STT Activities in Jülich

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Outline

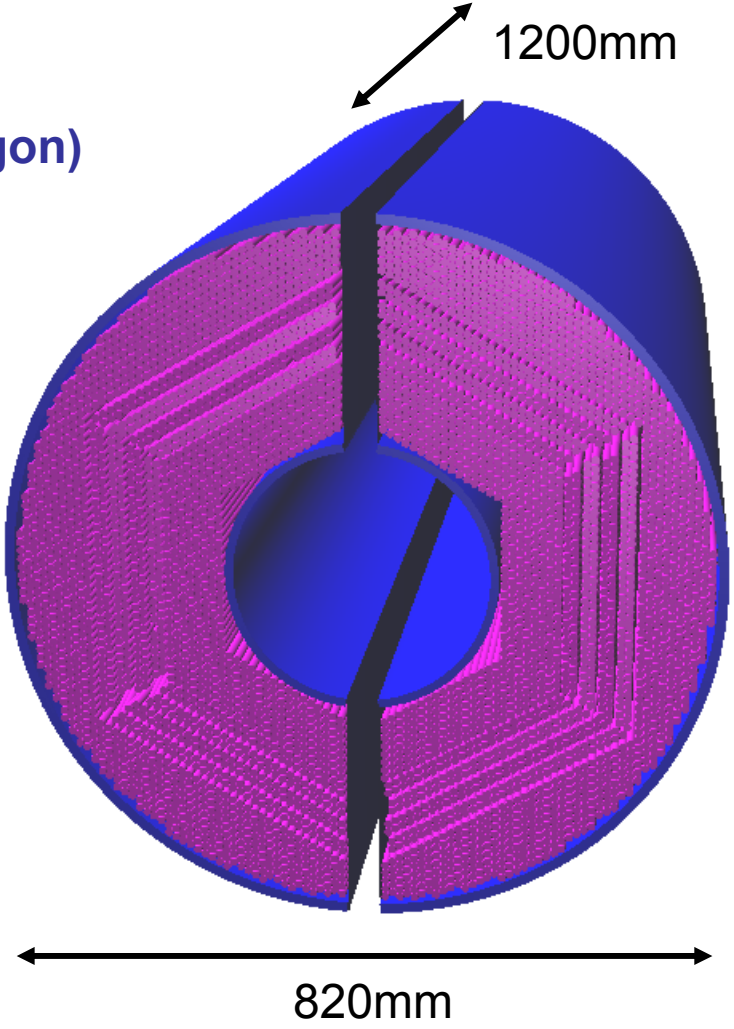
- STT design
- Activities in Jülich
- Particle intensities

1. STT Design

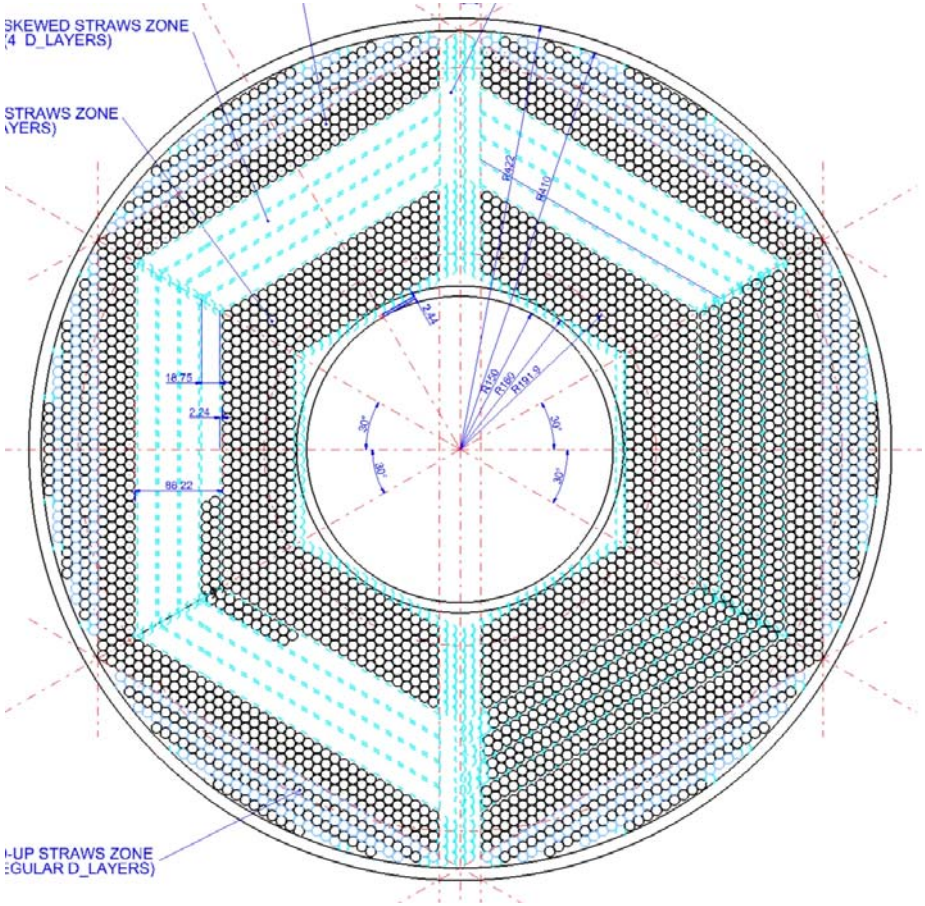
4200 straws

- 20-26 planar layers in 6 sectors (hexagon)
- 8 skewed layers (±3°) for 3d-reco
- ~80% (85)% active volume
- Ar/CO_2 at p ~ 2 bar
- high efficiency
- dE/dx capability

- $\sigma_{r\varphi}$ ~ 150 µm
- σ_z ~ 2.9 mm
- X/X_0 ~ 1%

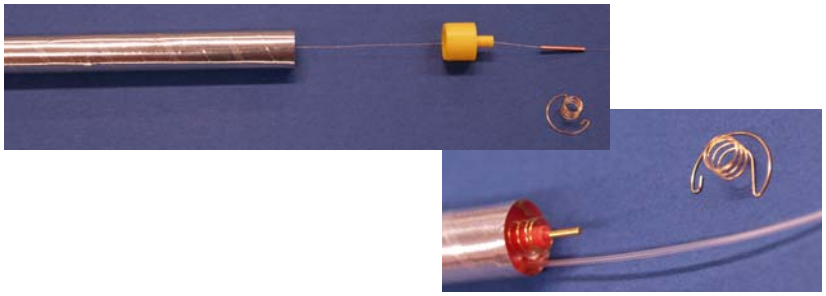


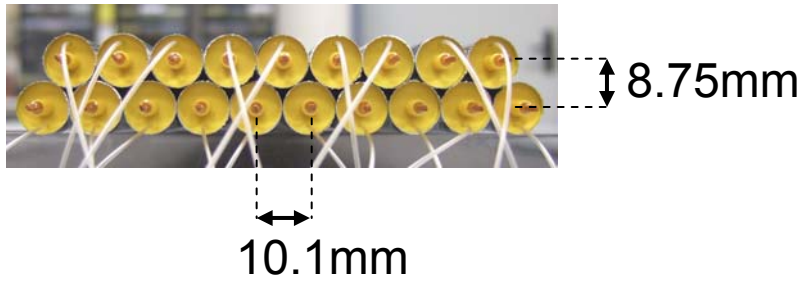
STT Layout



CAD drawing by Dario Orecchini (INFN Frascati)

- **4200 straws**
  - **Al-mylar film, d=27µm**
  - **∅=10mm, L=1200mm**
- **close-packed with 15µm gaps in**
- **self-supporting double-layers**
- **STT Length: 1200 / 1500mm**
- **inner/outer radius: 160 / 410mm**





Mechanical Frame

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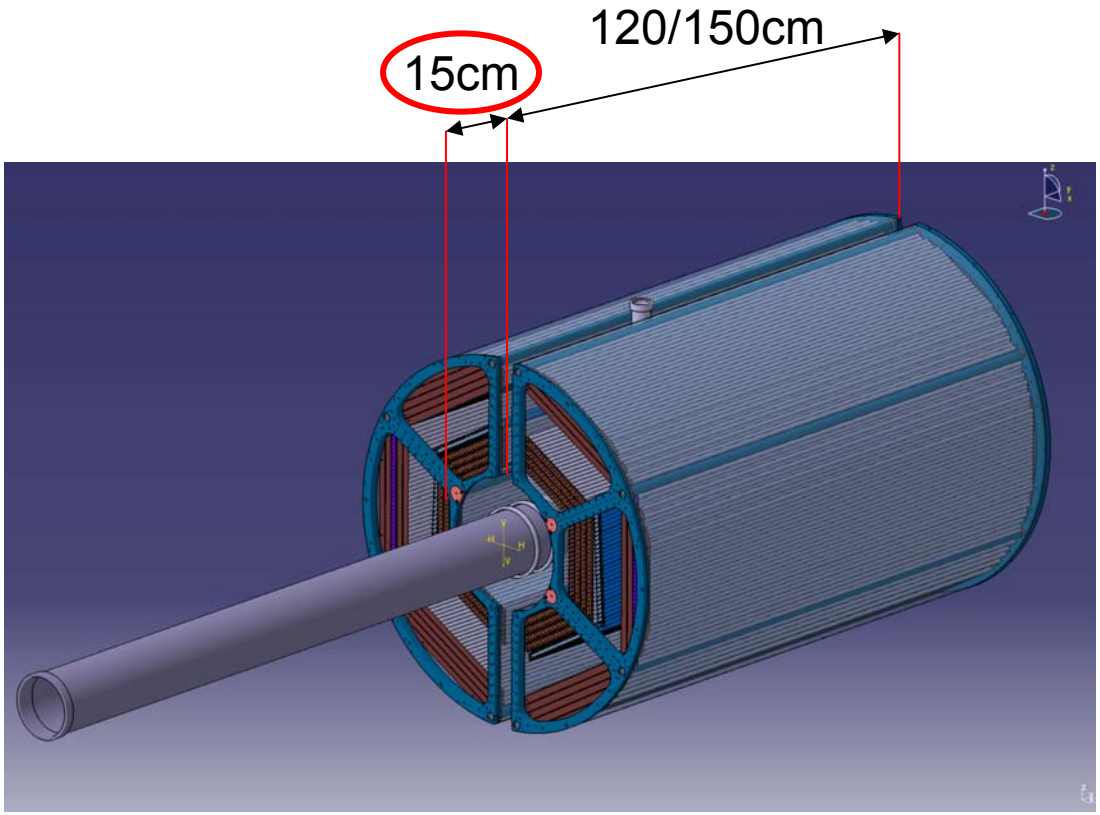
2 semi-barrels around beam-target cross-pipe

- **light-weight frame structure (Dario)**
- **self-supporting straw layers**

Supply & readout

- **15cm longitud. space for**
- **electric straw contacting**
- **gas manifolds/ supply**
- **cable routing**
- **readout boards**
- **cage**



Drawings and design by Dario (INFN Frascati)

2. Activities in Juelich

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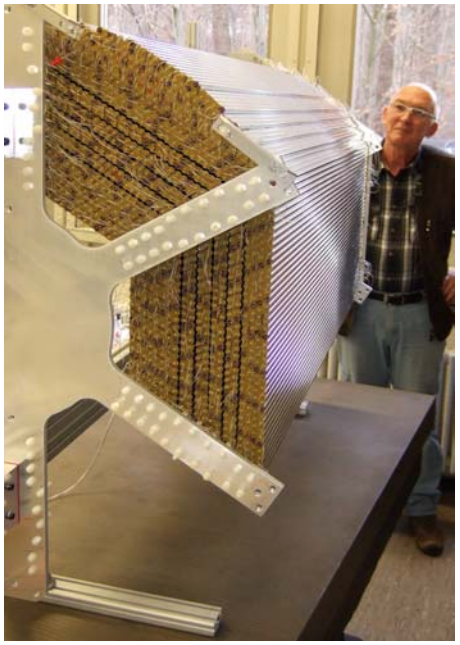
Design & construction of full-scale prototype

- straw production going on
- electric & gas connection of split tubes
- new design electric straw contacts
- optimise gas supply



Small-scale prototype setup

- 8×16 straw setup, 1500mm length
- test of different readout options
  - *TDC, fQDC*
  - *dE/dx (Krzysztof)*
- cosmic tests *(Susanna, Valeriy)*

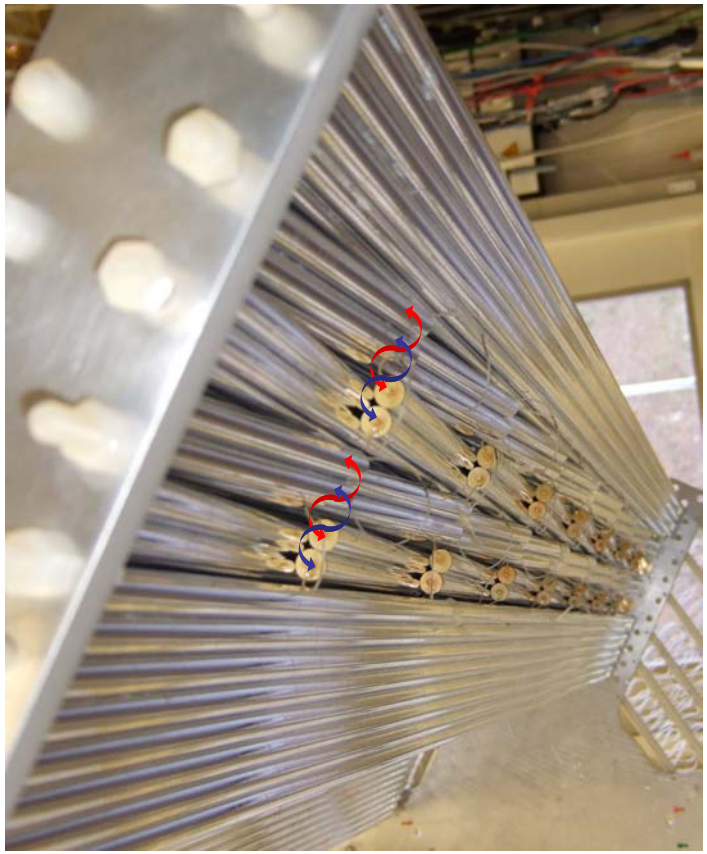
STT Full-Scale Prototype

- Setup at IKP
- Simplified mechanical frame structure (Al)
- Straws not all wired
- Check mechanics of straw stacks
- Develop compact gas & HV supply
- Develop real-scale assembly technique

- Mechanical precision tests finally with reconstructed cosmics / p-beam tracks

Current Design Issues

- **Integrated double-layer supply**
  - gas & HV
  - standard connector to RO
  - limited longitudinal space
  - ➡ simplified, modular assembly
  - ➡ supply & readout at backward side
- **Split tubes connection**
  - impedance matching
- **Add one axial straw layer**
  - 80 ➡ 85% active volume helps
  - dE/dx resolution and
  - track recognition



STT @ COSY-TOF

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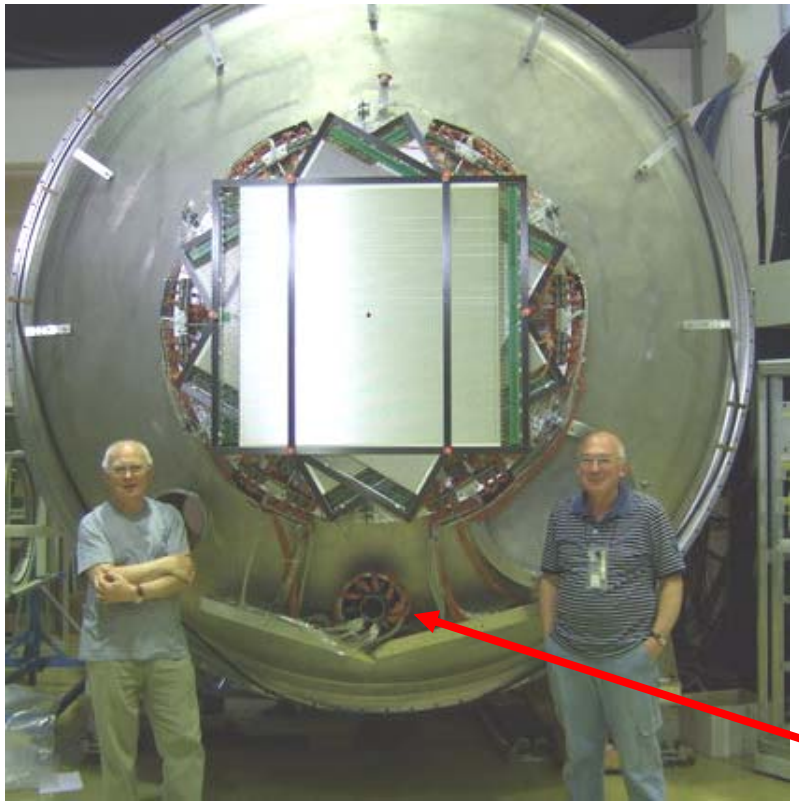
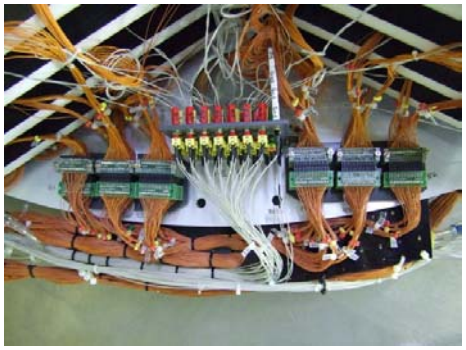
STT mounted at the COSY-TOF front cap in spring 2009



V. Kozlov & S. Orfanitski in front of STT

Mounting the front cap with STT to the vacuum barrel



STT @ COSY-TOF

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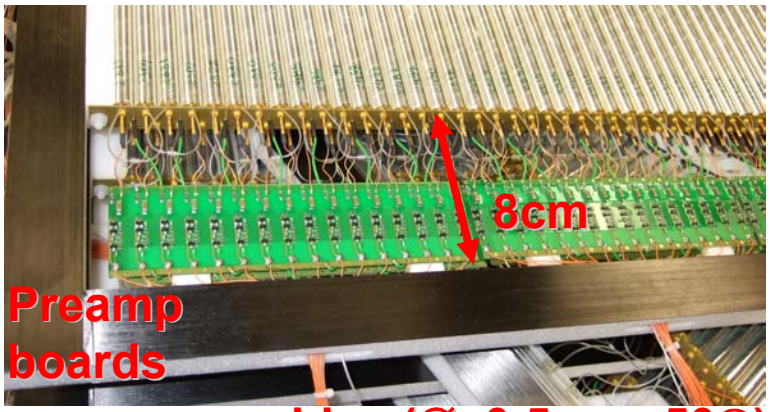
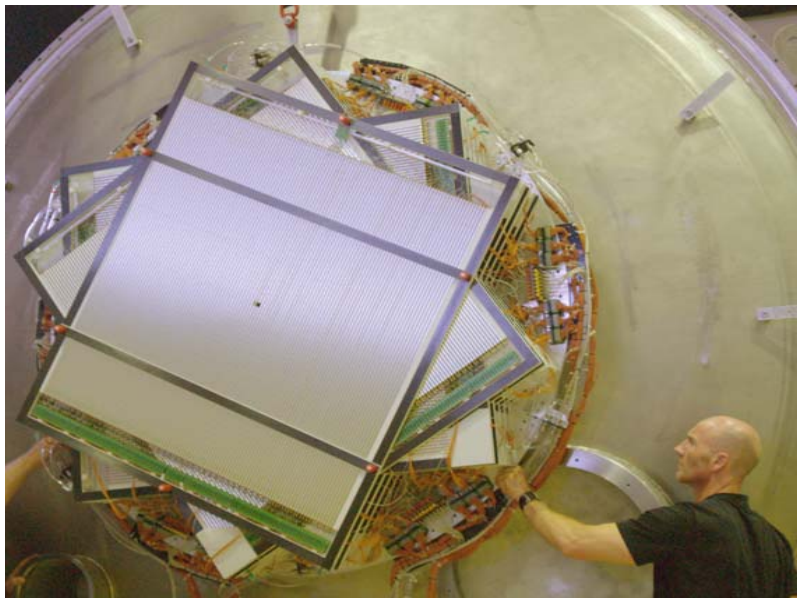
- 2740 straws, stack of 26 planar layers
- Operated inside vacuum at ~10^{-3} mbar
- Ar/CO2(10%) at p=1.25 bar (absolute)
- Readout:
  - preamps in vacuum, 13m cables
  - discr.(ASD8) + TDC(GPX)





Installed & 1st beam time in May 2009,
p p ➨ pKΛ at 2.95 GeV/c, 2 weeks

- Test system for PANDA-STT:
  straw calibration method similar

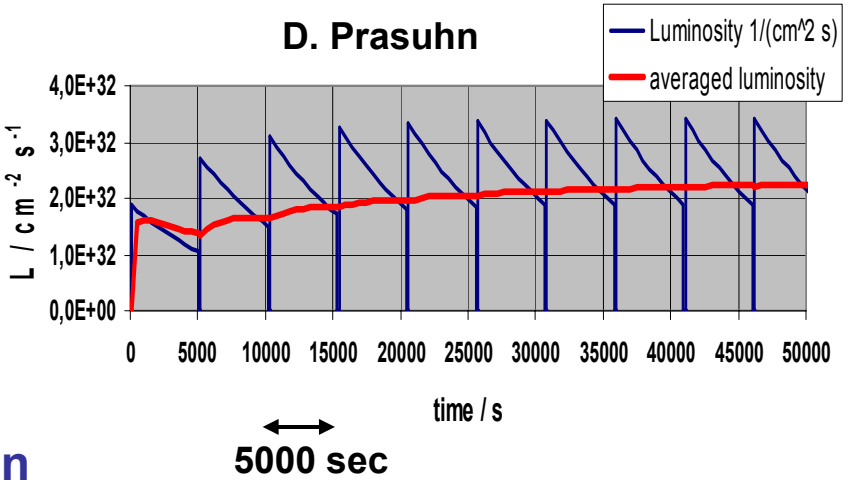
3. Particle Intensities

- p(bar) beam intensity during HESR cycle
- pellet beam variation
- p(bar) p interaction cross-section
- particle hit numbers in STT geometry

Luminosity at PANDA

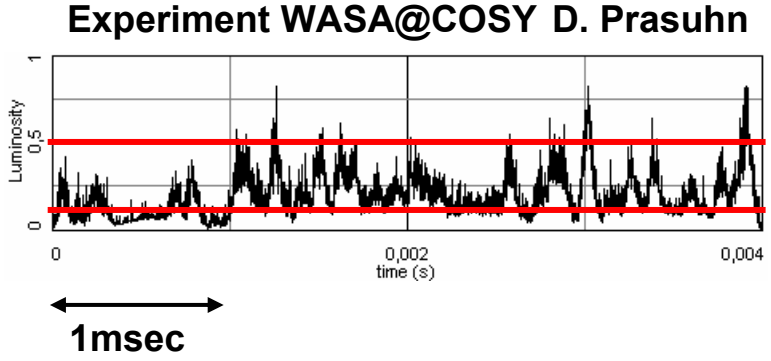
Luminosity in HESR (@15GeV/c)

- average: $L_{ave} = 2.0 \times 10^{32}\ cm^{-2}\ s^{-1}$
- initial: $L_0 = 3.5 \times 10^{32}\ cm^{-2}\ s^{-1}$
- time structure by beam lifetime τ_{beam}=8450s



Lumi variation by pellet beam distribution

- max. variation factor ~5
- peak: $L_{peak} \sim 8 \times 10^{32}\ cm^{-2}\ s^{-1}$
- microscopic time structure
  τ ~1msec



Hit Numbers in STT

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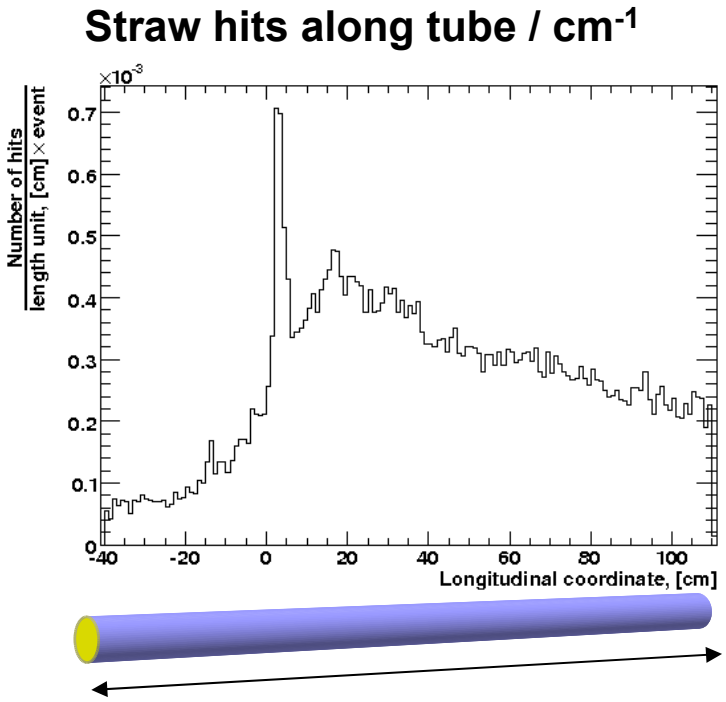
Event numbers:

- initial: 2×10^7 events/s ($\tau \sim 8500$s)
- average: 1×10^7 events/s
- peak: 4×10^7 events/s ($\tau \sim 1$ms)

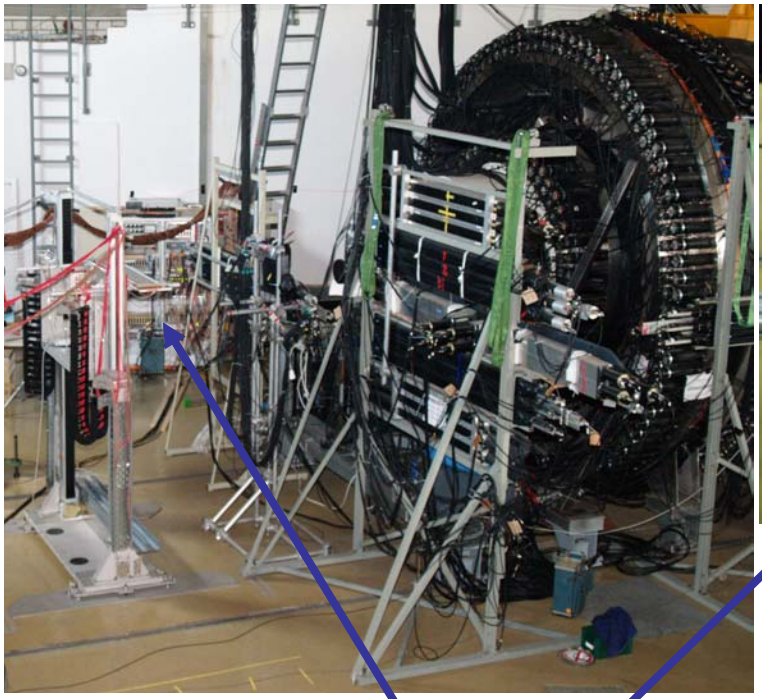
Number of particle hits in STT geometry from p(bar) p simulation

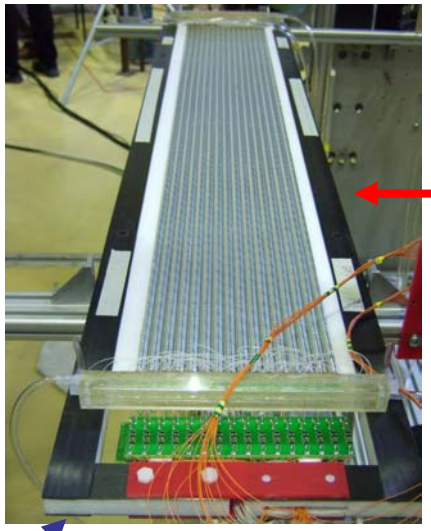
- at innermost straw layer
- hit numbers for 2×10^7 events/s
  - 1.4×10^4 /cm/sec @ z=2cm (elast. scat)
  - 7×10^5 /straw/sec and 6×10^3 /cm/s
- peak intensities for 4×10^7 events/s
  - 3×10^4 hits/cm/sec
  - ~1.5×10^6 hits/straw/sec
  - on ~ 1msec timescale



Beam Tests

Straw beam tests in COSY-TOF area (Jun 2007)





p-beam, 3GeV/c,
2.3×10^6 s^{-1} cm^{-2},
10days

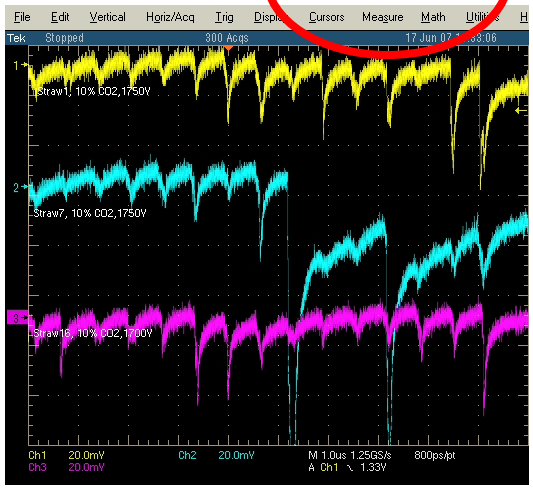
Straw setup
(2x16 straws)

Single straw: ~ 2×10^6 s^{-1}

18 peaks /10µs

18 peaks /10µs

17 peaks /10µs



time structure from
beam extraction

➡ Up to 2×10^6 protons/sec/cm
beam intensity possible

Particle Rates Summary

- Intensities much below 10^5 hits/sec/cm
  - ➨ no space charge effects in STT
- At ~1.5×10^6 hits/sec/straw and ~250 ns electron drift
  - ➨ double-pulse resolution gets important