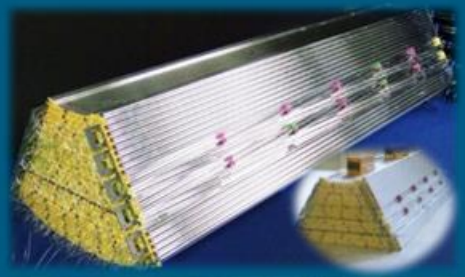
Scope of the Meeting

Peter Wintz (IKP, FZ Jülich)

STT RO WShop | Krakow | Jan-30/31 2017



Aim of the Meeting

- Definition of the process how to decide on the final electronic readout system for the PANDA-STT: two alternative options (ADC or TDC w/ time-ovr-thr)
- Find group-inside full agreement on the process: “transparent” decision
- Decide whether informal agreement sufficient or we need memorandum

- Set up project control towards the decision
- Main decision criteria: readiness of readout system for STT (“pre-series”)
- Clear definition of criteria and deliverables needed
  - Test systems (“pre-series”) & measurements, system boundaries, on-/offline SW, ..
- Organisation of WPs, workflow plan, contact persons & timelines
- After decision: start with final production stage

- Involvement of PANDA by Tech. Coordinator (Lars, Tassos)
- Decide on regular meetings and reporting

Readout Decision & Implications

- Critical discussion of the two system designs inside the group wanted
- Identify weak, open points and solutions for both
- Consider all aspects: performances, complexity, MPs & financials

  (performances, e.g. resolutions and efficiencies, complexity of HW & SW, maintenance, robustness, e.g. noise, pickup, failure-safe, man power, financials within given STT budget, ..

- Integration of STT readout system in PANDA
  - Consider connection to PANDA-DAQ (in-/outputs), but PANDA-DAQ not avail.
  - Mechanical integration (front-end, cable routing, maintenance, humidity&temp., ..)
  - Main input for experiment (software) trigger: robust & highest hit efficiency
  - Continuous data stream with (some) pattern recognition (t0-determination)
  - Robust & failure-safe operation required: no hang-up, fast, ~100% efficiency, ..
  - No instant access to PANDA-experiment hall during beam time
- Involvement of PANDA TechCoord. during the whole decision process
- Reports in specific TechBoard session(s) for mech. integration, install., DAQ

TDR Approval & Criteria by FAIR-ECE

- Reminder: STT TDR evaluation by FAIR-ECE panel (experts committee exp.)
  - dE/dx results by Amp/FADC (240 MHz) prototype, remind: TPC/STT eval.
  - Tech. specs for ASIC/TRB system
- Full TDR approval by experts in 2013, but: "since electronics R&D not as advanced as mechanics, following both alternative electronic readout options is a wise approach"
- Decision on final readout due since 2013

- Panel gave clear recommendations for how to proceed with STT production
  - Final system prototype or spare module to conduct a production readiness review
  - Expose electronic chain to full dynamic range of pulse heights by in-beam tests
  - Failure studies!, ..
  - Experts offered availability for advice at any stage of the STT production

- We will comply all recommendations and remarks made by the experts

(W. Riegler & L. Musa (CERN), C. Meyer (CarnMell U), J. Vavra (SLAC), R. Frühwirth (HEP Vienna), T. Hemmick (Stony Brook), A. Pellegrino (CERN), M.Capeans (CERN))

Decision Process & Timelines

- Current meeting to start the readout decision process
- Organisation of the process
- Define criteria & timelines
- Agreement on the process

- Since 2013 sharpening of both readout system designs
- Stage reached to set up pre-series readout systems & in-beam tests for both

Timelines: 2018(9) - 2021 for final production of readout system, pre-testing ..

- Q2/2018: readout decision and part of STT pre-series test (FAIR-M8)
- Q1/2018: beam time planned, request submission due in Apr/May 2017
- End-2021: PANDA-STT site acceptance test (FAIR-M9)
- 2022: STT system ready for installation at FAIR
- Optional: STT system pre-mounting (Jül?), due to limited hall space at FAIR

Structure of the Meeting

- Monday & early Tuesday: various status reports
  - Group activities, room for (critical) discussions
  - Propose Q&A during (longer) presentations

- Tuesday: devoted to decision process (intros & round-table discussions)
  - Criteria & deliverables
  - Test systems & measurements
  - Analysis, results & comparability, extrapolation to PANDA-STT
  - PANDA-DAQ integration

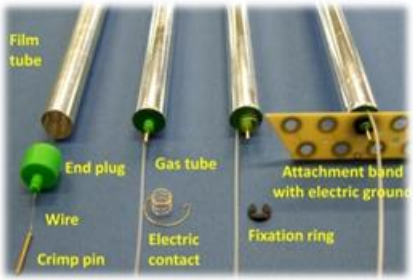
  - Organisation of the decision process
  - Further meetings and reporting
  - Timelines

- AOT ? Anything else ??

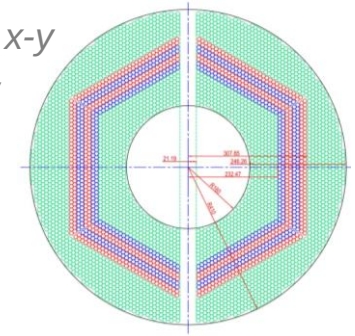
PANDA – Straw Tube Tracker (STT)

- 4224 straw tubes in 2 split semi-barrels
  - 27µm thin Al-Mylar film, 10 mm diameter, 1400 mm length
- 23-27 radial layers in 6 hexagonal sectors
  - 15-19 axial layers (green) in beam direction
  - 4 stereo double-layers: ±3° skew angle (blue/red)
- Ar/CO_2 (10%) @ 2 bar, 5×10^4 gas gain
- X/X_0 ~ 1.25% (~ $^2/_3$ tube, $^1/_3$ gas, $^1/_8$ STT mantle)
- Time & charge readout for PID by dE/dx (p,K,π <1 GeV/c)
  - σ_r ~150µm (σ_z~3mm), dE/dx ~10%
- Momentum resolution ~ 1-2% (B=2T)
- Continuous readout & RT tracking
- ~17 GB/s (5 bytes for ch, time, charge)

Straw components

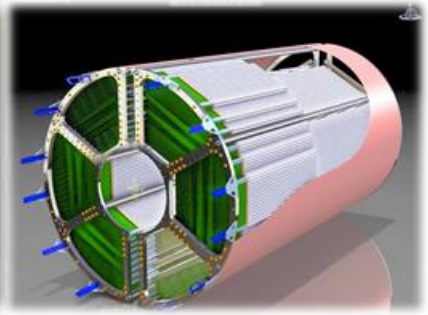


STT x-y view



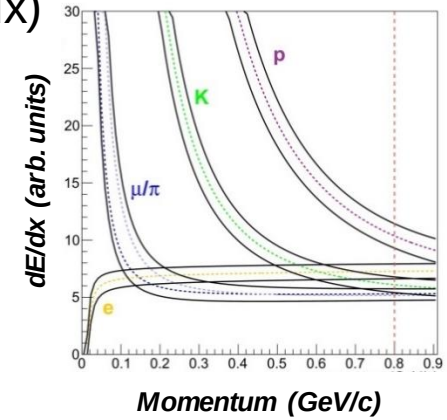
STT prototype

STT 3D-view



PANDA-STT Electronic Readout

- Specific energy-loss (dE/dx) readout together with high spatial resolution is a non-standard task for straw detectors, in particular at PANDA
- STT with readout of drift time and charge for PID (dE/dx)

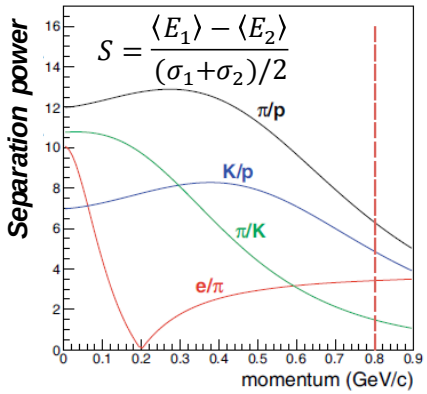


- FE-ASIC / TRB3 (time & time-over-threshold)

PASTTREC-ASIC FE-board (by AGH & JU Krakow)

- Amp/ADC - FPGA (pulse shape sampling)

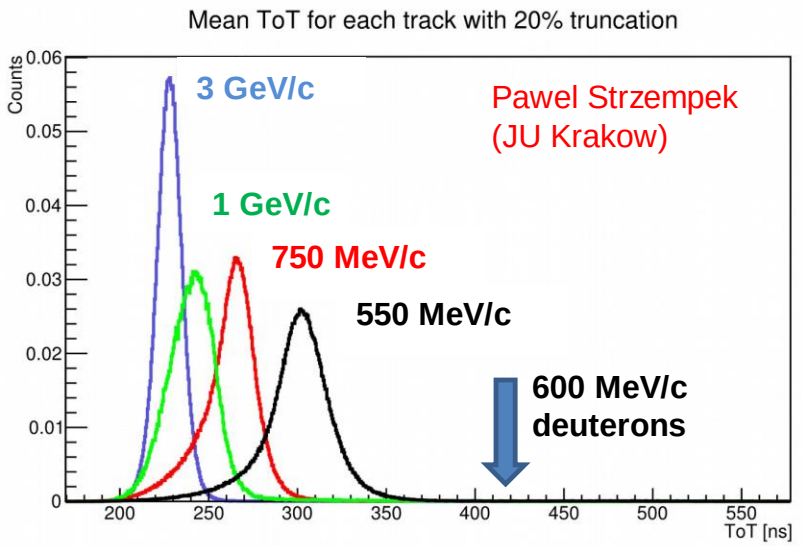
Testboard with ADC (LTM9011-14) and FPGA readout (ZEA-2/FZJ)



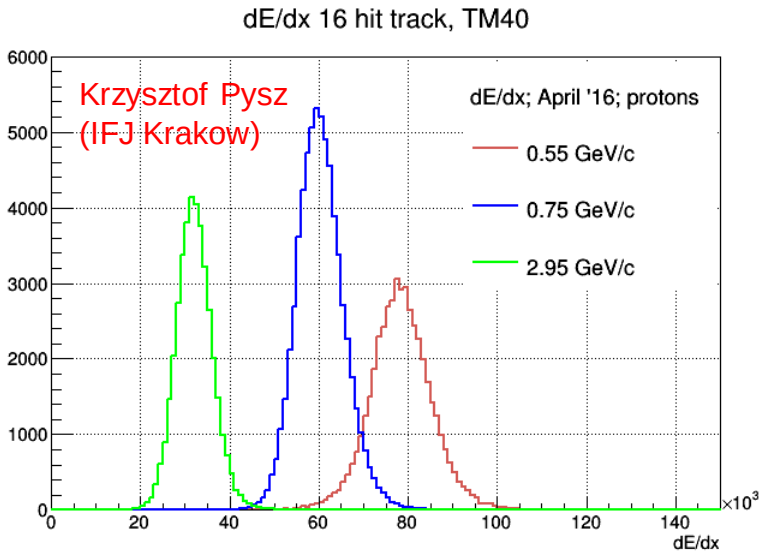
PID by dE/dx measurement. Simulation for STT (from TDR)

Report on Beam Tests in 2016

- 2×1 week: protons@ 3, 1, 0.75, 0.55 GeV/c, deuterons@ 1.5, 0.75, 0.6 GeV/c
- Ideal to test proton/kaon separation at PANDA < 1 GeV/c
- Covered dE/dx range: ~ 5 - 50 keV/cm (Ar/CO_2 @ 2bar)
- Both readouts competitive: dE/dx separation demonstrated for both (see below)
- Analysis ongoing, further improvements possible



Measured time-over-threshold (ns) for proton beam (time corrected, 20% trunc.)



Measured dE/dx by FADC (40% truncation) for proton beam.

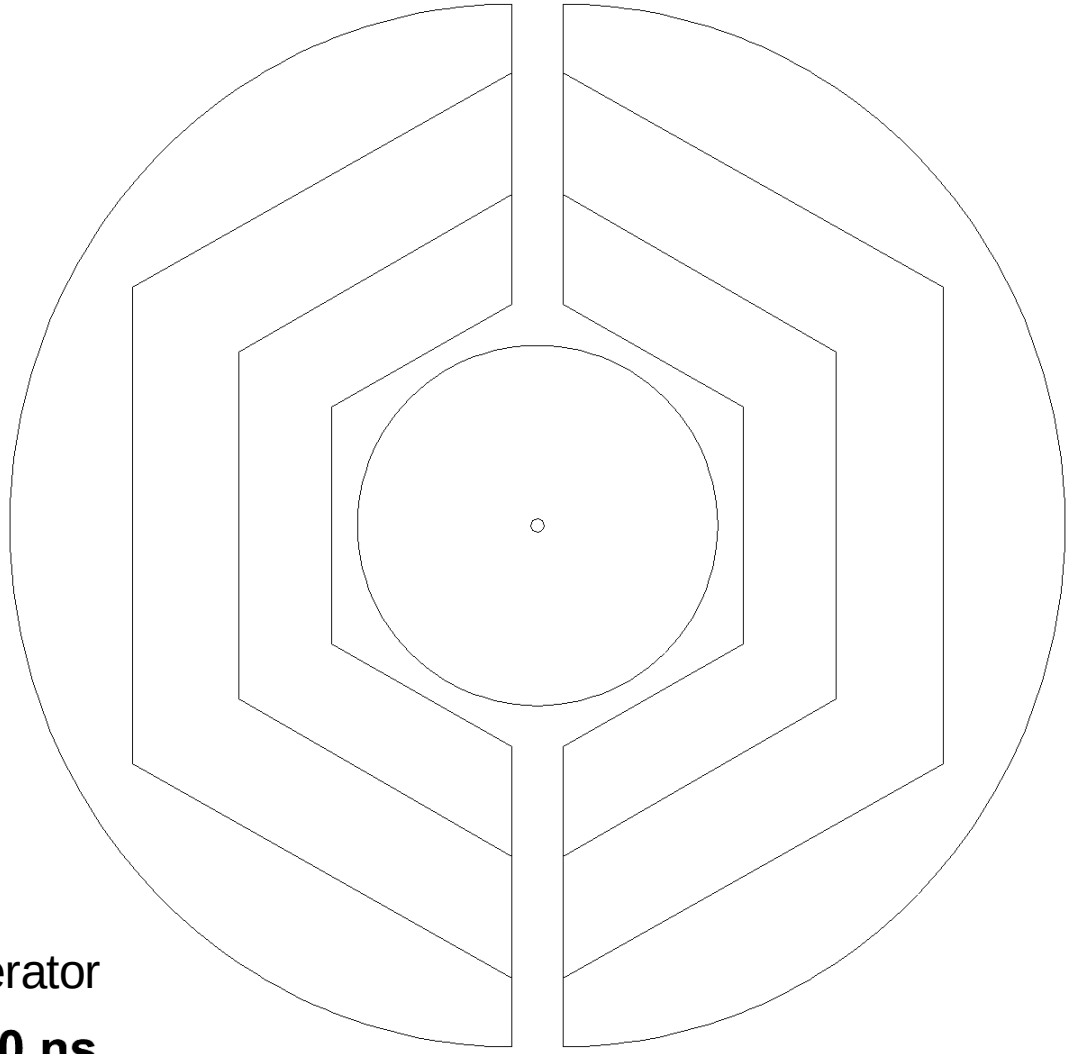
PANDA Event Simulation

Hitstream display:
15 GeV/c DPM,
50 ns mean time,

STT standalone pattern reco
and track recognition

DPM Benchmark:
Realistic event rate and structure, continuous operation

Dual Parton Model (DPM):
Standard pp background generator



0 ns

Thank you all

and

looking forward to

a

fruitful meeting

New Beam Area and STT Testsystems