Topics for Today

- Minutes last meeting
- Testbeams (2018)
- Cabling Scheme at PANDA Target Spectrometer (proposed)
- Readout System Architecture
  - Talks by Greg and Ljuba
- AOT

Next Testbeam Time

- CBAC Meeting on May 26/27th for COSY beam times
- Request for 1 week Deuteron + 1 week Proton, preferred at end Q1/Q2-2018
- Approved and recommended by CBAC
- Allocated a 2-week block: 12/03 – 26/03/2018 (easter days 29/03-02/04)
- 1-2 days needed for cyclotron target change proton to deuteron

- Final beamtime for purpose “STT Readout Decision“
- CBAC questioned the sense of 2 pre-series systems
- Reasons explained, needs seen by CBAC

- Timelines for STT presented, main construction phase: 2018-2021

	2017				2018				2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Straw-Tube-Tracker							**M8**											**M9**			**M10**			

STT at PANDA Target Spectrometer

In-beam position

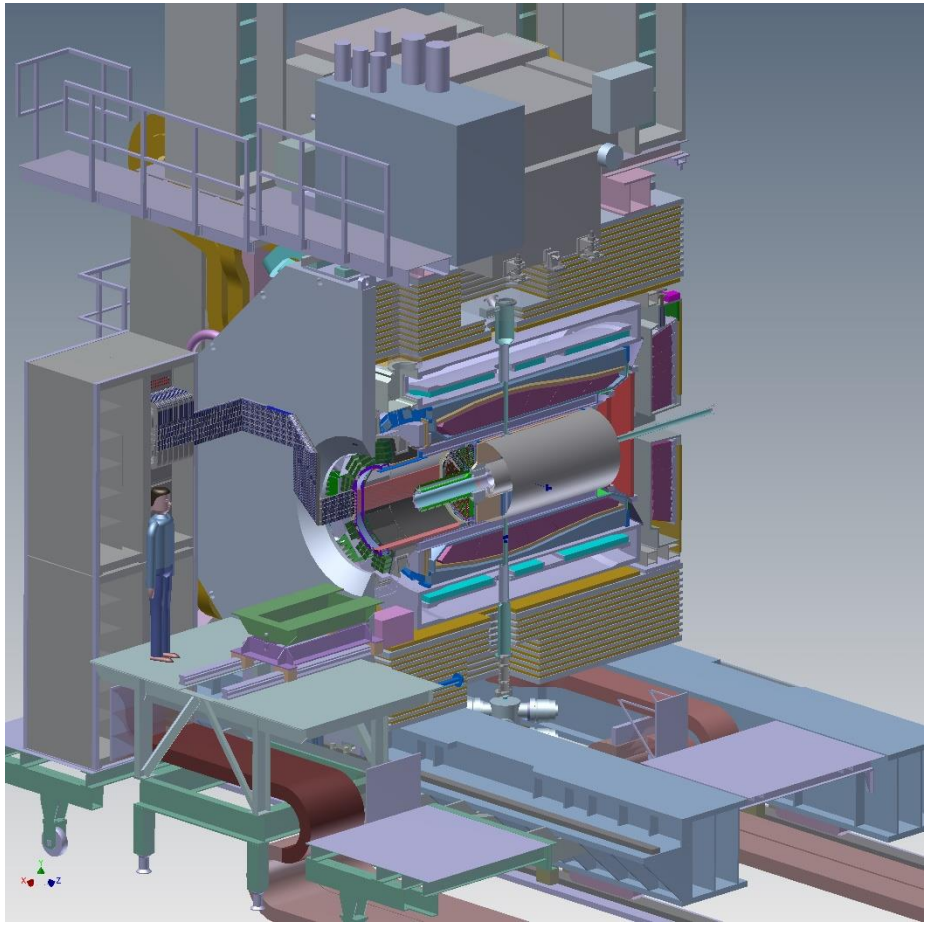
- Radiation area (sealed doors)
- No instant access
- Water sprinkle system

Mounting hall position

- Whole TS sliding sideways (~10m)
- Larger mounting platform inserted
- Mounting of central detector systems and backEMC

STT readout & service racks

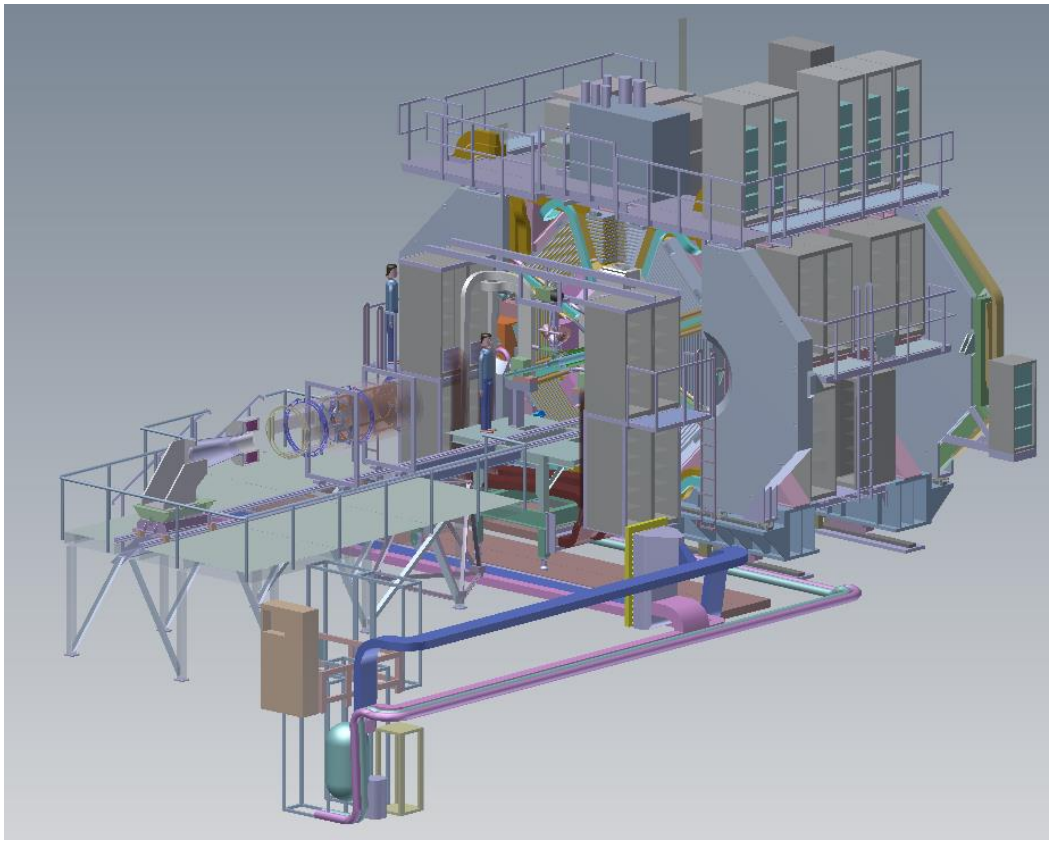
- One rack on right side
- One rack on left side
- STT system incl. cabling split into two independent halfs
- ~ 8m total cabling length



TS In Mounting Position

Mounting scheme

- Central frame structure on rail insertion system
- CFS (one unit) supports
  - beam pipe
  - MVD
  - STT
- bEMC insertion after CFS
- TS closed
- Magnet doors closed
- Move TS into in-beam position



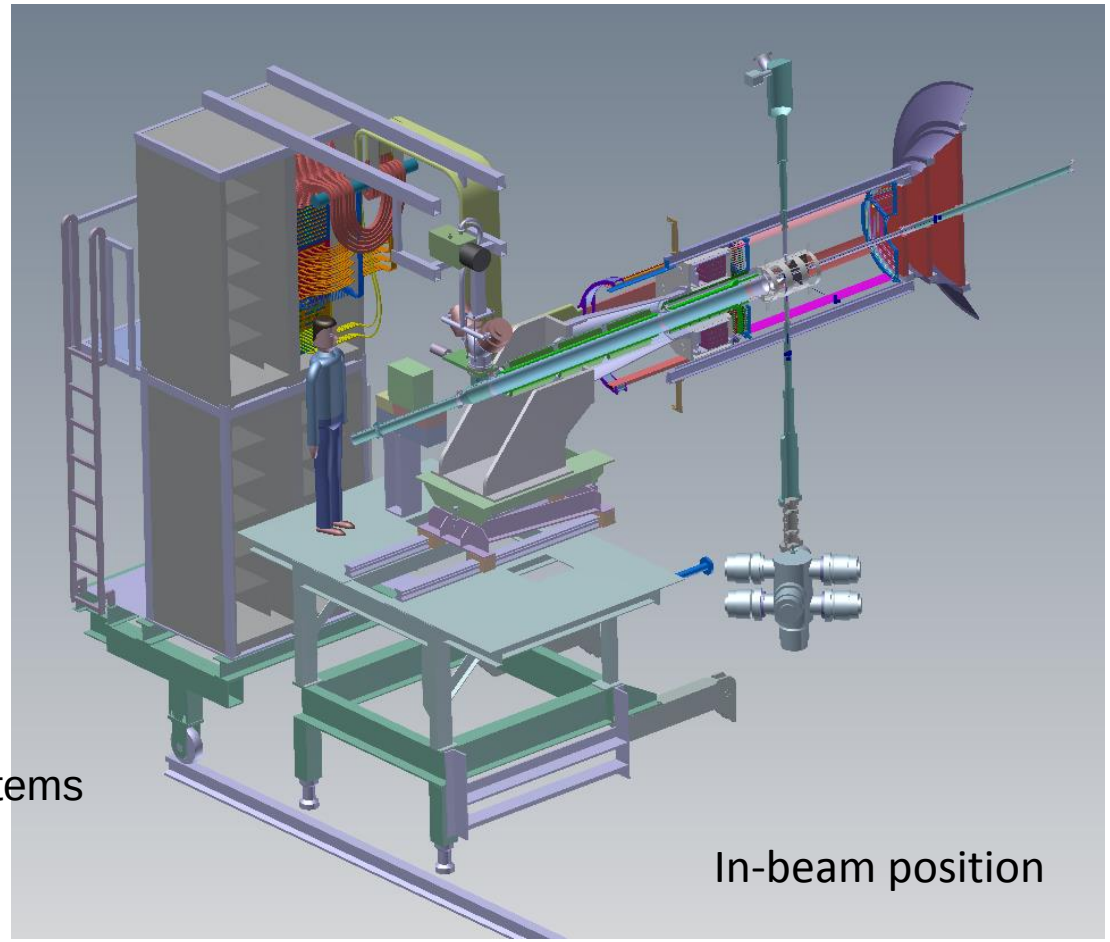
STT Cable Scheme

Closed cabling routing from detector front-end to readout rack

- Shielded routing channel
- Rack position (top, first) not yet confirmed (MVD request)

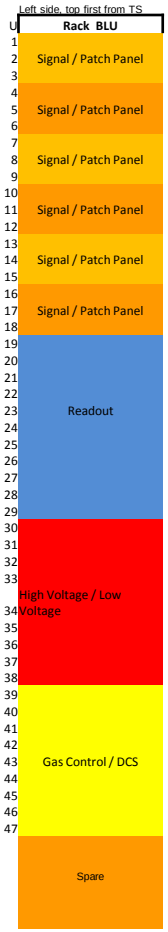
Mounting scheme

- Disconnect cables at rack
- Open cable channel
- Put cables (~5m) on platform
- Slide out CFS & move cables
- Dismounting in reverse order
- One-step installation
- No interference with other systems
- Protected system

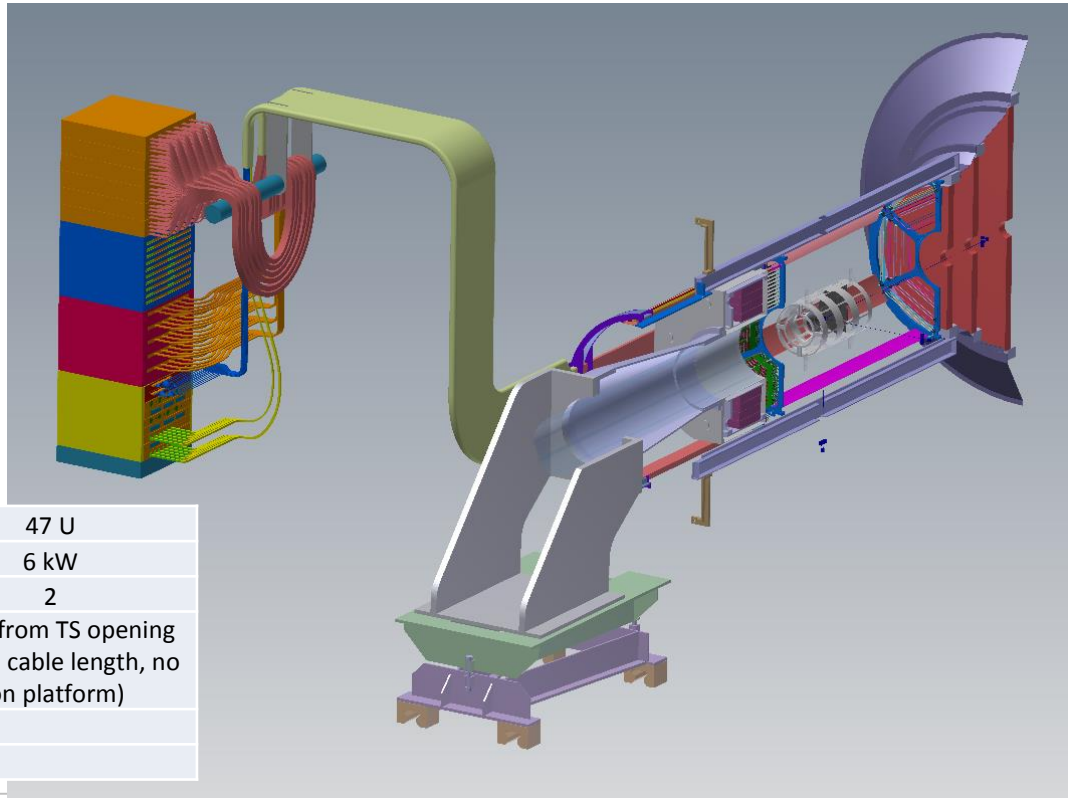


STT Readout & Service Racks

- One rack on left side, one rack on right side
- Each rack for 2112 channels
- 2089 mm heigth required + 267 mm spare (to be confirmed by Mec. Integr.)



Allocated Space per Rack	47 U
Electric Power per Rack	6 kW
Number of Racks	2
Location on platform	top first from TS opening (minimal cable length, no cabling on platform)
1 HE = 1U = 44.45mm	



Next Topic: System Architecture

Questionaire (missing points?), architecture presentations by Ljuba and Greg

- Time synchronization by SODAnet:
  - Link to SODAnet source, hardware type
  - #Links to readout boards/data concentrators
- Readout boards & data concentrator:
  - #channels per board
  - #boards per crate
  - #boards for 2x2112 channels
  - Data word size (no of bits per hit: ch, time, charge/tot, ..)
  - Buffer time window (2 µs?)
  - max #hits per time window
  - max #hits per board
  - Data buffer size
- Connection to compute nodes farm
  - #links to compute nodes
  - Type of link
  - Data format and size
  - Data throughput per link
- Power consumption per channel front-end
- Power consumption per channel readout (backend)

Backup:

Specs: Experiment Environment

Item	Pre-series In-beam	PANDA Phase-1*	PANDA Phase-2	Remarks
No. of straws	~ 400	4224	4224	
Gas mixture, pressure	Ar/CO2 (20±10%), 2 bar			
Gas gain (default)	5x 10^4			HV=1800V (10% CO2), gain by space charge limit
Max. drift times	140-200 ns (B=0T)	200-250 ns (B=2T)		Ar/CO2 (20±10%),
Time resolution (σ)	1 ns			1ns ≅ 50 μm resolution close to wire
Spatial resolution (σ)	< 150 μm	150 μm		Overall
I.P. for MIP	185 I.P./cm			Ar/CO2 @ 2 bar
Charge dynamic range (eff.)	2 – 1000 fC			2 fC = single cluster charge @ 5x10^4 gas gain, 10% eff. signal
dE/dx dynamic range (eff.)	5 – 50 keV/cm			Ar/CO2 @ 2 bar
Max. no. hits / straw	5× 10^4 cm^{-2} s^{-1} (space charge limit)	5× 10^4 s^{-1}	1× 10^6 s^{-1}	Innermost layer
Avg. no. hits / straw	2× 10^4 cm^{-2} s^{-1}	2× 10^4 s^{-1}	4× 10^5 s^{-1}	all layers
Data rate per channel (max / avg)	250 / 100 kB/s	250 / 100 kB/s	5 / 2 MB/s	for 5 Byte data word
Avg. no. of events	1-2× 10^5 s^{-1}	1× 10^6 s^{-1}	2× 10^7 s^{-1}	Pre-series with single tracks (beam), 3-4 tracks/event at PANDA

**Phase-1 with factor 20 less luminosity than nominal*

Specs: HW Readout Systems

Item	ASIC/TRB3	ADC-based	Remarks
Readout method	Discriminator with signal leading & trailing edge detection	Waveform sampling by ADC, baseline determination, leading edge & slope determination, signal amplitude summation	
HW Front-end	PASTTREC-ASIC (2x8ch), HV decoupling	Signal coax lines soldered on printed boards	
Special features	Online adjustable gain, thresh., shaping parameters per ASIC, BLs per channel	ADC with interleaving mode, full waveform sampling	
Signal line (norm)	LVDS	Signal on high voltage, coax line	
Signal cable	Amphenol Spectra Strip, 20 pairs, flex twisted pair	Elspec MK7501, 75Ω, 210 dB/100m @ 1 GHz, 1.1mm ∅	
HW back-end	TRB3 system	HV decouple crates, readout crate	
Readout board	TRB3	custom op-amp per channel, 40×ADC (4ch), central FPGA, communicator add-on	ADC: HMCAD1520, 12-bit, 160MSPS ADC-FPGA:
Readout channels per board (max.)	256	160	2112 straws per semi-barrel
Time window	2 µs	???	
TDC / time window/binning (typical)	1 µs / 0.5 ns		
Data rate / board at full luminosity	400 MB/s		5 Byte data word, inner-/outer layers to one board

Maintenance

Item	ASIC/TRB3	ADC-based	Remarks
HV failure (broken wire/capacitor)			
ASIC / amp failure			
ADC / TDC failure			
FPGA failure			
EMI / pickup			
Baseline stability / high-rates			
DAQ stability / hang-ups			

Costbook

Item	ASIC/TRB3	ADC-based	Remarks
Total cost per channel			
Cost per channel front-end HW			
Cost per channel readout board			
Cable costs per channel			
Cost spares (exchange units)			

Specs: Performance Tests & Results

Item		ASIC/TRB	ADC-based	Remarks
HW stability	BL, NL, thresh., amp, .			~ 400 ch system
DAQ stability	In-beam / cosmics			
Drifttime measurement	Time resolution (test pulse)			
	Spatial resolution			Cosmics, mip
	Efficiency (radial)			Cosmics, mip
	Sensitivity			55Fe pulse detection threshold
	Time calibration method			
	Hit efficiency			
	Double-pulse resolution			After-pulse
dE/dx measurement	Covered range (5-50 keV/cm)			Amp/shaping saturation test
	Resolution			pulse width / pulse area
	Calibration method			
	Hit efficiency			
PID / separation power	Diff. proton momenta			
	Proton/deuteron			
DAQ operation	Max. readout rate (in-beam)			
	Buffer time window			
	Deadtime / data-loss			