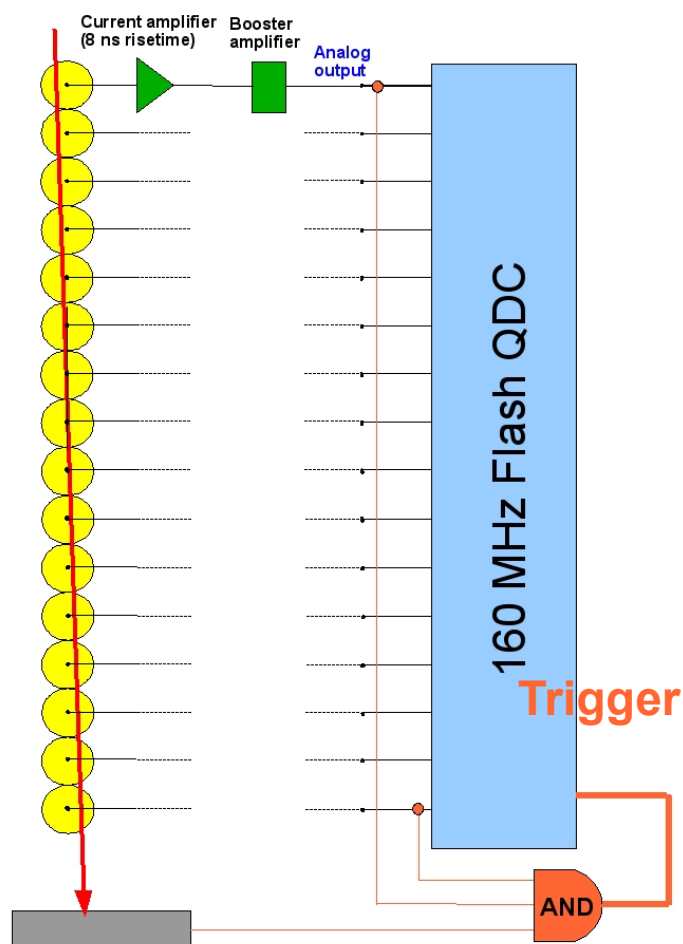
Tubes:

- **1.5 m long**
- **Φ 10 mm**
- **30 μm wall thickness**
- **20 μm anode wire**
- **operated at overpressure (1 bar)**
- **mixtures: Ar/CO₂ (90/10), Ar/C₂H₆ (80/20)**

reminder – measurement with beta particles

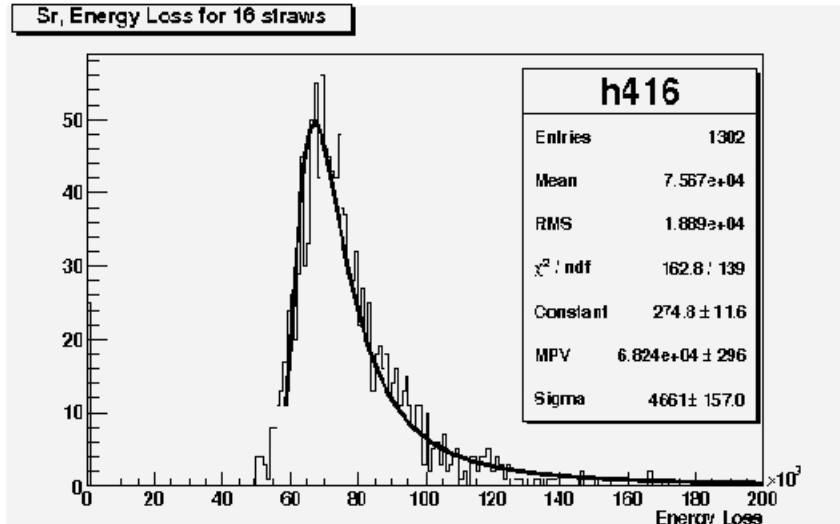
$^{90}\text{Sr}/^{90}\text{Y}$ beta source

16-channel, 160 MHz flash-ADC
6.25 ns sampling time

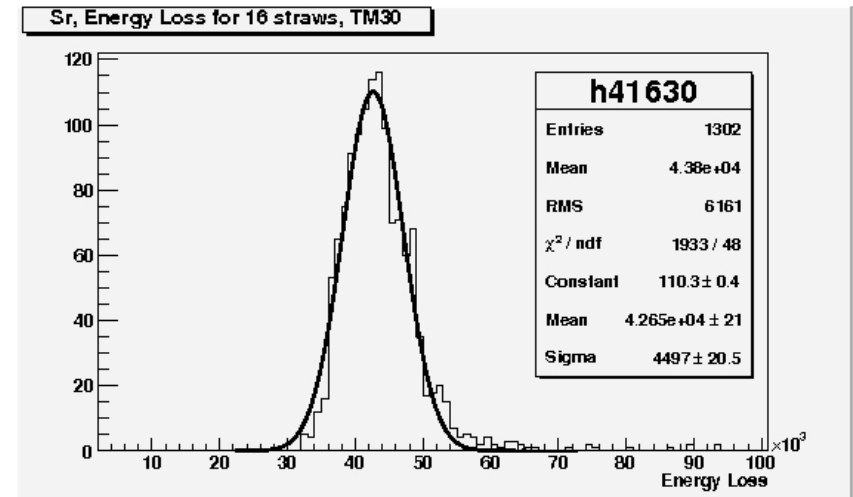


- check of multiplicity,
- signal integration,
- truncation mean,
- energy loss distribution

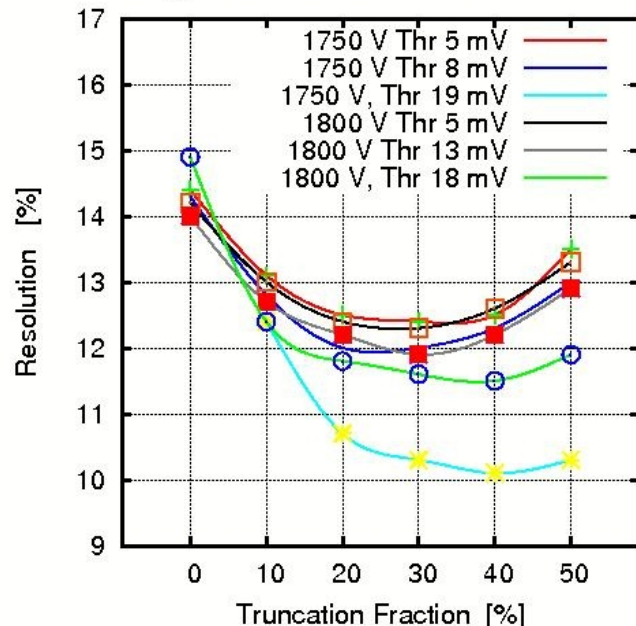
reminder – results for electrons



TM
→



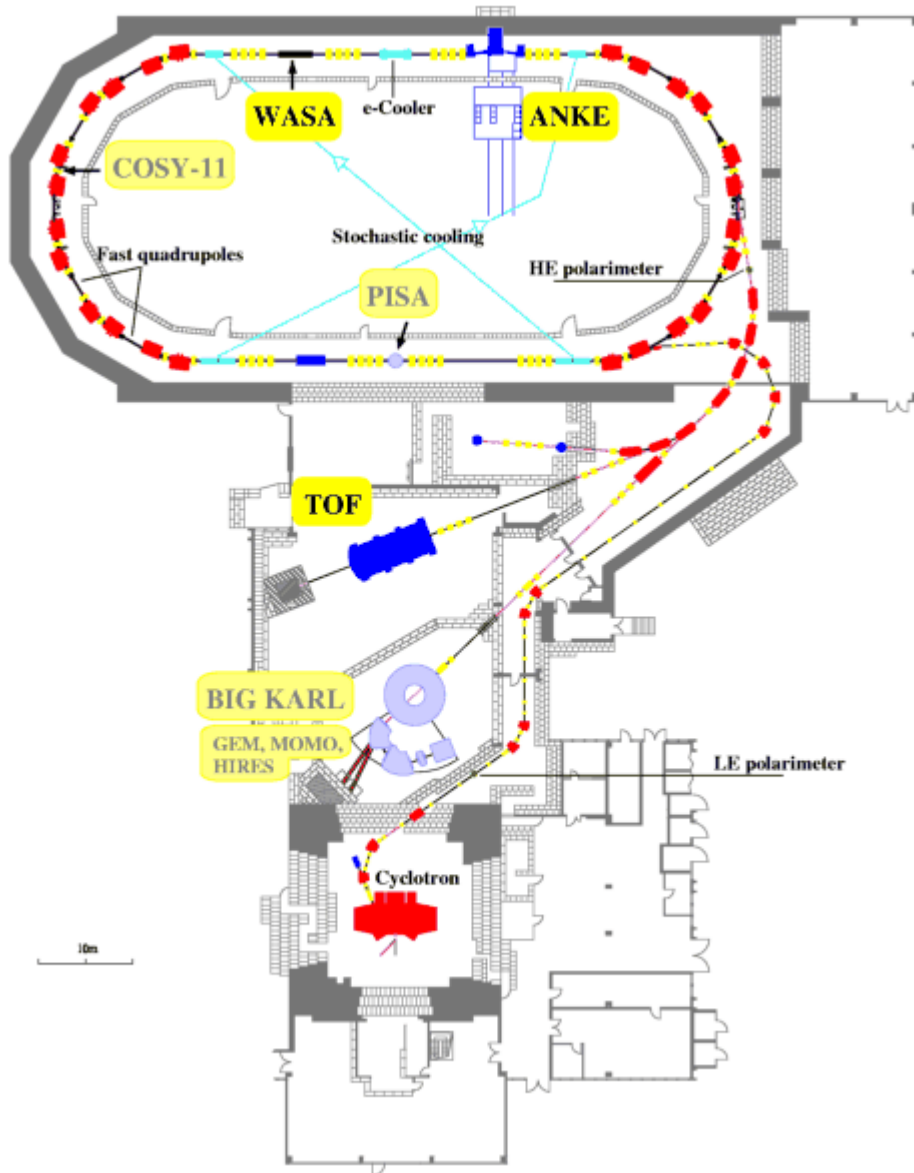
Energy-loss resolution with Truncation Mean



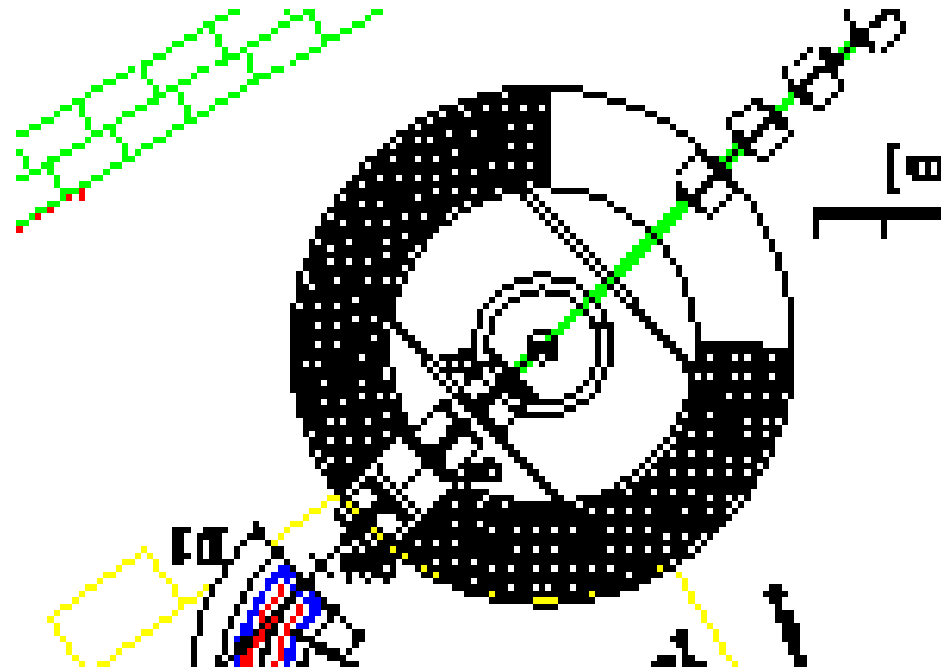
For 16 firing straws and for truncation of 30 – 40 % the obtained **dE resolution** was **~ 10 %**

Still without tracking and path corrections !

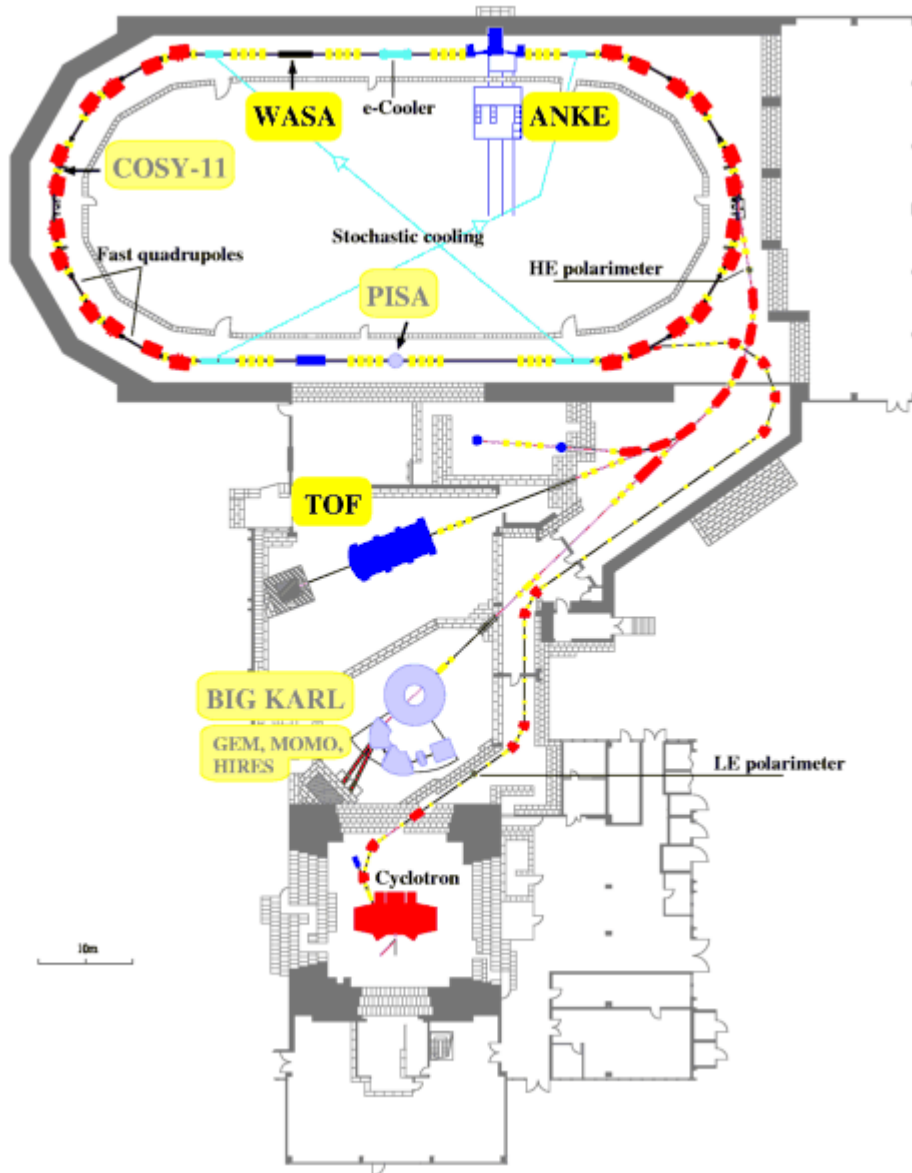
BEAM TEST- place



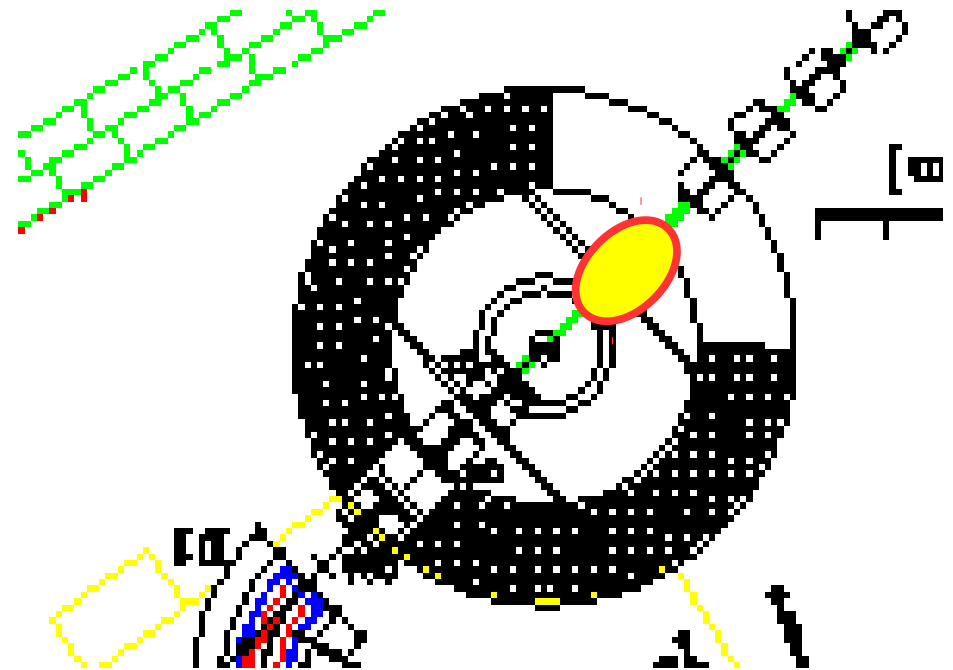
TEST PLACE at BIG KARL



BEAM TEST- place



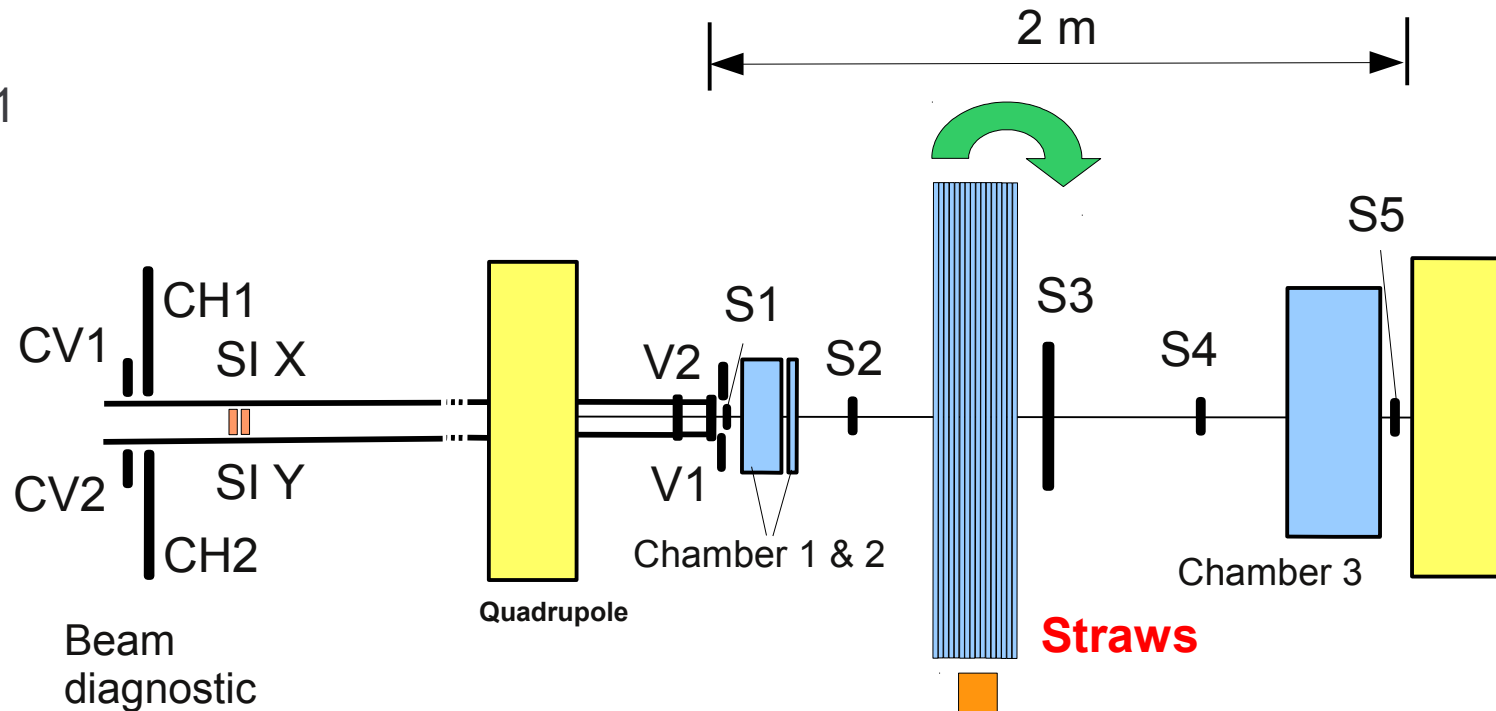
TEST PLACE at BIG KARL



- proton/deuteron beam
- energy: 0.4 - 2.6 GeV
- intensity: $10^3 - 10^9$

BEAM TEST- setup

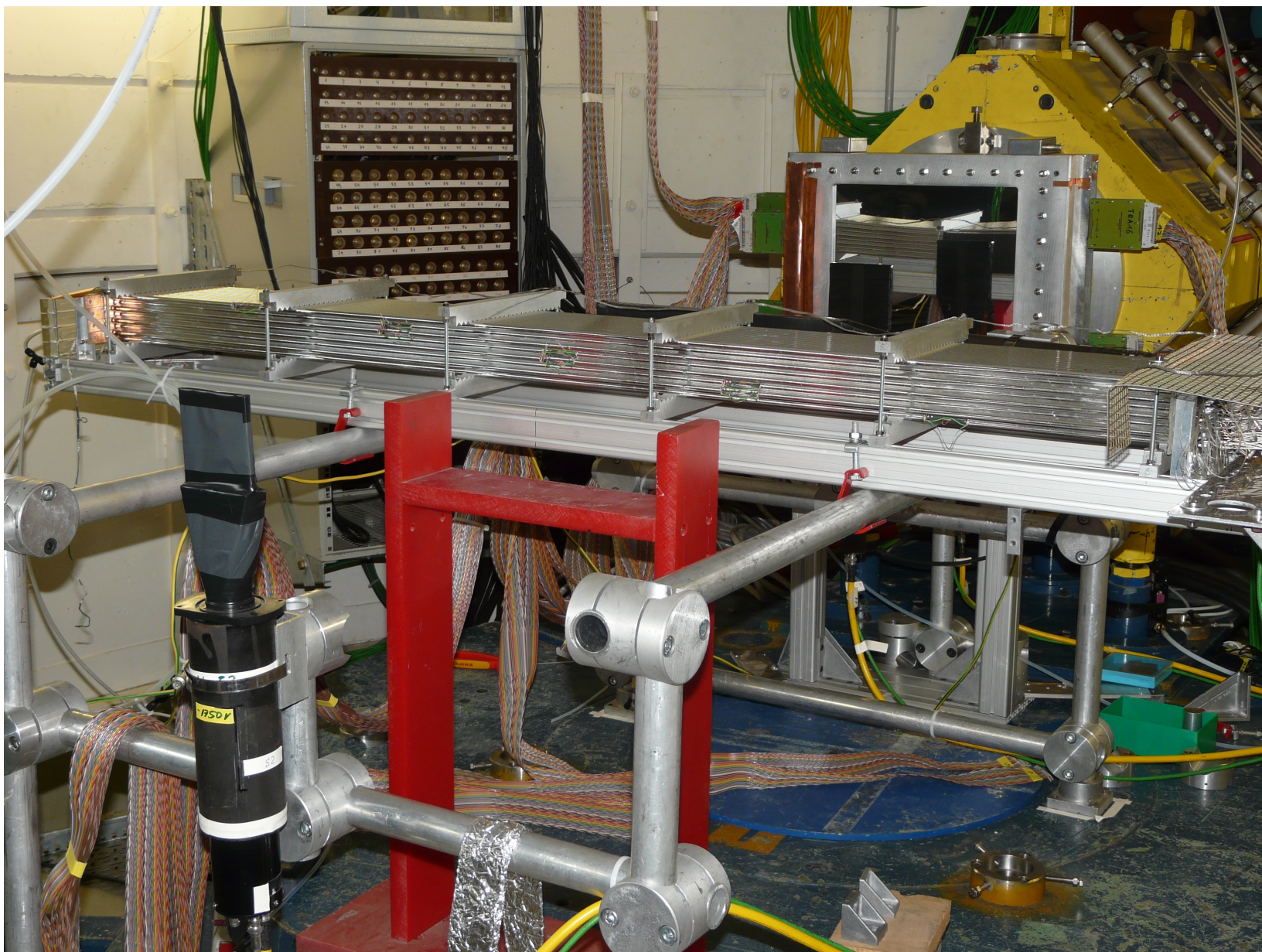
Nov., 20 - 21



- S1-S5** – trigger scintillators
- V1,V2** – veto scintillator
- Chamber 1** - drift chamber with GEM readout
- Chamber 2** - set of 4 mm diameter straw tubes (X direction position sensitive)
- Chamber 3** - drift chamber (X- and Y position sensitive)

240 MHz Flash ADC
4.17 ns sampling time
1.17 ns “threshold time” resolution

BEAM TEST- setup



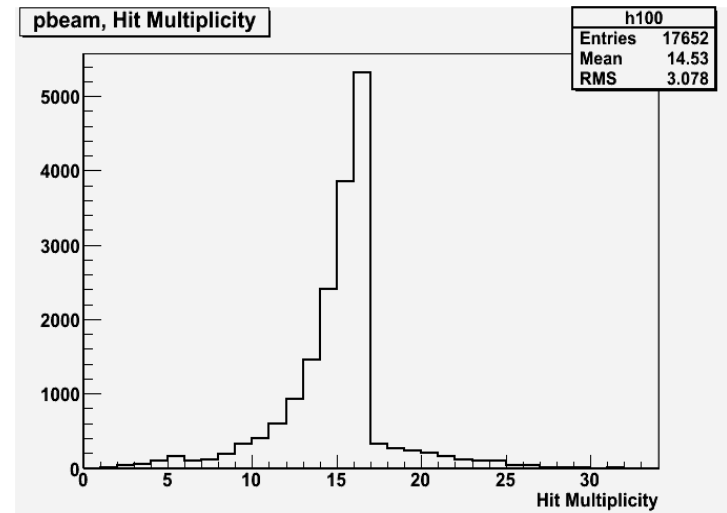
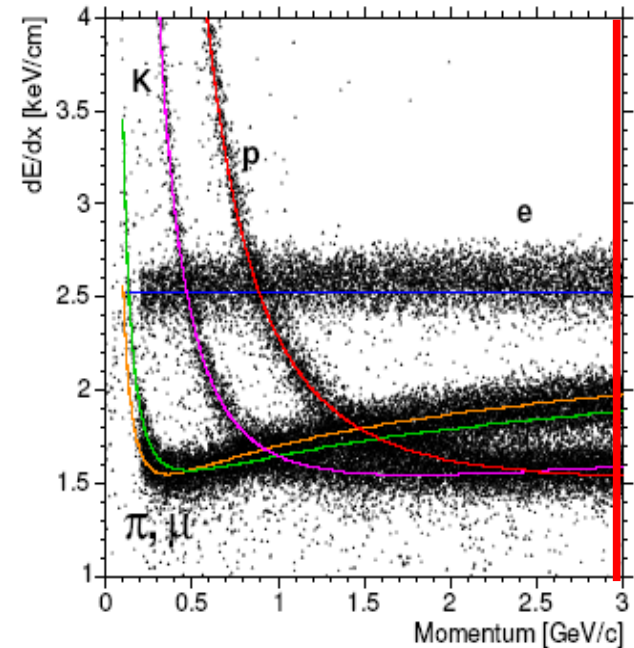
BEAM TEST- conditions

Proton beam

- Momentum: 2.95 GeV/c
- Intensity: $1 - 6 \times 10^3$
- Dimension: 1 cm (X), 4 cm (Y)
- Perpendicular to the straws

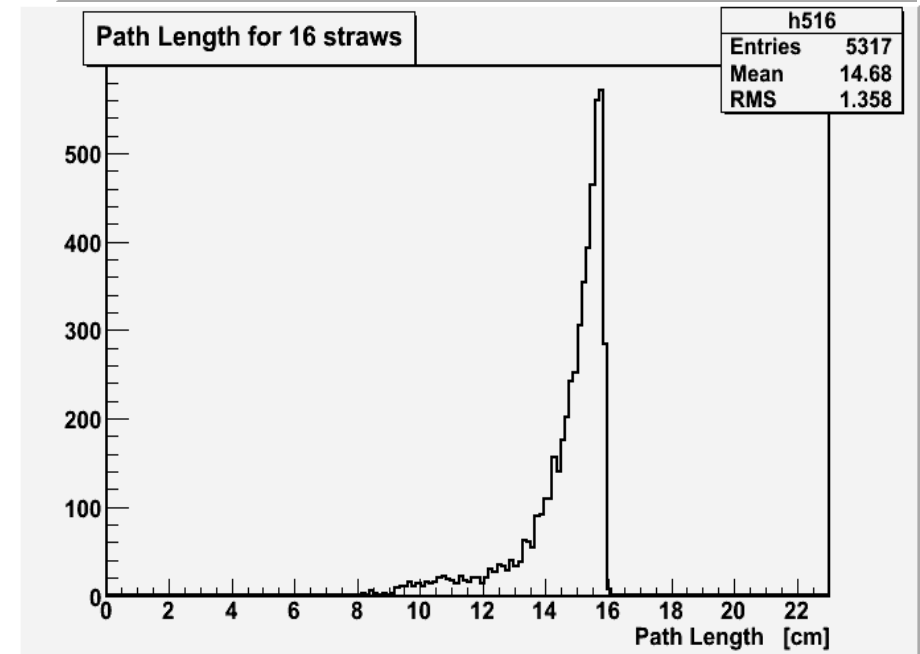
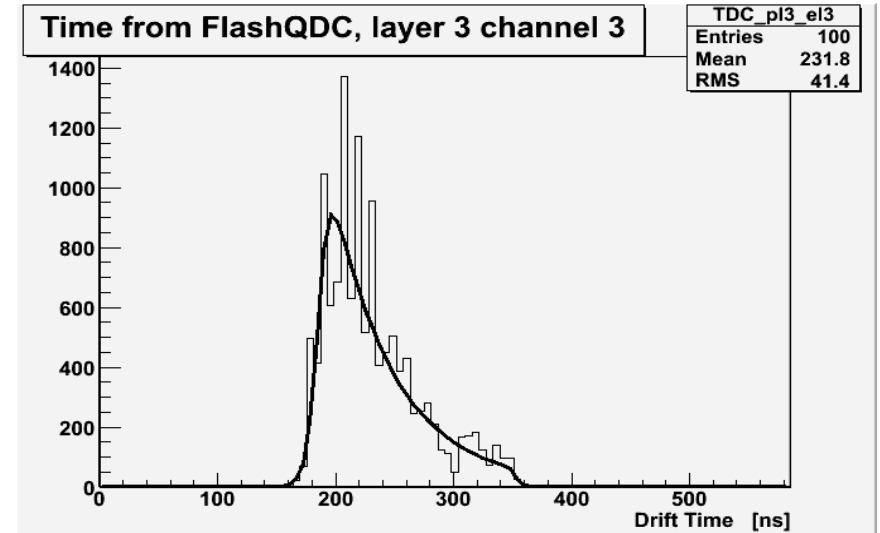
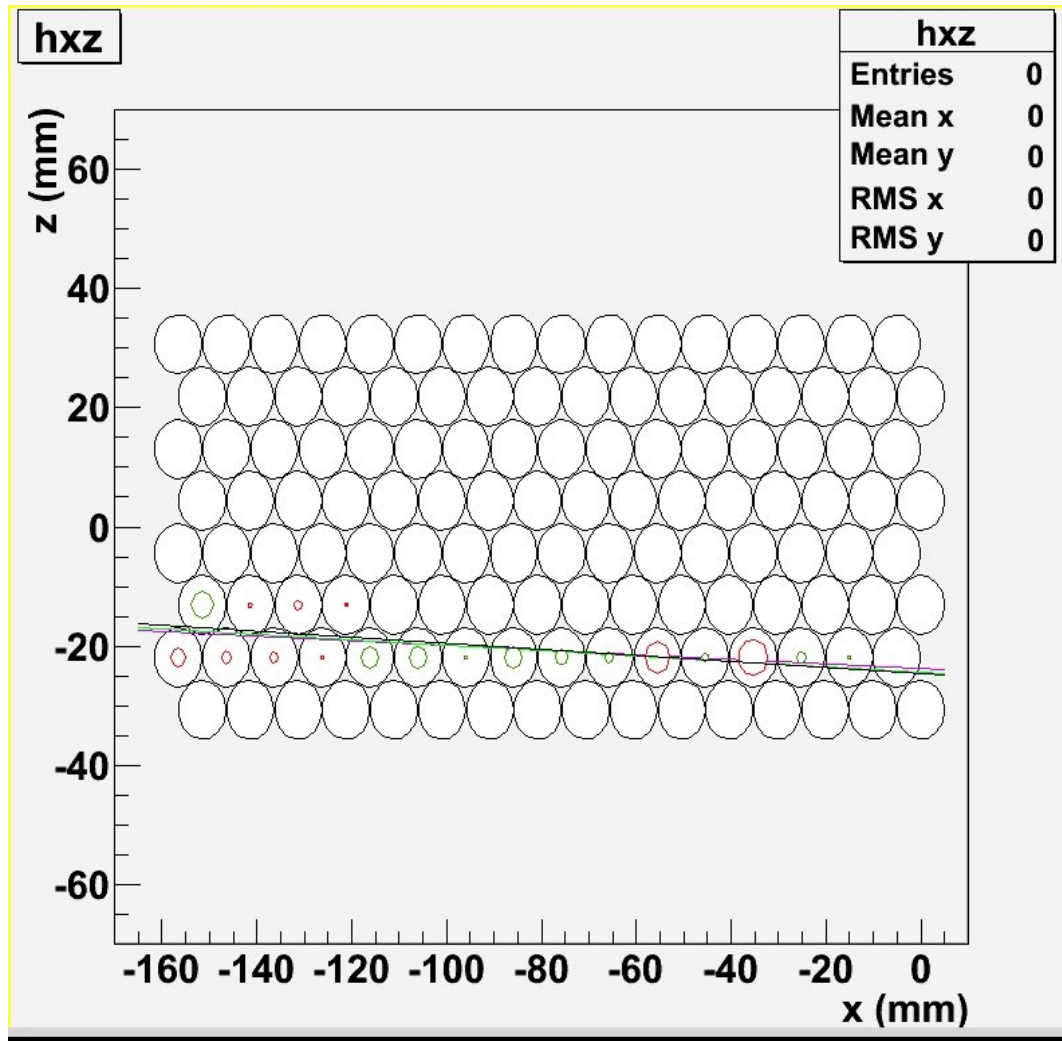
Detector

- Gas: Argon + CO₂ (9/1)
- Pressure: 1 bar overpressure
- Efficiency: very high
- Readout: optimized for dE measurement

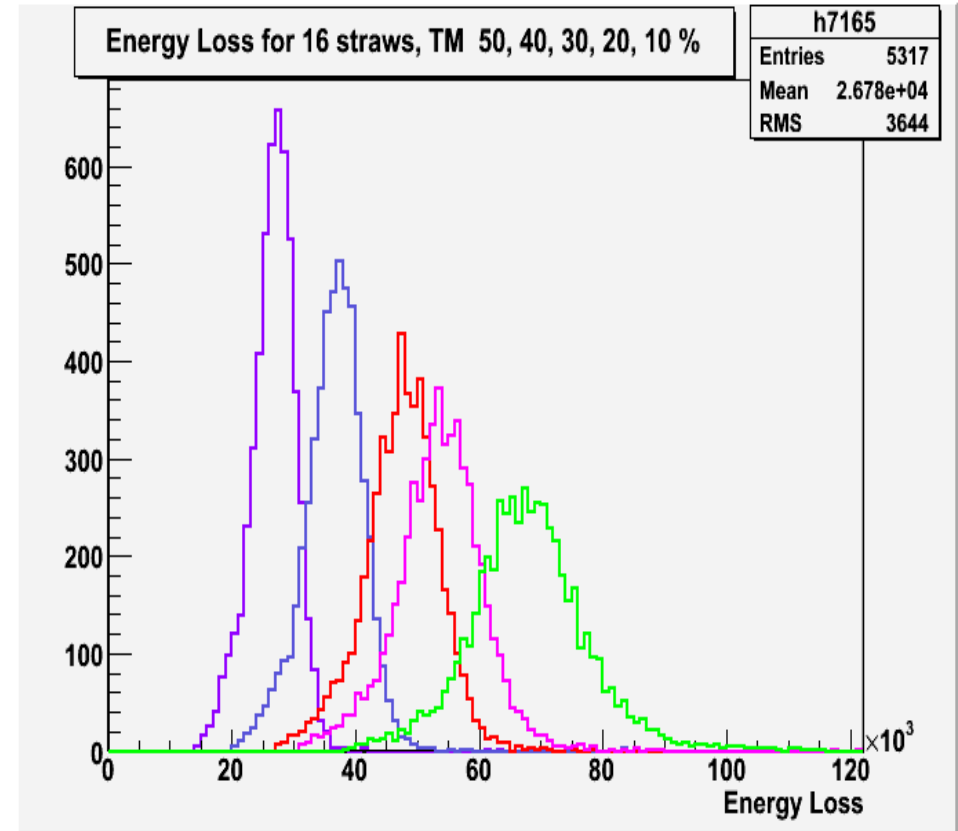
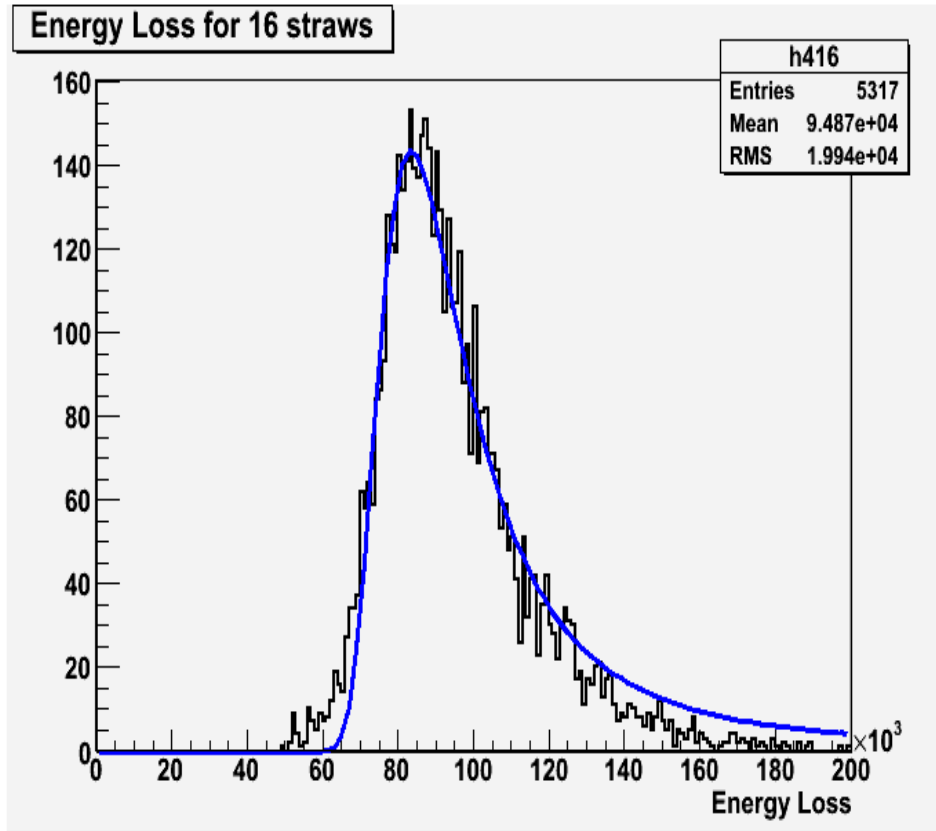


BEAM TEST- tracking

Tracking code of Susanna Costanca adapted:

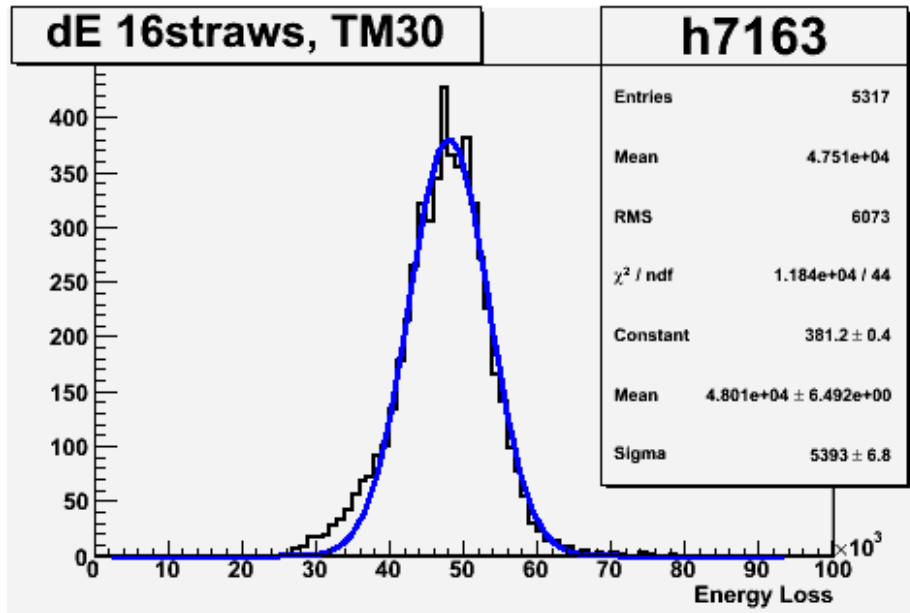


BEAM TEST- energy loss

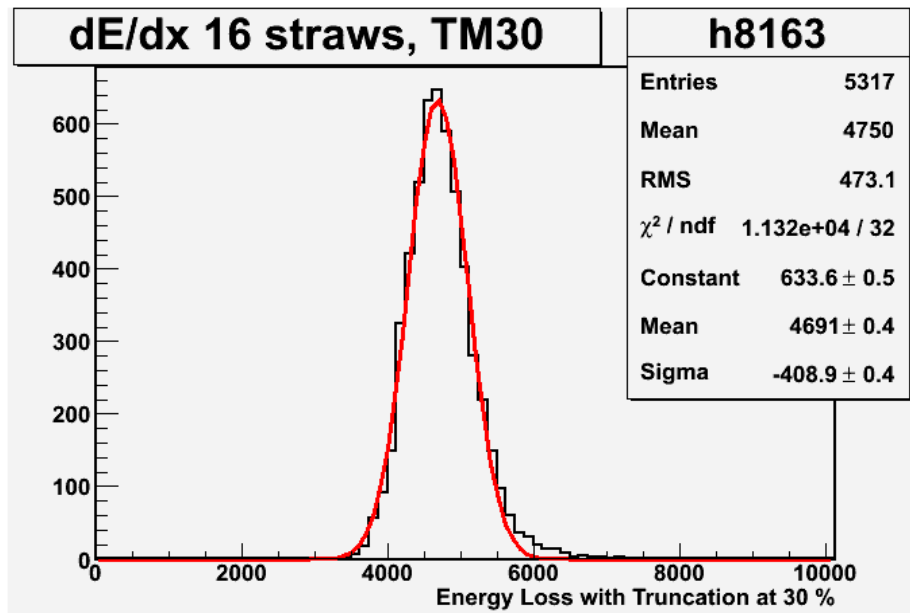


The best resolution is for TM 30 %

BEAM TEST- energy loss



dE : 11 %



dE/dx : 9 %

BEAM TEST- conclusions

- **First check of the energy resolution of the STT at the monochromatic proton beam took place at COSY (Big Karl).**
- **Due to limited time and some technical limitations not whole experimental program of the test measurement could be completed (various impact angles of the beam, different operation voltages).**
- **Test measurements will be continued in 2011. Especially promising is the beamtime in March 2011, when during 5 days the dedicated beam of different energies (0.6 – 1.5 GeV) will be supplied.**

CONCLUSION & OUTLOOK

Results of the energy loss measurement in STT, both with the use of beta-particles as well as with the monoenergetic proton beam have shown that energy resolution of the STT formed of 25 layers might be below 10 %.

Influence of track inclined along the straw axis has to be still checked.

In order to achieve such good energy resolution the read out electronic fulfilling both the requirements of the time measurement (at high detector load) and assuring the optimal energy resolution has to be prepared.

CONCLUSION & OUTLOOK - cont.

Current options for readout electronics:

1. Present solution i.e. analog signals from straws are amplified and fed into fast, FPGA programmed, flash ADC.

Necessary improvements:

- present “macroscopic” preamplifier replaced by small, low power “signal transmitter”. Signal transmitters are fixed in close vicinity of the straws,
- analog signals are taken out with the long cables to the shaping amplifier with the optimized shaping time,
- outputs from shaping amplifier are fed into flashADC of the improved FPGA code: present - leading edge discriminator is replaced by constant fraction discriminator in order to obtain the time resolution better than 1 ns. FPGA gives also the optimized energy output.

Both the “signal transmitter” as well as the shaping amplifier are under preparation.

This option, although not modern and elegant, seems to be fully feasible !

CONCLUSION & OUTLOOK - cont.

Current options for readout electronics (cont.):

2. New ASIC devoted for Time and Energy measurement in Straws.

Such chip is under design at AGH University Kraków (Marek Idzik).
Prototypes are expected by middle of 2011.

This option is the most required solution for simultaneous time and energy measurement in STT.

We are impatient to test it !