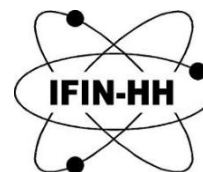




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Beam Test Report

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L. PANDA CM, TRK session, Sep-9th, 2014

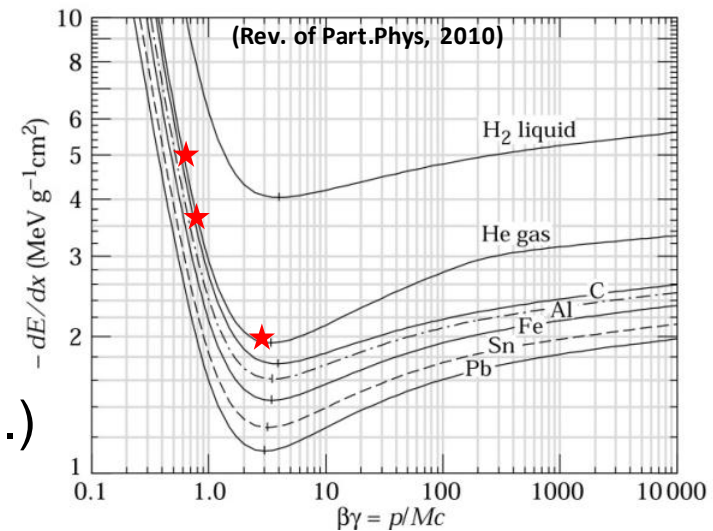
Outline Beam Test Report

- Goals
- Setups
- Beam
- Data analysis
- TRB data (snapshot)
- Outlook

Beam Test Goals

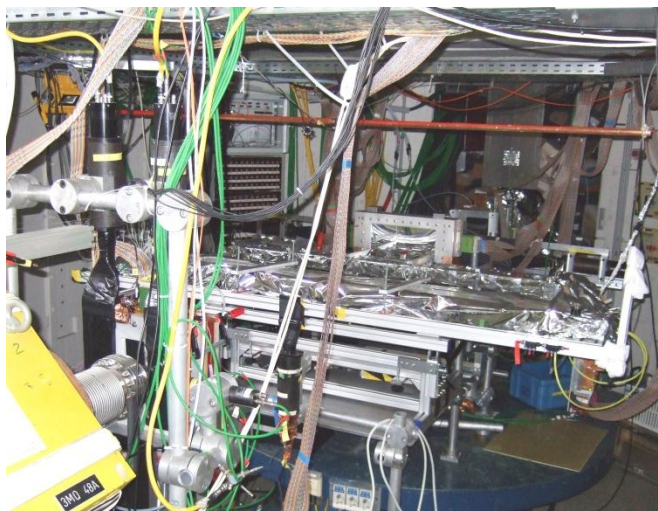
- **Proton / deuteron separation** in momentum range 0.6 – 3.0 GeV/c, 3× 1week in 2014
- 1st test week in July with protons at 0.6, 0.8, 2.95 GeV/c

- **Readout tests & optimisation**
 - Time & spatial resolution
 - dE/dx resolution
 - Verify / tune settings
 - Straws (gas, high-voltage)
 - Electronic parameters (shaping,..)
 - Full data analysis needed

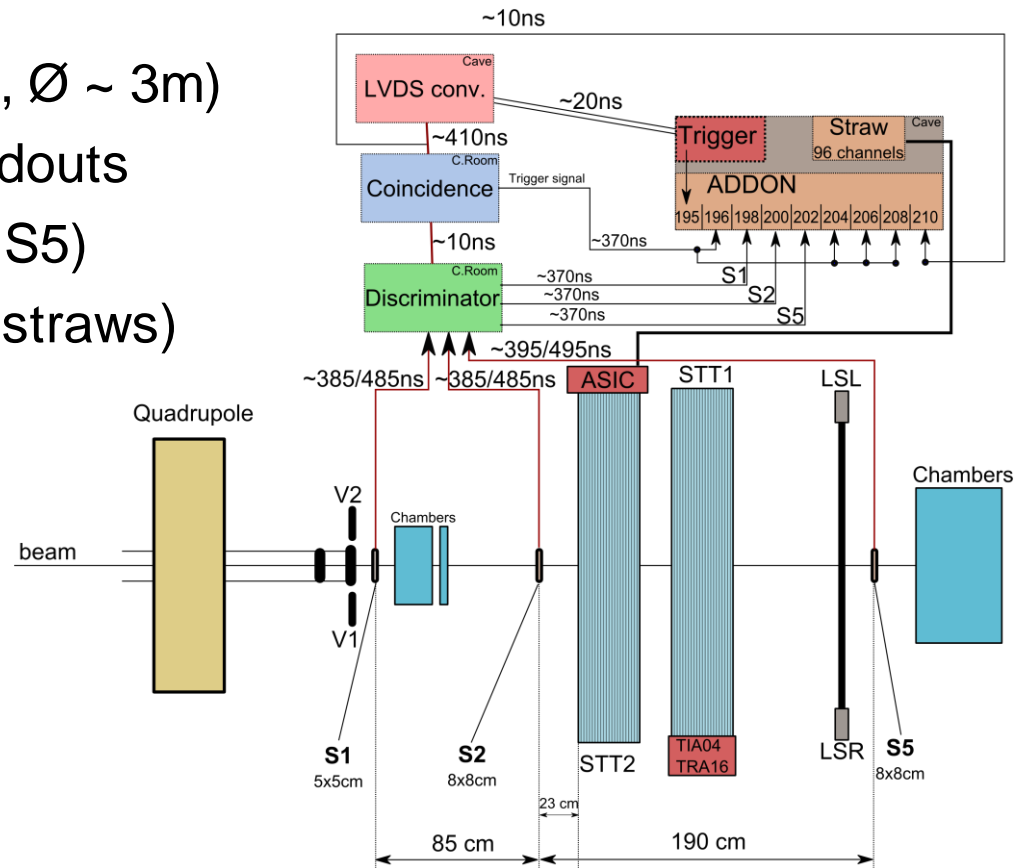


Straw Setups

- In COSY-BigKarl area (igloo, $\varnothing \sim 3\text{m}$)
- $2\times$ straw setups for both readouts
- Trigger scintillators (S1, S2, S5)
- Additional chambers (GEM, straws)



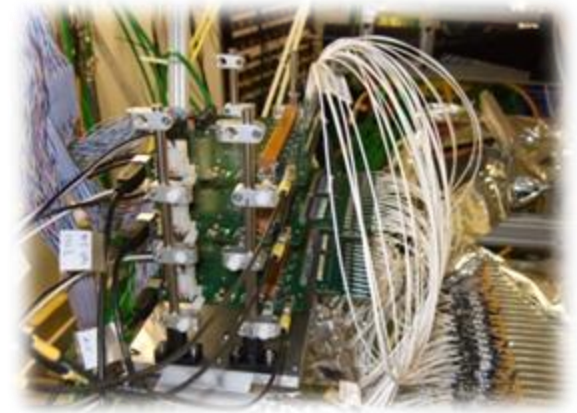
Photograph of setups, beam from lower left



Sketch of system setups, beam from left

Straw & Readout Setups

- Readout channels
 - 96 straw channels (ASIC)
 - 32 + 64 straw channels (FADC)
 - Trigger & individual scintillators (offline timing)
- Straw settings:
 - Ar/CO₂ (10%) at 2 bar pressure (absolute)
 - Straw voltage range: 1750-1900V (= 3- 13 ×10⁴ gain)
 - Default: 1800V (= 5× 10⁴ gain)
- ASIC (discriminator) settings
 - Lowest threshs ~ 20mV (noise level ~ 5-10mV), stable, no noise
 - Max. signal amplitudes 750mV (preamp saturation)
 - Tuned with pulser, noise level, cosmic runs, ..

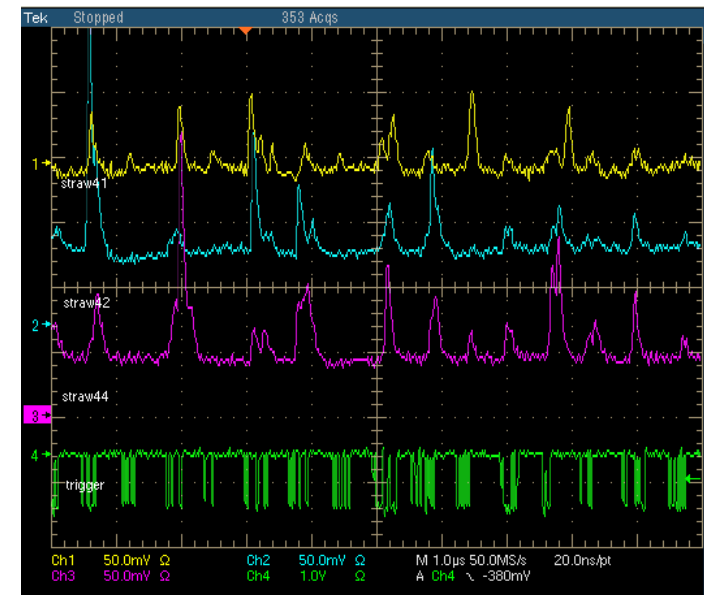


3× ASIC boards a 32 channels

Beam

- Proton beams, 0.6, 0.8, 2.95 GeV/c momentum
- **Beam spot** $\sim 3 \times 1 \text{ cm}^2$ (vert. \times horiz.), few data with $\sim 1 \times 1 \text{ cm}^2$
- Straw setups centered in-beam, slightly inclined, beam perp. to wire
- High/low beam intensity, few 10 kHz/cm² - **few MHz/cm²**
- No DC beam at COSY
- **Beam bunches**, time structure
 - Extraction every $\sim 700\text{ns}$
 - Bunch width $\sim 250\text{ns}$
 - **Multiple tracks, triggers (mixing)**

Oscilloscope snapshot (beam triggered) of straw signals (yellow, blue, purple) and scintillator trigger (green)

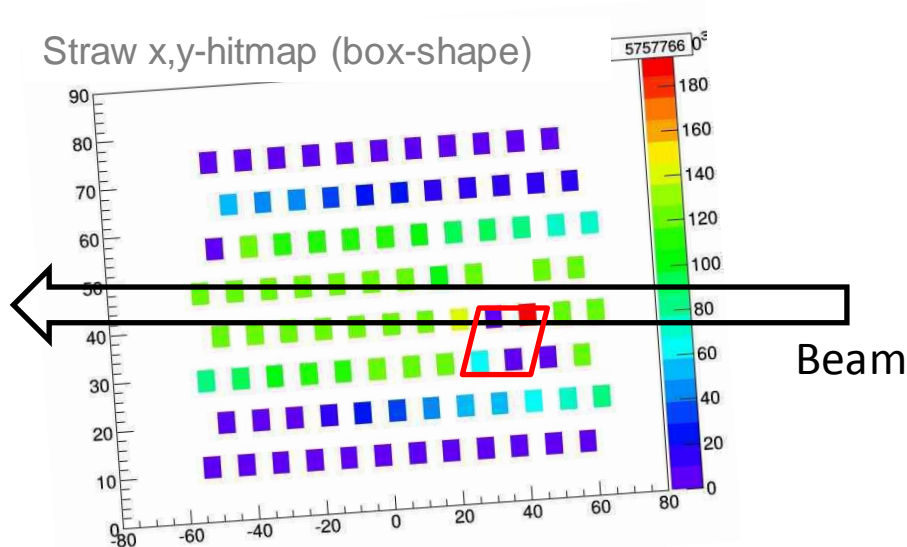


Data Analysis

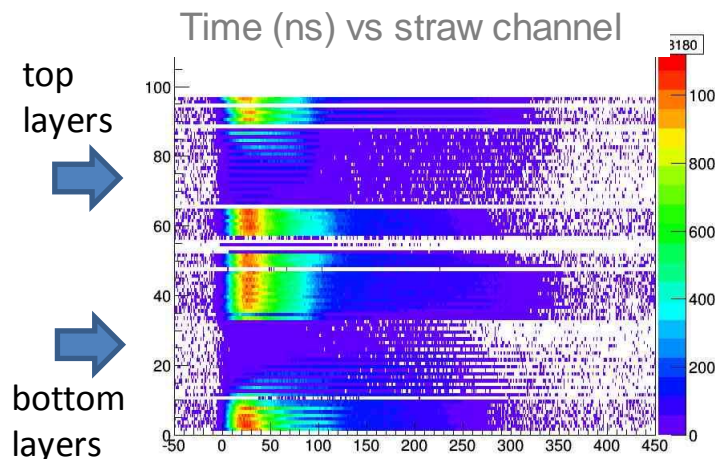
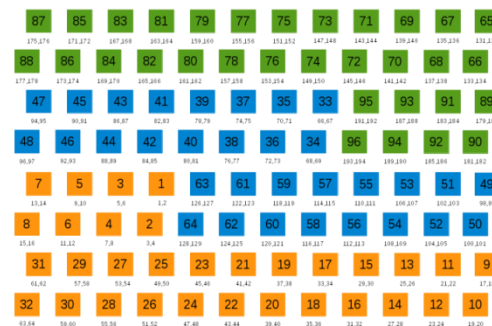
- FADC-data: Krakov & Pavia, ASIC/TRB-data: Krakov & Julich
- Example, TRB-data: >150 data runs a 1.6 GByte
- Analysis steps & program
 - Data selection: raw spectra, hit filtering, identify background sources
 - t0-determination, timing checks (scintillator signals)
 - Isochrone calibration (radius \leftrightarrow drift time)
 - ToT-calibration
 - Tracking \rightarrow spatial resolution, hit filters (δ -electrons, track mixing, ..)
 - Re-calibration with reconstructed tracks (iteration)
 - Final tracking \rightarrow spatial resolution, dE/dx-information
 - Comparisons of data sets, high/low intensity, high/low thresholds
 - Data sets of different beam momenta \rightarrow dE/dx resolution

Data Analysis Snapshot (TRB)

- Hitmap
- Straw – channel association (right figure)
- Narrow beam, top/bottom layers not hit
- One ASIC (4ch) required resets (red box)



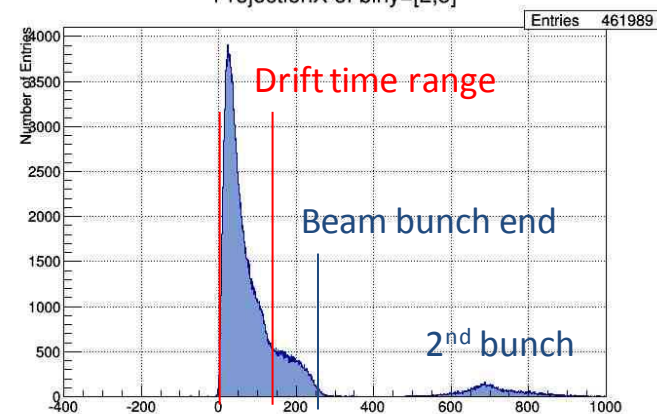
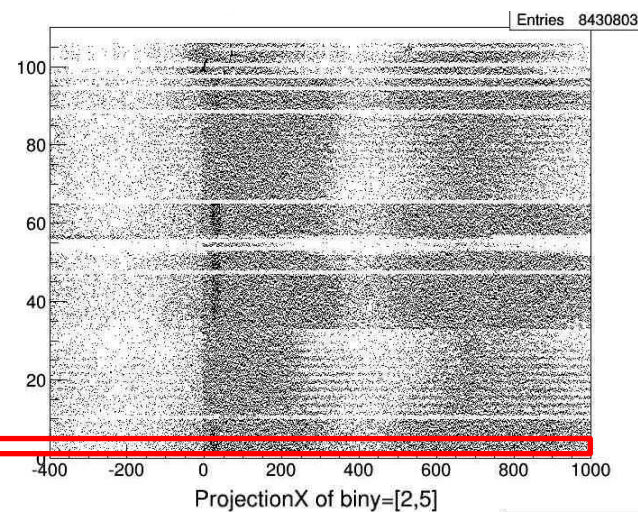
Straw readout channels



Time Spectra

- Raw time spectra (time offset corrected)
- Multiple tracks in one beam bunch poss.
- Bunch time structure
 - 2nd bunch around ~ 700ns
 - Bunch width ~ 250ns+140ns drift time range
- Straw drift time range ~ 130-140ns
 - ~ 140ns from simulation (GARFIELD)
 - ~ 140ns from cosmic data
- ~ 20% beam background
 - Multiple tracks, delayed to 1st trigger
- Note: no electronic noise (low threshs!)

Times (ns) vs straw channels (1-96)

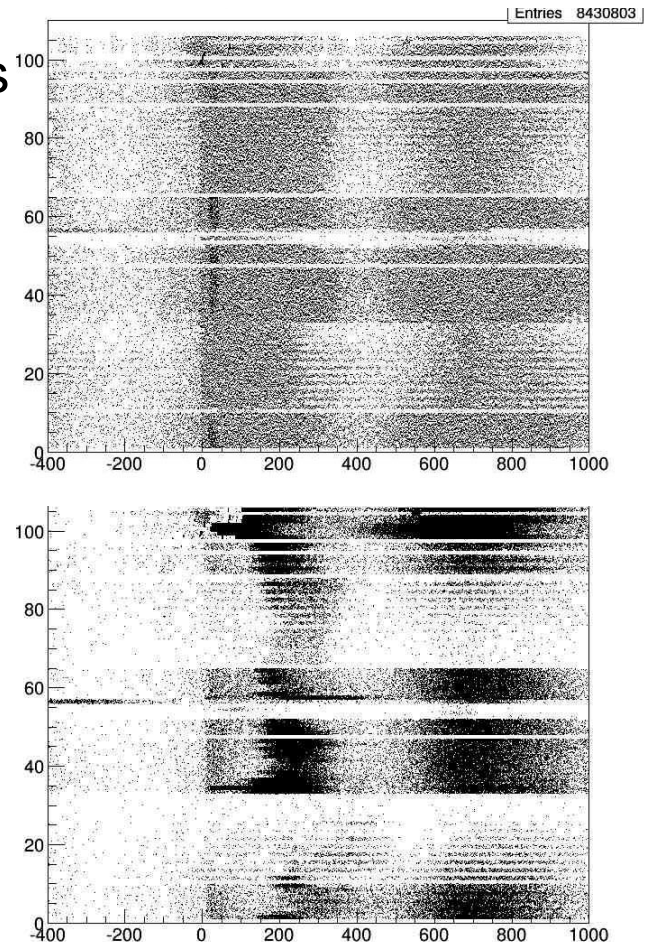


Times (ns) for straw channels 1-4

Beam Background

- Multiple tracks, produce delayed/addit. hits
- Time spectra 1st straw hits (top figure)
 - Extended time range to ~ 300-400ns
 - 1st straw hit from delayed 2nd track
- 2nd straw hit spectra (bottom figure)
 - Hit from 2nd track in same straw
 - Start typically at 150-200ns
- See also trigger & scintillators (ch 96-104)
- **Analysis of track mixing ongoing**
 - Rejection criteria (2nd straw/scintill. hit) ..

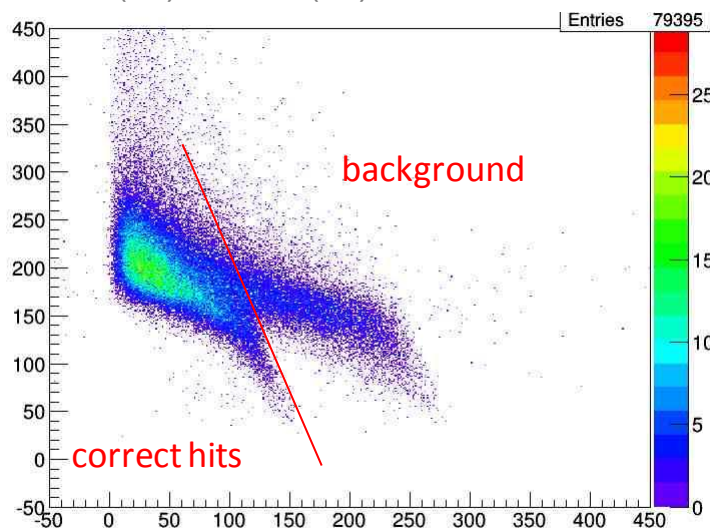
Times (ns) vs straw channels,
top: 1st hit, bottom: 2nd hit in straw



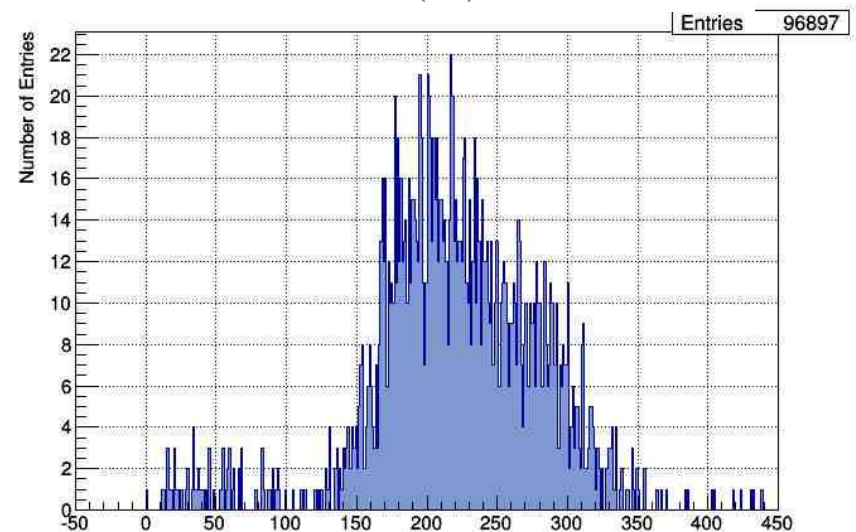
Time-Over-Threshold

- Drift time vs time-over-threshold
- ToT range ~ 30 .. 220 ns (mean)
- Beam background extends drift time range > 150ns (2nd-leg)
- Background sources still under discussion

Time (ns) vs ToT (ns) for straw 7



2nd hit times (ns) for straw 46



Outlook

- Straw setups, readout, DAQ worked properly
- Data-takings stable, no noise, no failures
- No DC beam possible (bunch structure)
- (Beam)-background identification / offline-rejection ongoing
- Full data-analysis ongoing (time resolution / tracking)

- Thanks to all colleagues involved in the set ups
- More analysts welcome (> 150 data runs)