Status of STT Activities in Juelich

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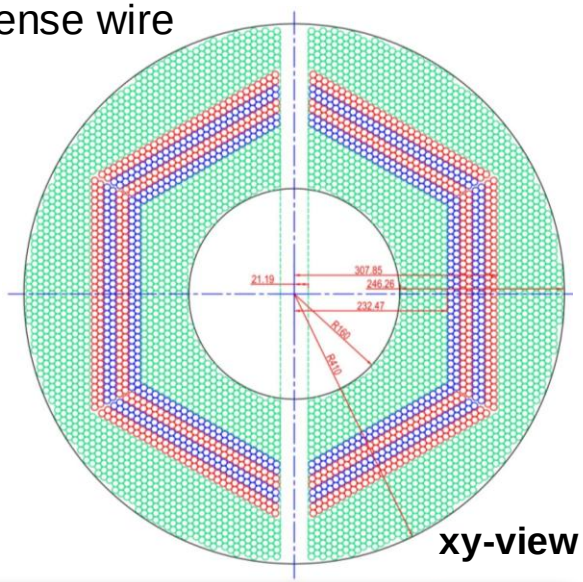
PANDA - CT Group Meeting,
December-13, 2011, Darmstadt

Outline

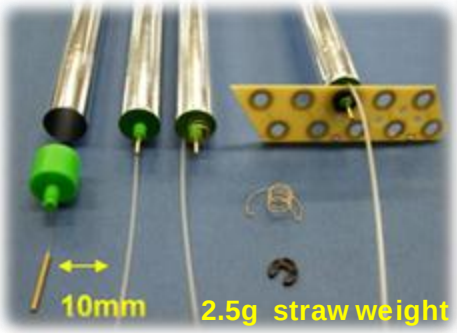
- STT Layout
- Prototype assembly
- Readout issues
- Beam test

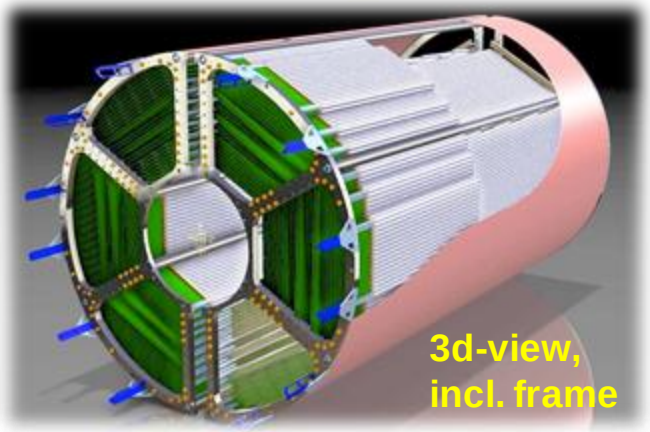
Central Straw Tube Tracker

- 4636 Straw tubes in 2 semi-barrels around beam / target cross-pipe
  - Al-Mylar film, d=27µm, ∅=10mm, L=1500mm, 20µm sense wire
  - Gas mixture Ar/CO_2(10%) @ p=2bar
- 23-27 planar layers in 6 hexagonal sectors
  - 15-19 axial layers (green) in beam direction
  - 4 stereo double-layers, skew angle ±3° (blue/red)
- $X/X_0 \sim 1.2\%$ ($^2/_3$ tube wall + $^1/_3$ gas)
- STT dimensions
  - R_{in}/R_{out}= 150/420 mm, L= 1650mm incl. FEE (150mm)
- Time & amplitude readout (isochrones & energy loss)
- $\sigma_{r\Phi} < 150$ µm, $\sigma_z < 2.8$ mm
- $\sigma_E/E < 8\%$ (p/K/π separation)
- $\sigma_p/p \sim 3\%$ (STT alone)
- $\sigma(t_0)/t_0 \sim 2$ns



xy-view

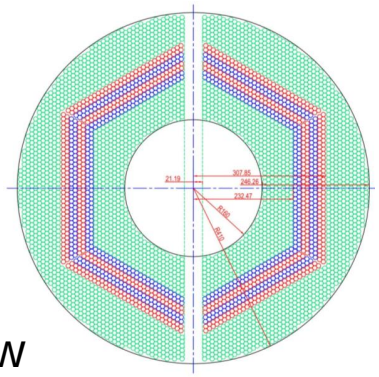




STT Layout

Layout of axial and stereo straw layers optimised for

- High momentum resolution for primary tracks
- Efficient track recognition based on axial blocks
  - association of hits in stereo layers to circle
  - event deconvolution : ~ 8 evts in ±200ns drift time window



Investigation of STT standalone capabilities (Lia Lavezzi, Pavia)

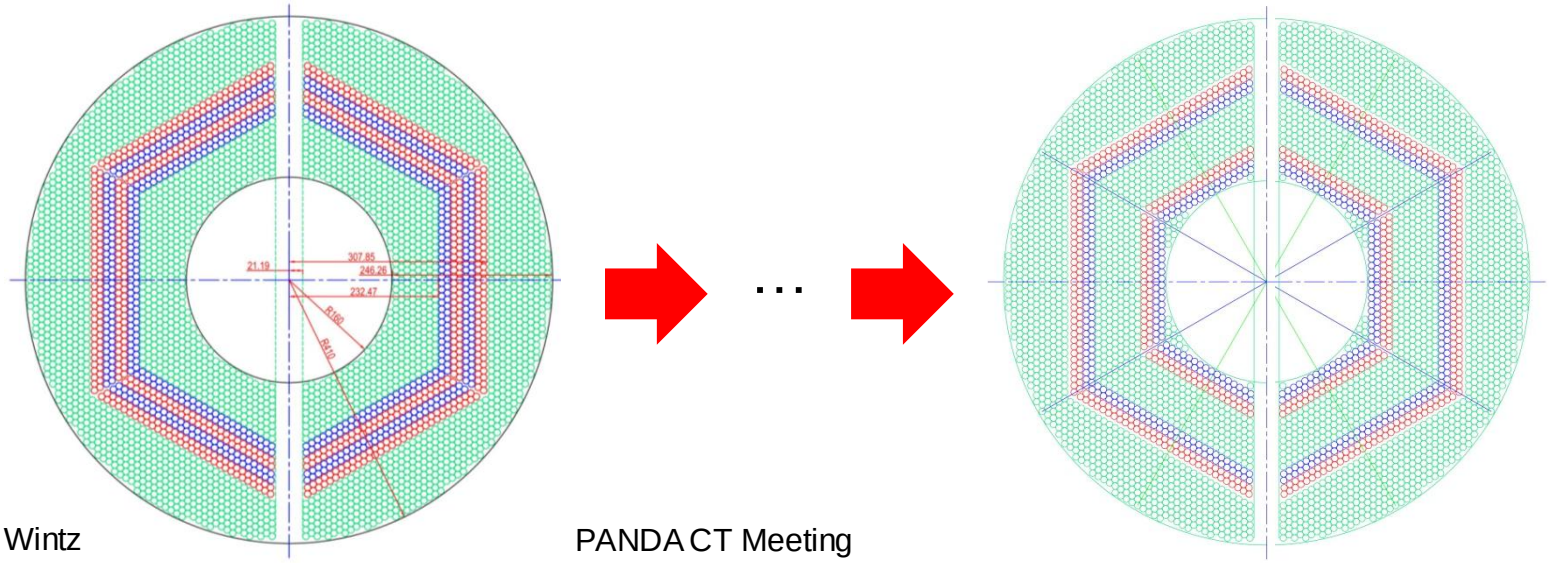
- $\lambda\overline{\lambda}$ event simulation, phase space distributed, not (yet) forward boosted
- Preliminary: ~ 30% reco efficiency (3σ-cut in IM)
  - Standalone trackfinder, simple vtx fitter, no kalman, no kinematical fit
  - Only STT: neglecting MVD + GEM hits
  - 91% of $\lambda\overline{\lambda}$ events with decays inside MVD volume !
  - MVD & GEMs have to be added
- Challenging: decays inside STT with almost horizontal decay tracks

STT Layout Options

Two main options possible

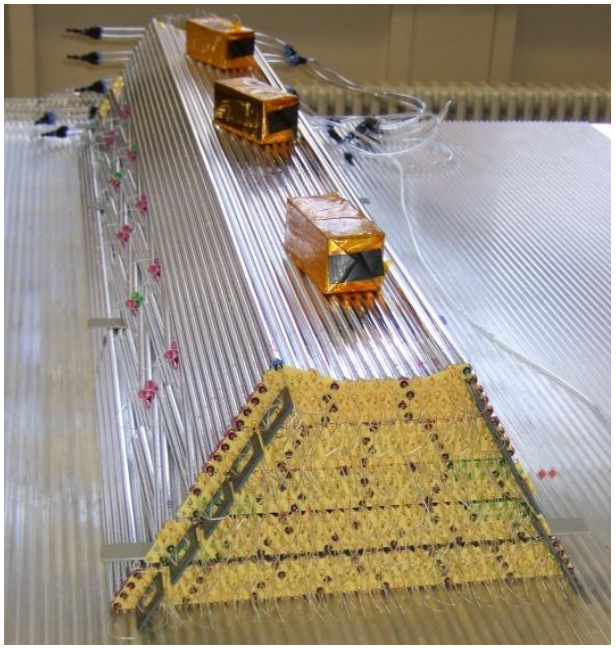
1. Inner and outer axial blocks with stereo modules in the middle
   - Maximum number of layers
   - Axial blocks largest, highest lever arm for p_{transv} measurement
2. Layout with inner stereo / axial / stereo / axial blocks
   - z – information for decay tracks leaving STT towards inner region
   - 1-2 less layers, lower lever arm for p_{transv} measurement

- Slightly different arrangements possible



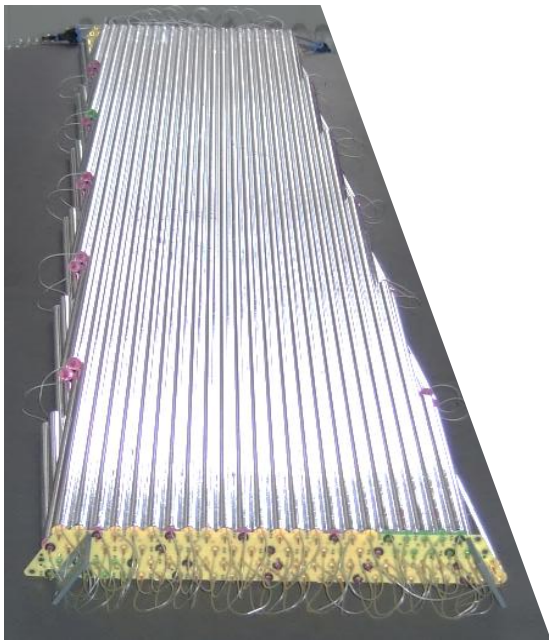
Self-Supporting Straw Modules

- Axial and stereo modules consist of 4 layers each
  - Strong rigidity & even number of gas/electric connections
- Outer axial module: 7 planar layers with decreasing number of straws



Stack of axial and stereo layer modules

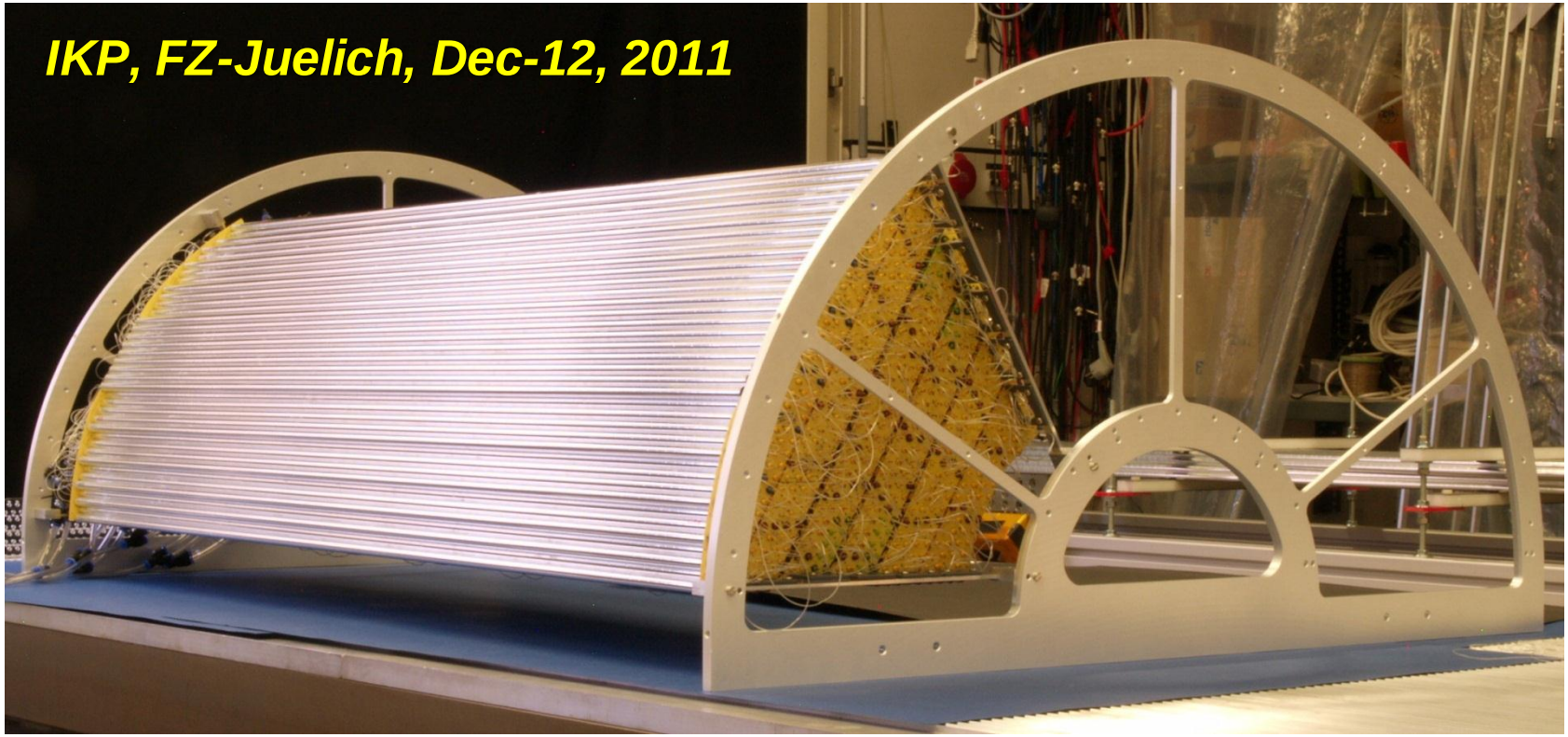
Outer sector module consisting of 7 layers



Skewed layer module:
- +3° double-layer
- -3° double-layer

Sector Module

Hexagon sector mounted in mechanical frame structure (not final)



Readout Issues

- FADC (240MHz) readout of straw signals (Krzystof)
  - Measured: σ (E) /E = 8±1% → ~ 6% energy resolution feasible for STT
- New ASIC + TRB readout (development by Cracow groups)
  - Readout scheme for forward straw tracker (FST), >10000 straws
  - PANDA-straw specific design
    - ToT measurement for amplitude information (dE/dx)
    - Ion tail cancellation
    - Baseline restoration (holder) for high rates
  - 1st beam test with high rates done, check straw coupling and shaping
    - ~ 1000 parameter combinations, testboard with remote setting (SW)
- Max. rates at PANDA: ~700 kHz/straw
  - ~ 400 kHz/straw on avg. (all layers)
  - Mean signal spacing Δt ~ 1.4 .. 2.5 µs
  - Min. Δt ~ few 100ns by poissonian event & drift time distribution
  - Readout tests with beam intensities up to ~ 1 MHz/straw required

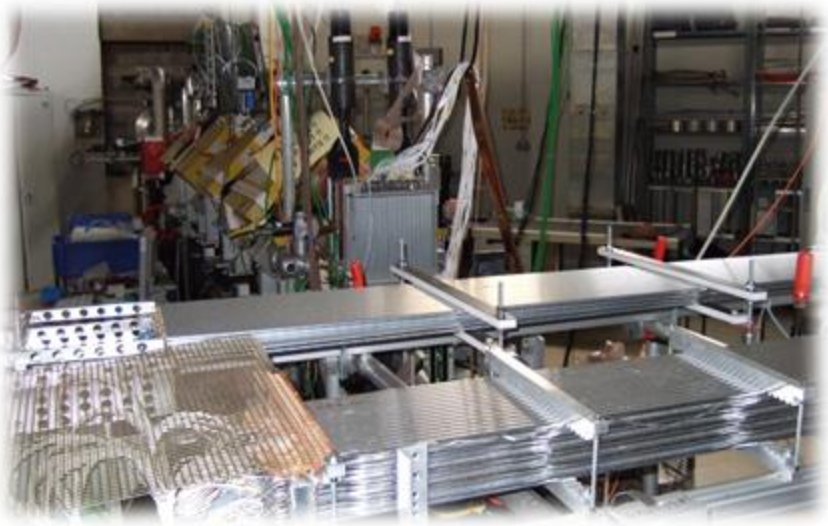
High Rate Beam Test (Dec 2011)

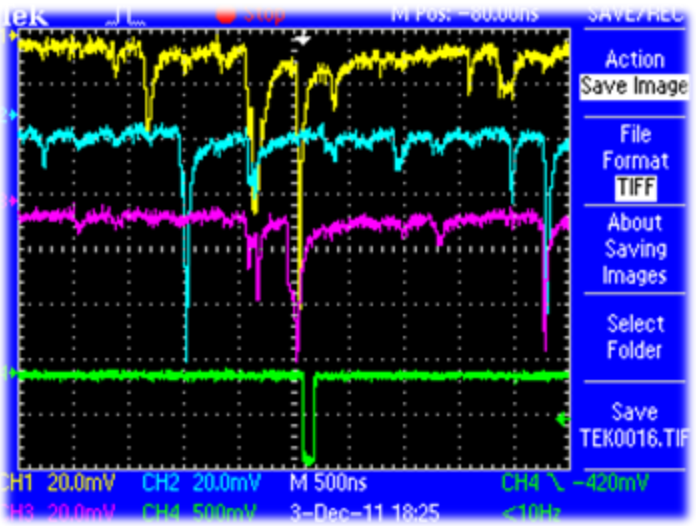
Proton beam: 2.7 GeV/s (Reminder: 1GeV/c in Mar-2011)

- 8 hours with ~ 200 kHz and 2 days with up to ~ 2 MHz
- no DC beam, limited beam quality (sharing with MVD tests in diff. area)

2 Straw setups:

- 128 straws, FADC readout
- 96 straws, 8 channels connected to new ASIC & DAQ, + analog RO by scope





~ 2 MHz / straw

Beam Test Acknowledgement

Proton beam setup:

COSY-Crew

Straw setups, FADC and measurements:

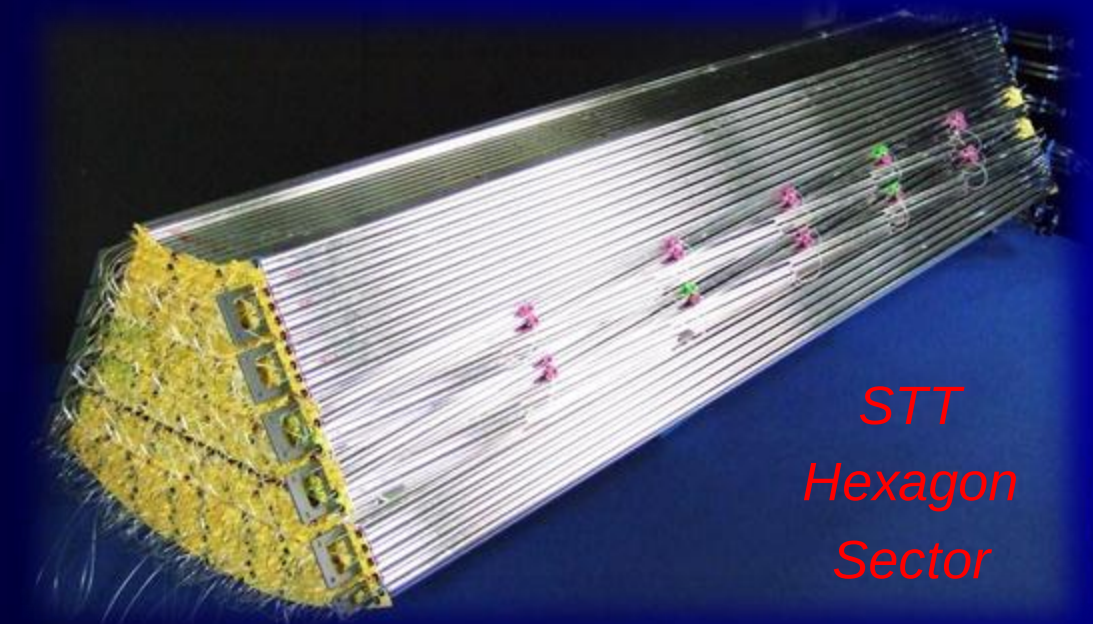
A. Erven, W. Erven, V. Kozlov, G. Kemmerling, H. Kleines, P. Kulessa, M. Mertens, H. Ohm, S. Orfanitski, N. Paul, K. Pysz, V. Serdyuk, P. Wüstner

New Asic, preparatory tests in Cracow, beam test:

Marek Idzik, Marcin Kajetanowicz, Grzegorz Korcyl, Bartosz Mindur, Andrzej Misiak, Marek Palka, Dominik Przyboro, Piotr Salabura, Jerzy Smyrski

Merry Christmas

and a Happy New Year



to all of you in the

STT – Group !