

Straw Constructions ..

Feb-28, 2013 | Peter Wintz, IKP - FZ Jülich

PANDA-STT Technical Meeting, Krakau

Outline

- Timelines & Funding
- Status straw constructions
- STT production readiness report issue
- Beam tests at COSY
- ASIC tests

STT Contributions From Julich

- Straw mass production (~75%)
 - Straw layer module assembly (~75%)
 - Quality assurance & beam tests at COSY
 - Contributions to readout / mechanical frame ...
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- Discussion/iteration of work packages inside STT group

Timelines In Julich

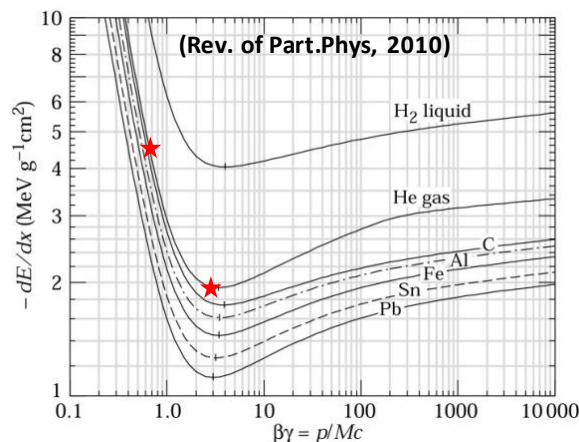
- **Funding period 2012-2016** (BMBF → HGF → Julich)
- Rough timeline for straw construction (proposal)
 - **2013: Final design freeze**
 - Full CAD layout: straws+mech. frame+RO space+supply
 - **2013-2015: Straw mass production** (3 years)
 - **2014/2015: Production Readiness Test ?**
 - **Full STT Hexagon sector** assembled
 - Equipped with readout (~ 800 channels), DAQ
 - Beam tests, comissioning
 - **2016: Completion of STT** assembly
- Readout timelines have to be included

Straw Productions in Julich

- Aim to start (final) straw production in 2013
 - Waiting for final Mylar tube delivery from LAMINA
 - Straw materials available, only minor design updates
 - Mounting tools prepared (e.g. profile reference plate, ...)
 - Straw mass production time ~ 3 years
- In 2012, pilot straw mass production run (~ 600 straws) was done
 - Definition of quality standards & straw production assurance
 - Leakage of mylar tubes was too high ($>10\times$ permeation level)
 - Re-define Mylar film tube specification (2 strips: gluing/winding)

Beam Tests at COSY

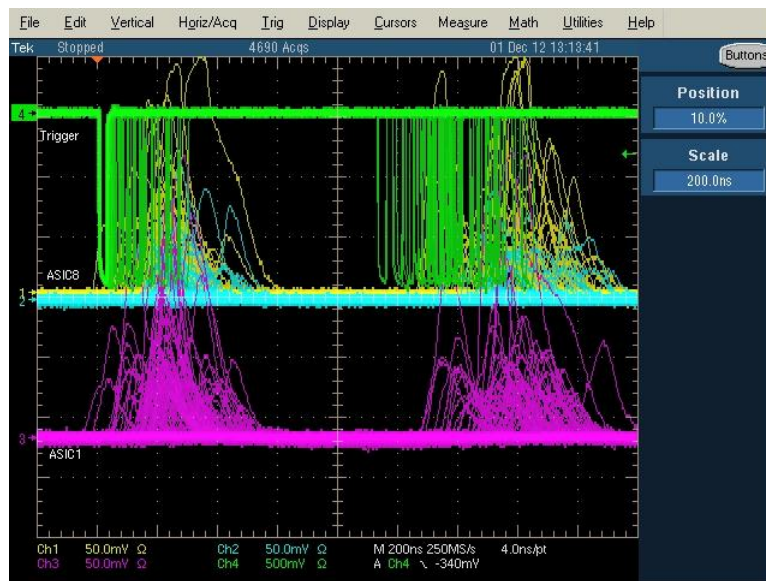
- Proton beam with different momenta
 - Range: $\sim 0.6 - 3 \text{ GeV}/c$ ($\times 2.5 \text{ dE/dx}$)
- 2 straw setups with different readout systems
 - Current amplifier + FADC: 240MHz sampling of analog pulse
 - Ampl-Shap-Discr (ASIC)+TRB: T, ToT



2 straw setups, proton beam coming from the back

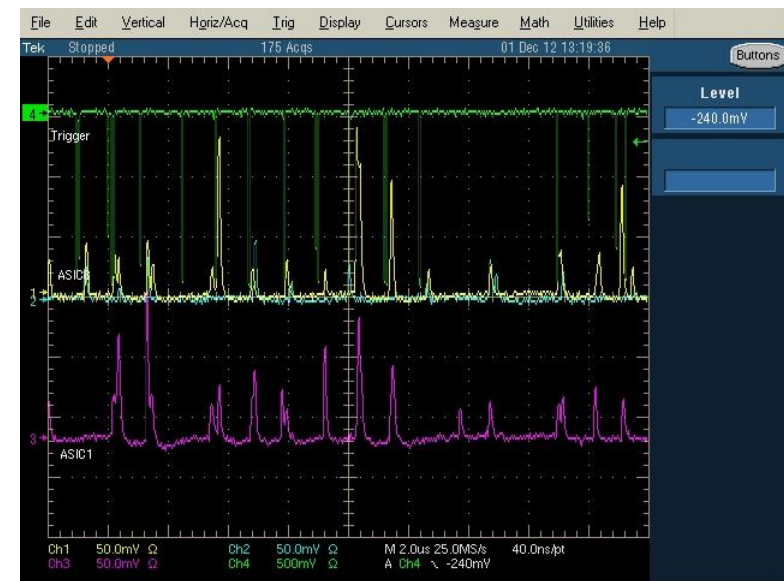
COSY-Beam

- Beam extracted from COSY-ring: beam bunches
 - ~ 300 ns bunch width, ~ 1.1 μ s bunch spacing in Dec 2012 beam time
 - ~ 500 ns straw signal bunch (~150ns drift time range)



Left: 2 μ s time window

Green: scintillator trigger; purple, yellow, blue: straw signals (ASIC analog out)



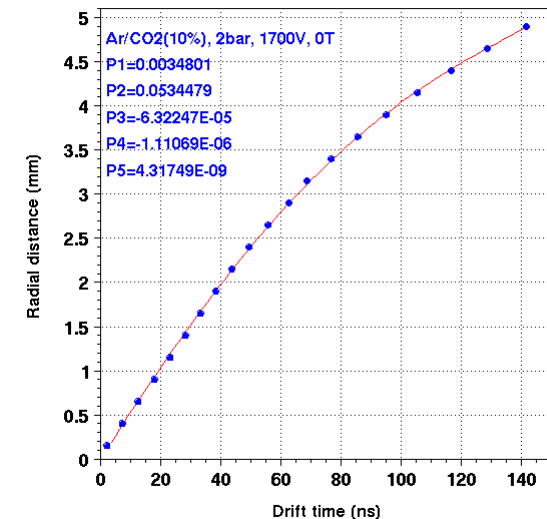
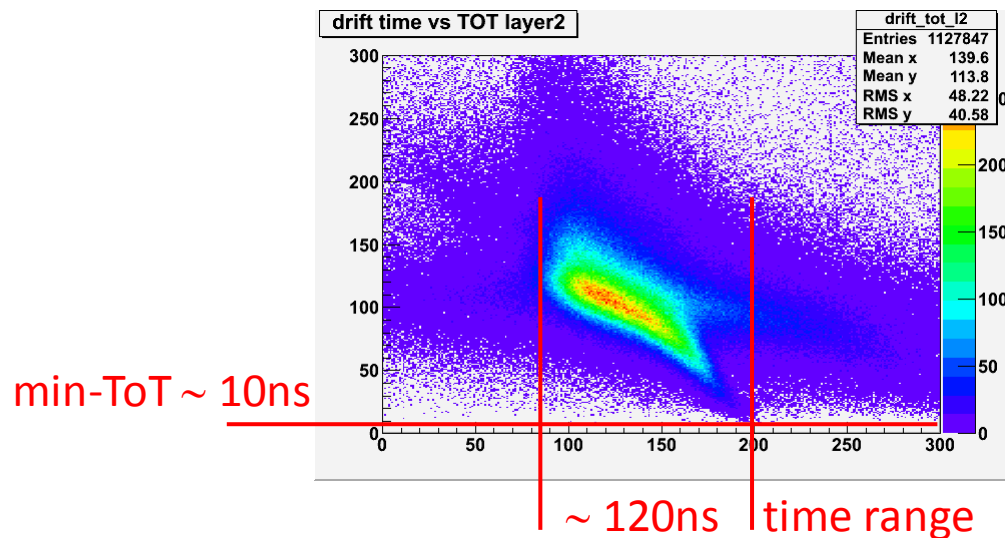
Right: 20 μ s time window (~ 1MHz straw rate)

Straw Timing

- Pileup of beam particles in one bunch
- Straw times convoluted by bunch time structure and pileup
- Pileup/timing to be recognized by offline track reconstruction
- Currently 32ch for ASIC+TRB readout: 2×16 straws
 - Dedicated tracking impossible, geometrical effects, positioning ..
 - Simple single hit-pattern cuts possible (1-2 layer selection)
- More readout channels for larger straw setups required
 - Inclined straw setup, $\Delta Y \sim 5\text{-}10\text{mm}$, combination of shorter and longer drifttimes in one track

ASIC Beam Test In Dec 2012

- 600 MeV/c protons, (example) “low” intensity, std „Cracow” ASIC setting
- HV= 1700V, 2×10^4 gas gain, Ar/CO₂ (10%), p = 2 bar
- Expect max. drift time $t_{\max} \sim 150\text{ns}$ (simulation)
- Data: $t_{\max} \sim 120\text{ns}$, missing last 20-30ns ?**
- ASIC threshold too high?**



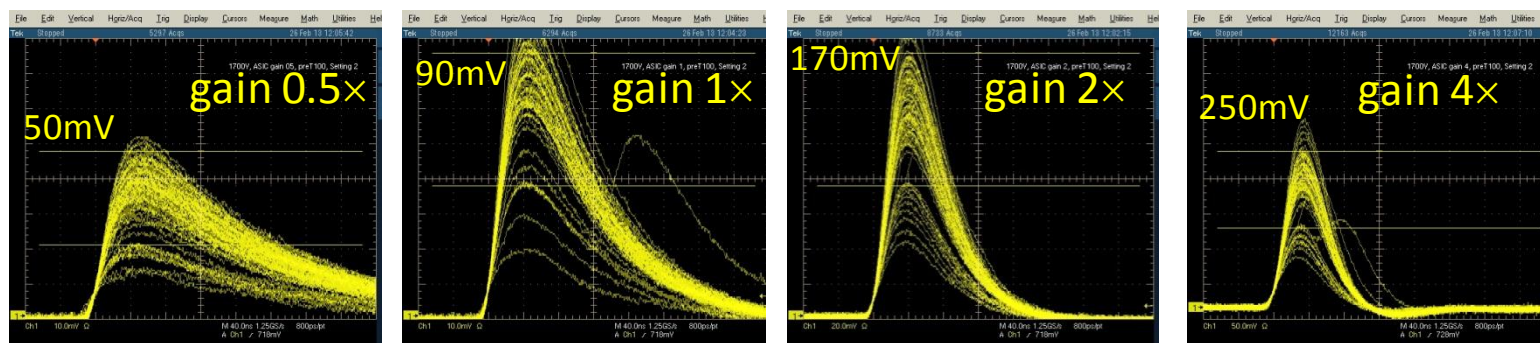
Isochrone radius – drift time relation (Garfield)

ASIC Studies After Beam Time

- Open questions (to Peter) during beam test
 - Pulse shape distortions at preamp gains >1 for def. setting
 - Limited usable range of preamp amplification: $0.5\times$, $1\times$
 - Efficiency, ToT characteristics
- Only analog ASIC output studied (on scope)
- Discriminator signal not accessible (supplies, converter)
- Pulse shape studies with Fe-55, Sr-90, cosmics, p-beam
- ASIC parameters investigated (software interface)

ASIC Tests With Fe-55

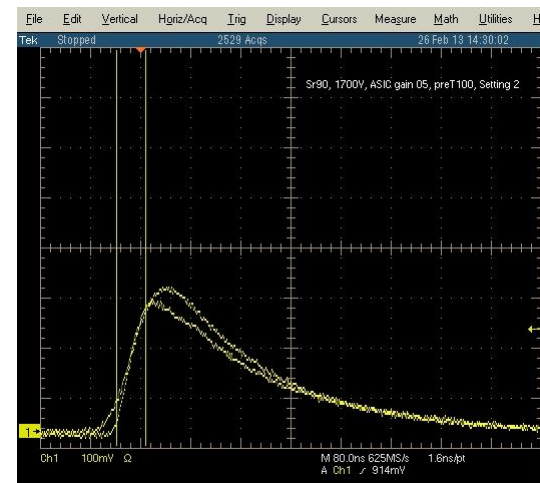
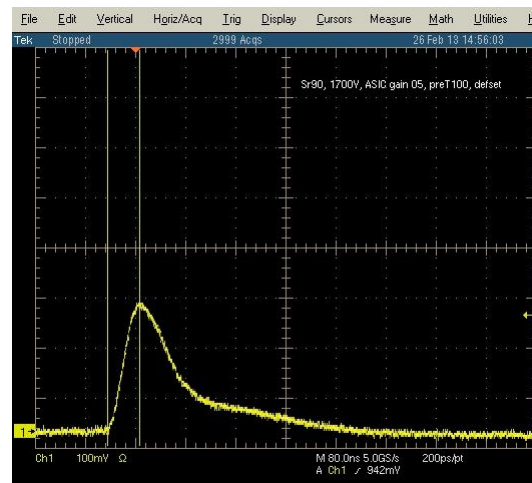
- New setting with max. dynamic range found (low preamp parameters)
 - ASIC preamp gain range 0.5 - 4×, almost linear response (fig.)
 - No pulse shape distortions (no BL undershots): ok
- HV range: <1600 - 1850V, gas gain $\sim 1 \times 10^4 - 1 \times 10^5$
 - Max. signal amplitudes $\sim 50\text{mV} - 500\text{mV}$, linear response, ok
- Resolution of amplitudes (5.9keV, 2.9keV) differs, (see Piotr's talk)



400ns time windows

Sr-90

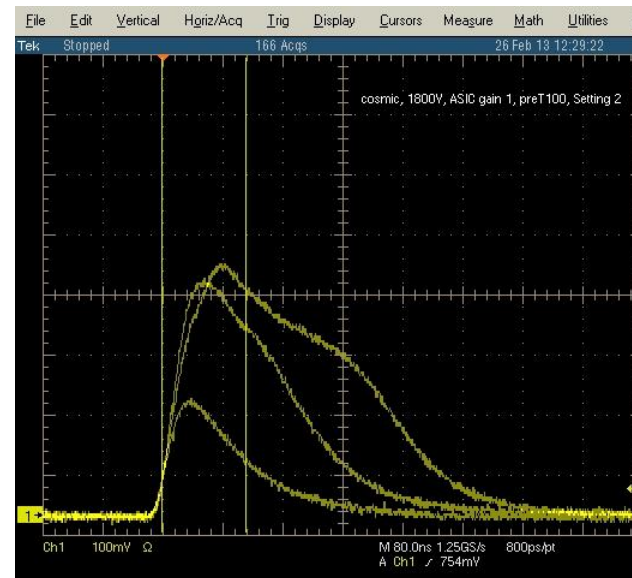
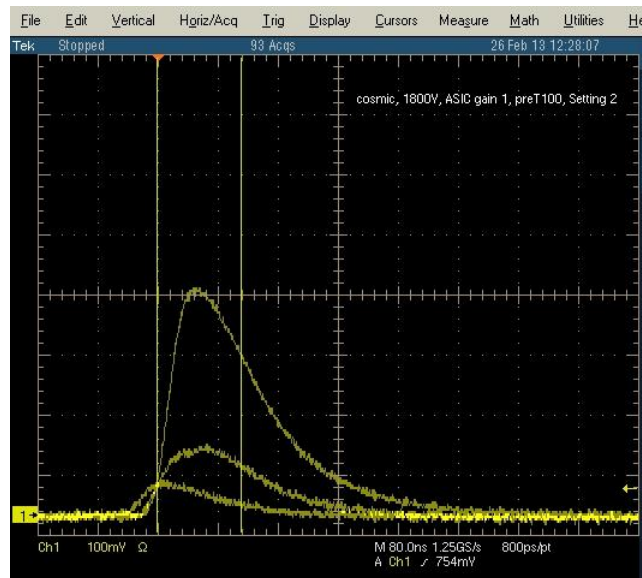
- HV 1700V, preamp gain 0.5×, low amplification
- Default ASIC setting: pulse shape distortions (left fig.)
- New ASIC setting: no distortion (right fig.)



Note the clean ASIC – straw coupling ..

Cosmics

- 180e⁻/cm ionisation, different tracklengths (vertical inclination angle)
- HV=1800V, $\sim 5 \times 10^4$ gas gain
- Pulse distortions start at ~ 500 mV/30ns amplitudes (right fig.)



Summary / Discussion

- ASIC tests ongoing, decide on possible next iteration
 - ToT with larger straw setups at different beam momenta
- FADC issues: readout at highest rate, analog FEE
- Straw mass production during 2013 - 2016
- Full hexagon STT sector in 2015 for production readiness test
- 800 channels readout & DAQ required for such a test