STT Simulations: state of the art

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The simulation environment

- Packages devoted to global tracking
  - LHEtrack → helix fit
  - GENFIT → Kalman fit
- Macro chain: simulation – digitization – reconstruction – fit
- Detectors setup:
  - MVD + STT + EMC + TOF + MDT + DRC + passive elements for simulation
  - MVD + STT for reconstruction
- Information on macros, geometry files, magnetic field maps used and details on the reconstruction and fitting procedures can be find in:
  - Presentations taken during the last collaboration meetings
  - PANDA-PV report (available online on the tracking wiki page)
  - Preliminary version of tracking TDR

Systematic tests

- Studies of:
  - Momentum resolution
  - Efficiency
- Depending on:
  - Straw tubes length
  - Skew angle
  - Drift tube resolution curves

Dependance on straw tubes length

Simulation

- 10000 μ^- @ 1 GeV/c
- $\phi \in [0°, 360°]$
- θ =
  - $\{20°, 25°, 30°, 35°, 40°\} \pm 2.5°$
  - $\{50°, 80°, 110°, 140°\} \pm 5°$
- Geometry layouts: 120cm & 150cm

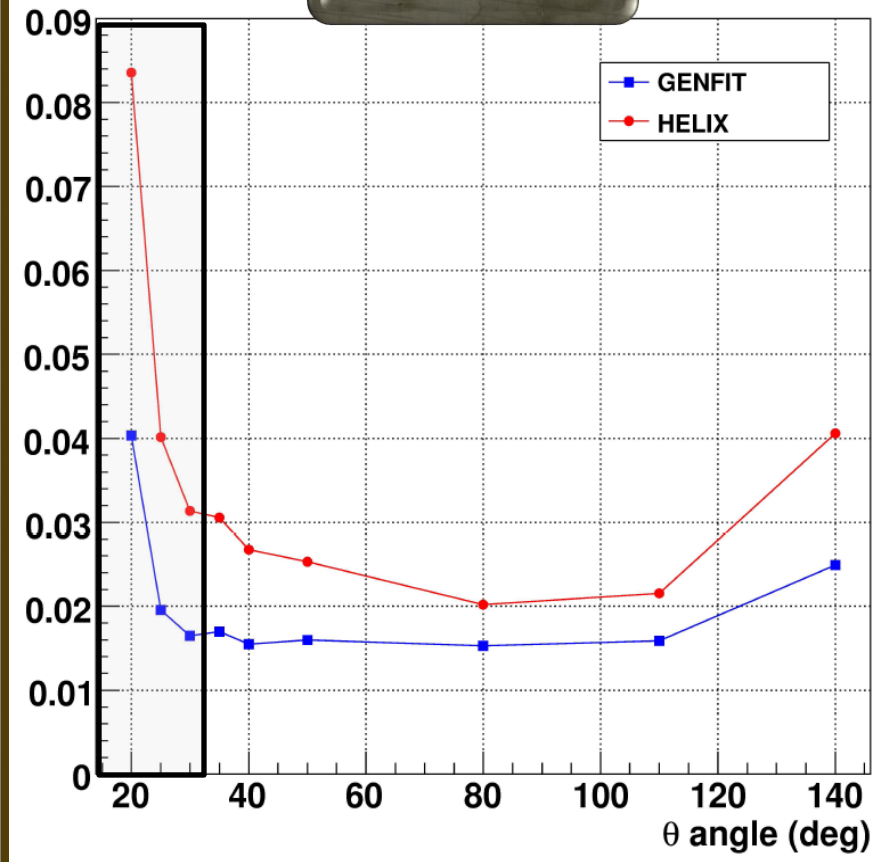
Studies

- STT + MVD
  - Efficiency
  - Resolution

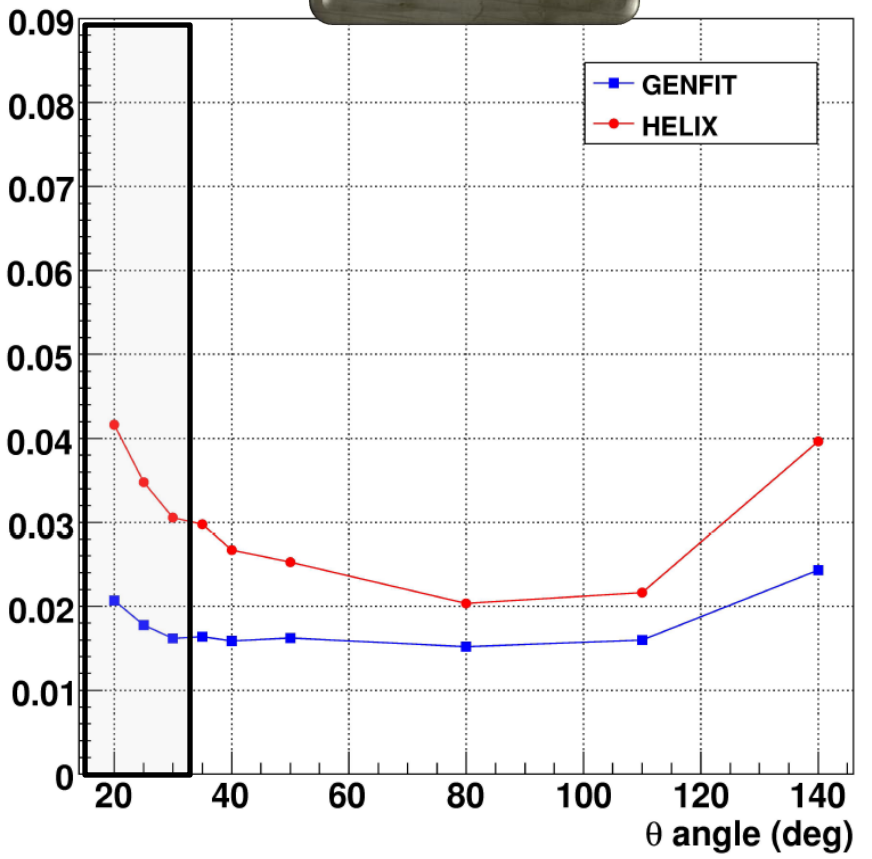
Momentum resolution @ different θ angles

10000 μ^- @ 1 GeV/c

120 cm



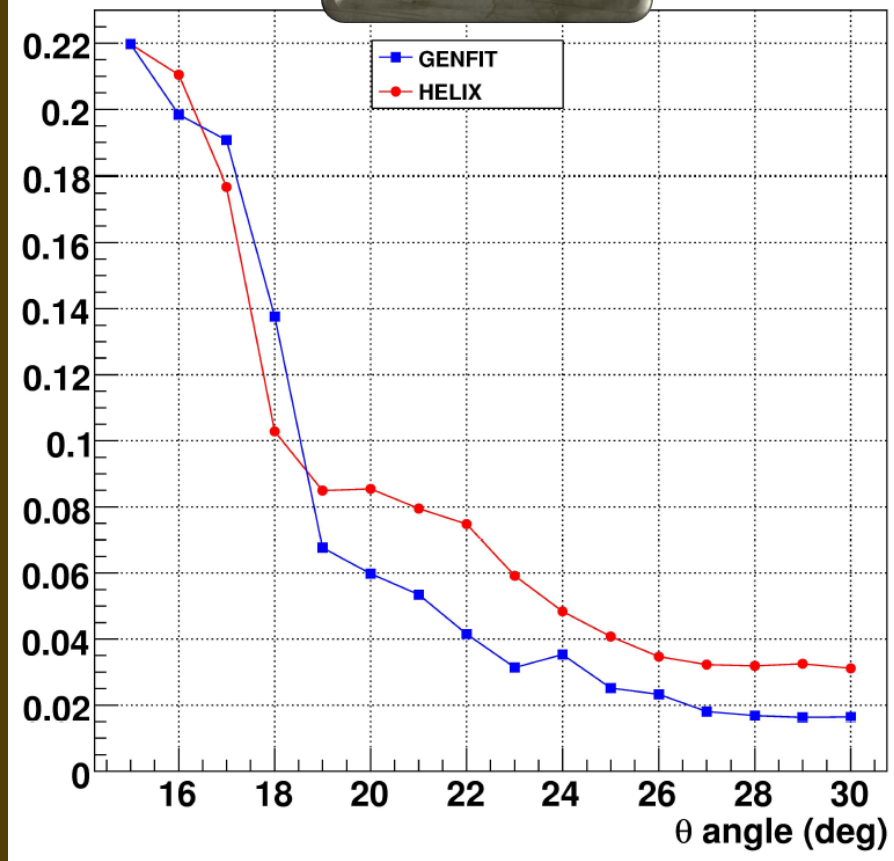
150 cm



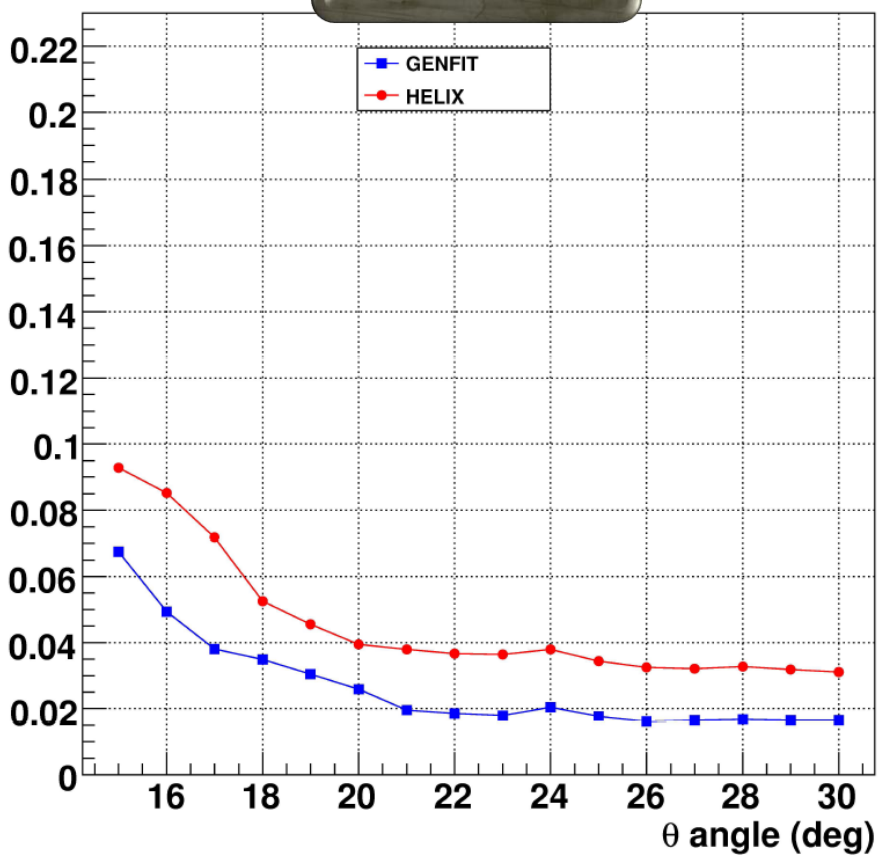
Momentum resolution @ different θ

Zoom on θ → [15°, 30°] ± 0.5°

120 cm



150 cm



Momentum resolution @ different θ

Values of the Kalman momentum resolution (%)

θ	120 cm	150 cm
20 ± 2.5	2.07	4.03
25 ± 2.5	1.77	1.95
30 ± 2.5	1.62	1.65
35 ± 2.5	1.64	1.70
40 ± 5	1.59	1.55
50 ± 5	1.62	1.60
80 ± 5	1.52	1.53
110 ± 5	1.60	1.59
140 ± 5	2.43	2.49

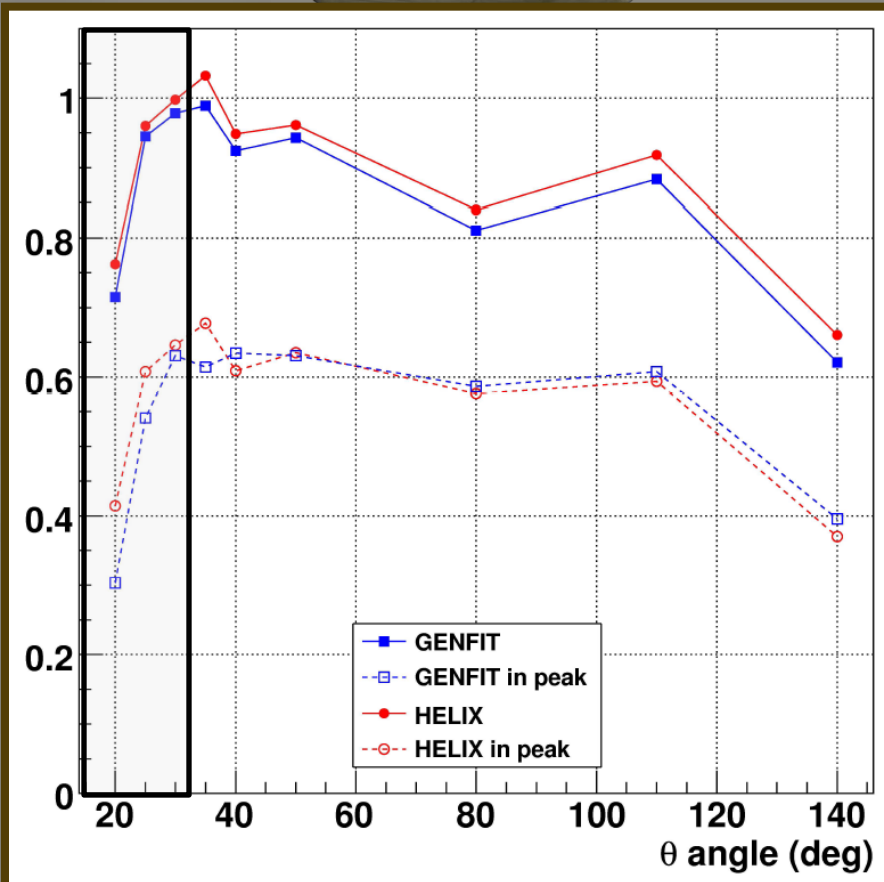
θ ± 0.5°	120 cm	150 cm
15°	21.98	6.75
16°	19.84	4.94
17°	19.07	3.81
18°	13.76	3.49
19°	6.77	3.05
20°	5.98	2.59
21°	5.34	1.96
22°	4.15	1.85
23°	3.14	1.79
24°	3.53	2.04
25°	2.52	1.77
26°	2.33	1.61
27°	1.80	1.65
28°	**1.68**	**1.68**
29°	**1.63**	**1.65**
30°	**1.64**	**1.65**

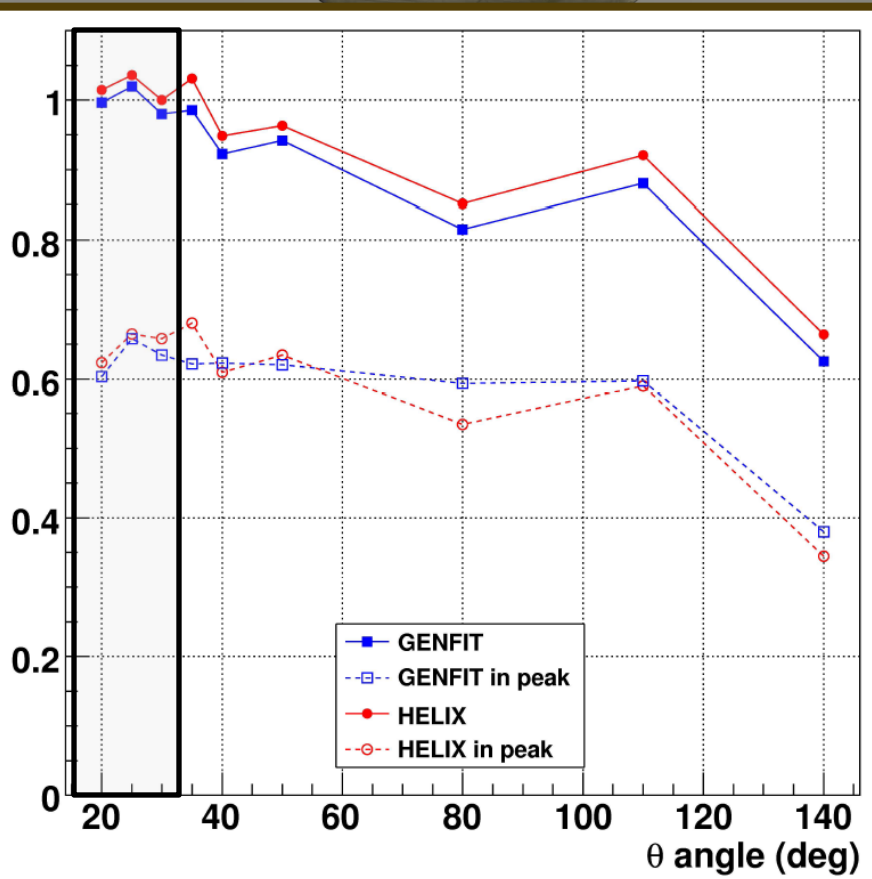
Efficiency @ different θ angles

10000 μ^- @ 1 GeV/c

120 cm

150 cm

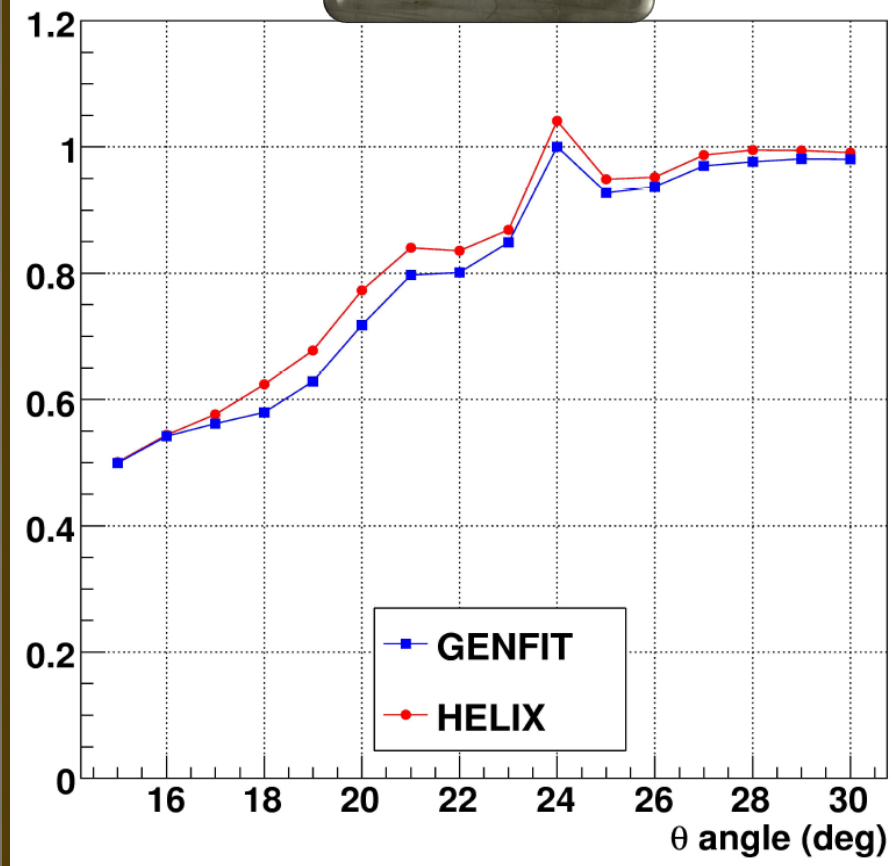




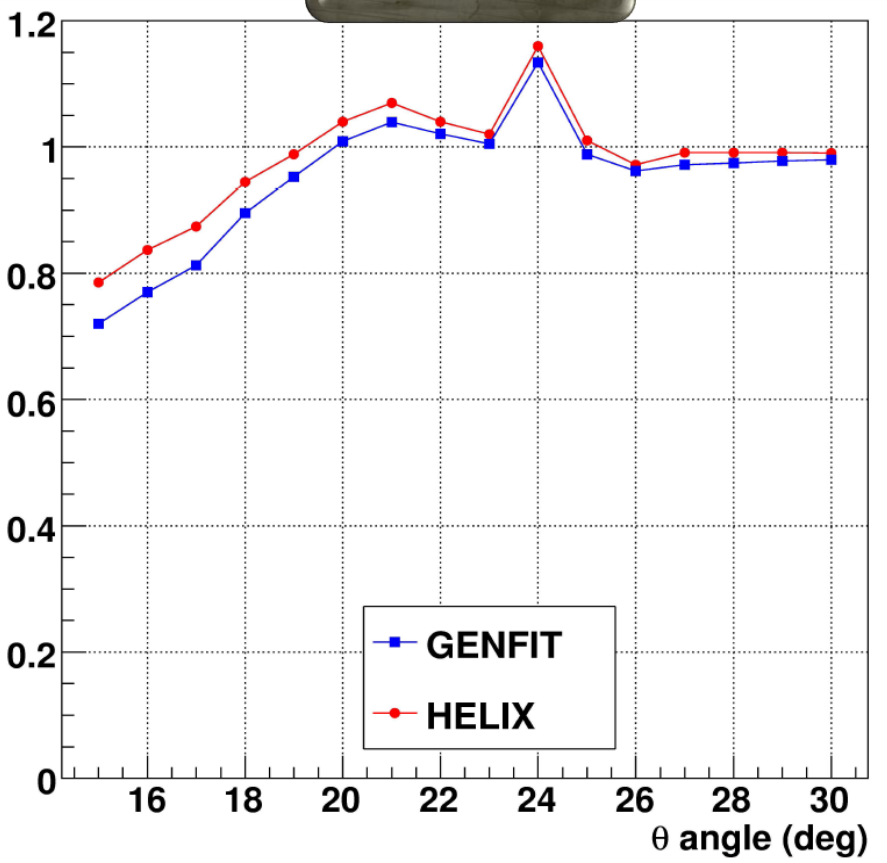
Efficiency @ different θ angles

Zoom on θ → [15°, 30°] ± 0.5°

120 cm



150 cm



Efficiency @ different θ angles

Values of the Kalman efficiency (%)

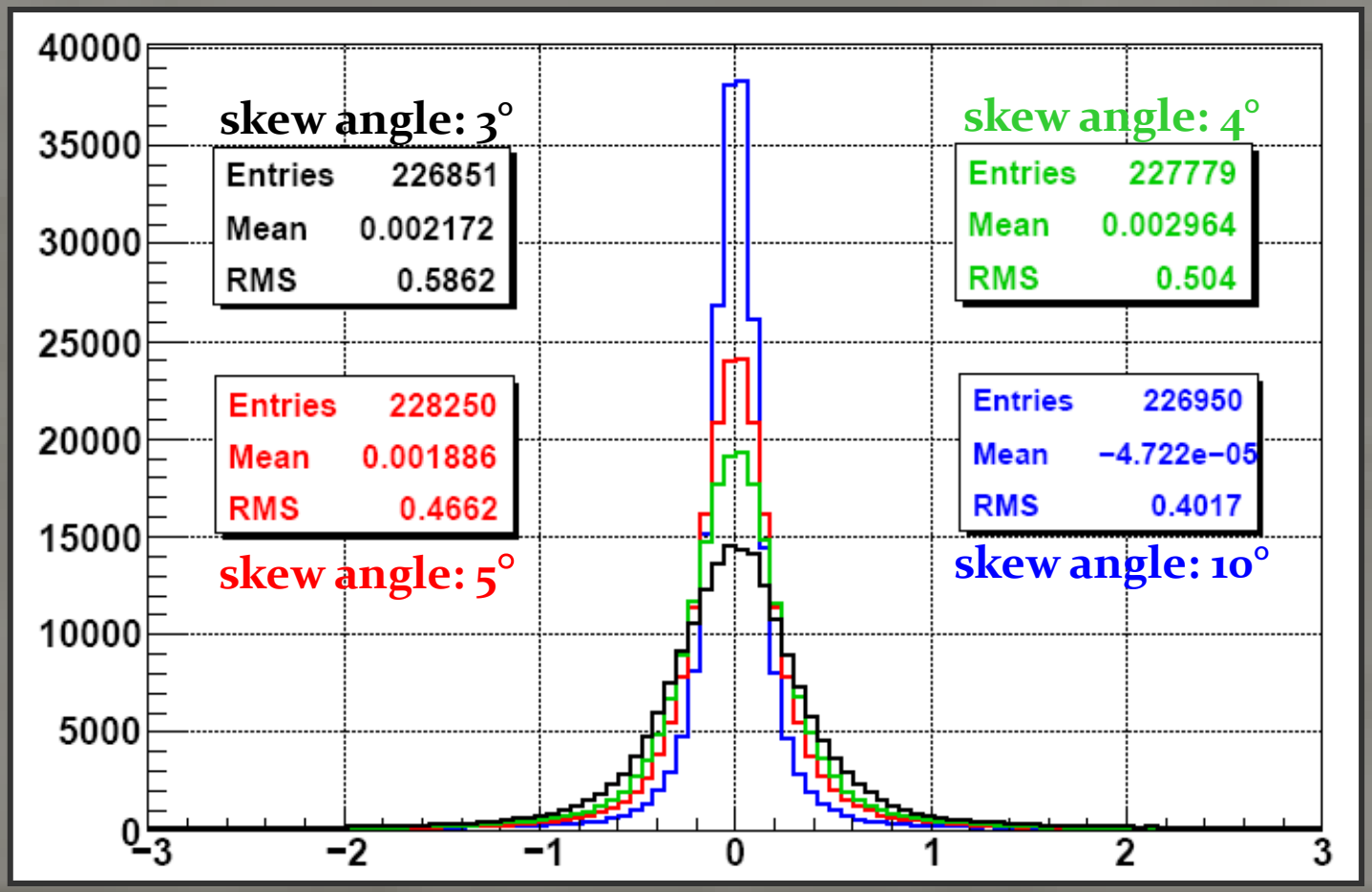
θ (°)	120 cm	150 cm
20 ± 2.5	60.37	71.52
25 ± 2.5	65.78	94.49
30 ± 2.5	63.41	97.83
35 ± 2.5	62.17	98.90
40 ± 5	62.26	92.39
50 ± 5	62.03	94.31
80 ± 5	59.38	81.08
110 ± 5	59.76	88.33
140 ± 5	37.97	62.09

θ ± 0.5°	120 cm	150 cm
15°	49.94	71.97
16°	54.17	77.00
17°	56.19	81.26
18°	57.94	89.49
19°	62.87	95.25
20°	71.79	100.9
21°	79.70	103.9
22°	80.15	102.1
23°	84.88	100.5
24°	100.0	113.4
25°	92.74	98.86
26°	93.70	96.19
27°	96.96	97.20
28°	**97.63**	**97.47**
29°	**98.11**	**97.79**
30°	**98.05**	**97.99**

Dependance on the skew angle

- 10000 μ^- @ 1 GeV/c
- ϕ = [0°, 360°]
- θ = [20°, 140°]
- Geometry layout: skew angle = 3°, 4°, 5°, 10°

Simulation



Dependance on the skew angle

Skew angle	momentum resolution (σ_z = 1 cm)	momentum resolution (σ_z = RMS z residuals)
3°	1.58%	1.59%
4°	1.58%	1.57%
5°	1.57%	1.58%
10°	1.50%	1.51%

By changing the σ_z in the Kalman, we do **not** get **significant differences** in the momentum resolution for STT+MVD, since the z info from the MVD is already very precise

→in the Kalman, it's worth giving a higher weigth to the most precise information we have, i.e. the **drift radius**

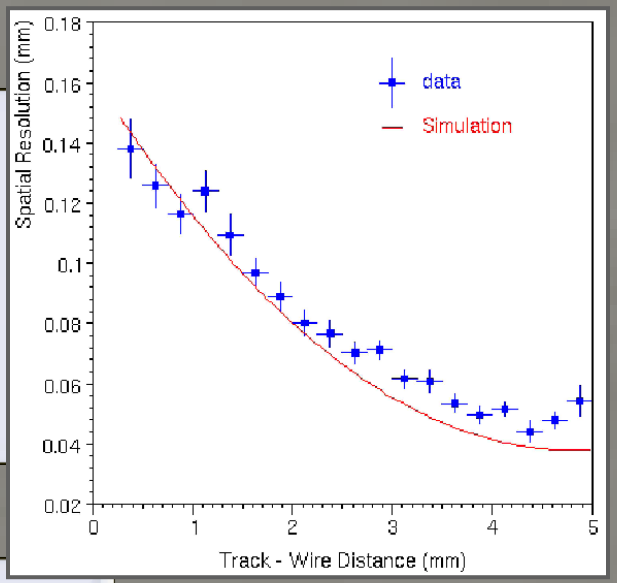
Dependance on drift tube resolution curves

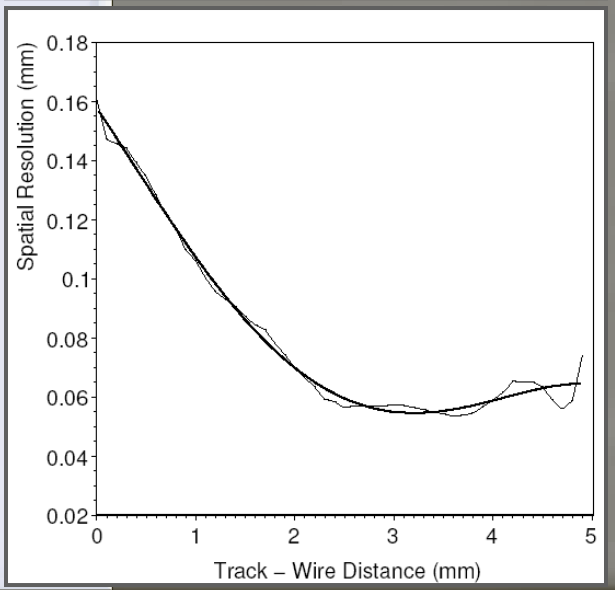
Simulation

- 10000 μ^- @ 0.3, 1, 5 GeV/c
- $\phi \in [0°, 360°]$
- $\theta \in [20°, 140°]$

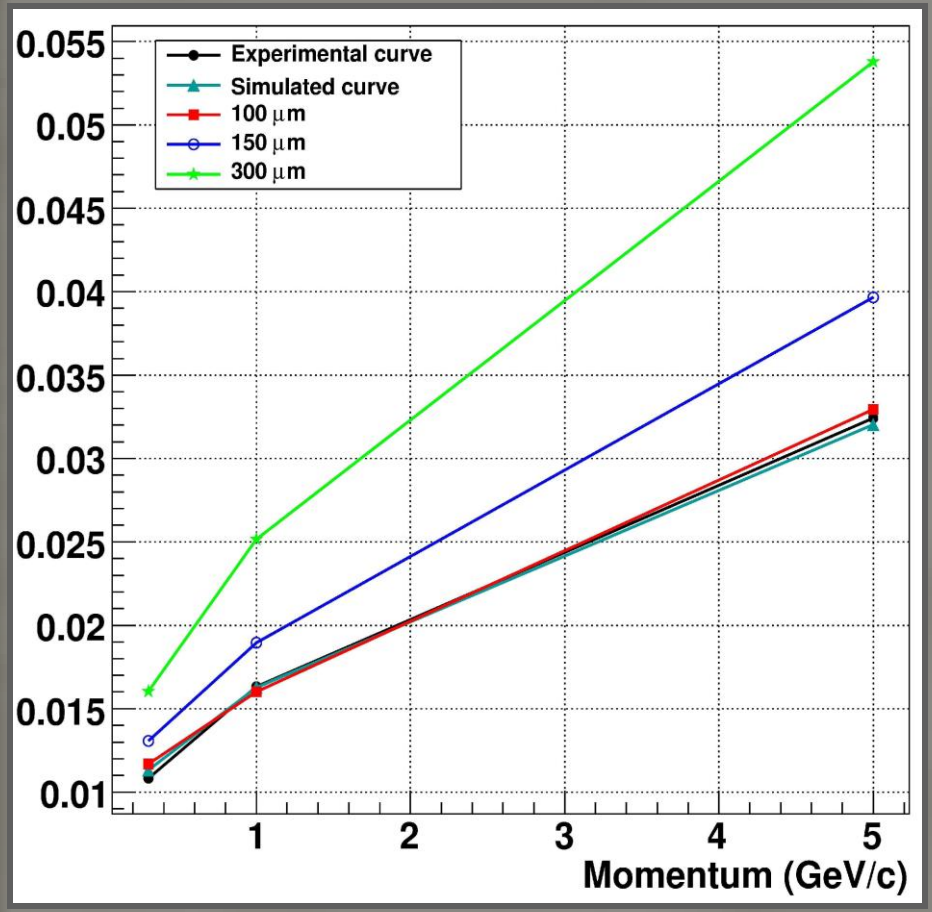
Drift tube resolution curves

- Juelich experimental curve without magnetic field
- Simulated curve with magnetic field
- Flat curve with σ_{xy} = 100 µm
- Flat curve with σ_{xy} = 150 µm
- Flat curve with σ_{xy} = 300 µm



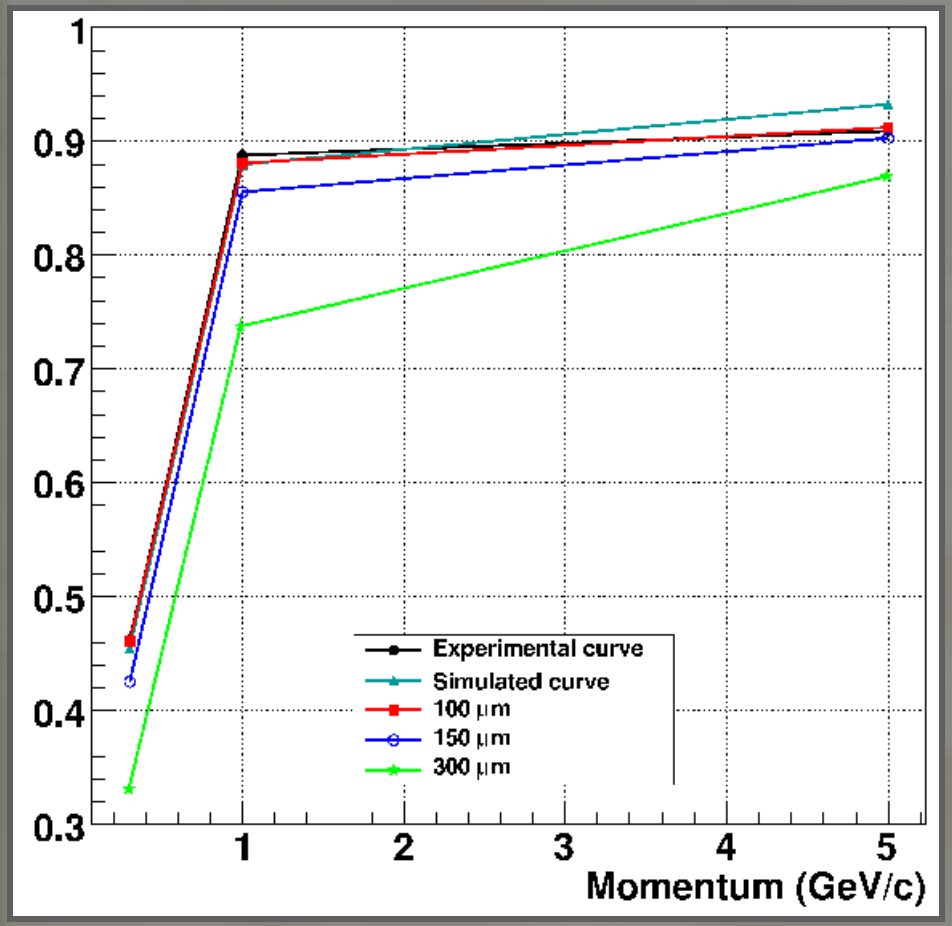


Dependance on drift tube resolution curves: momentum resolution



Resolution (%)		
@ 0.3 GeV/c	@ 1 GeV/c	@ 5 GeV/c
1.08	1.63	3.24
1.13	1.63	3.20
1.17	1.60	3.29
1.31	1.89	3.97
1.60	2.51	5.38

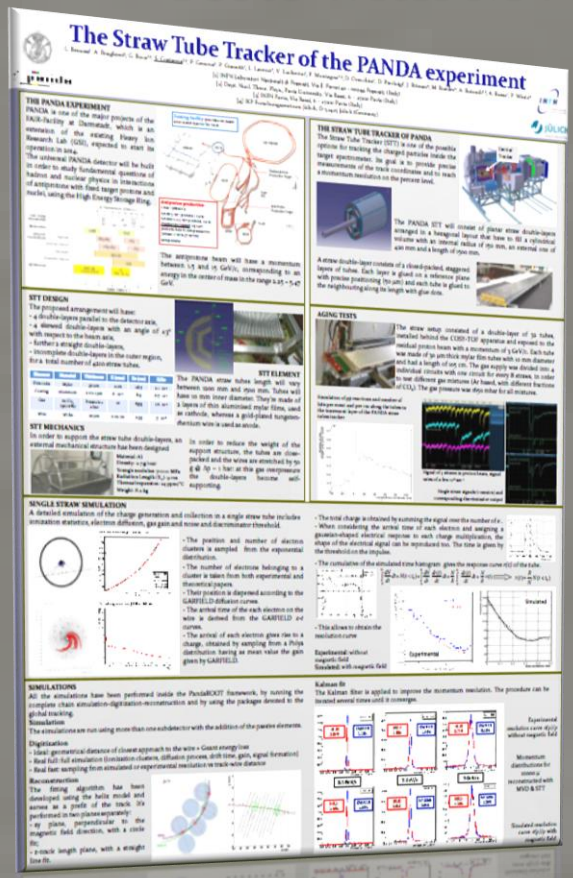
Dependance on drift tube resolution curves: efficiency



Efficiency (%) @ 0.3 GeV/c	@ 1 GeV/c	@ 5 GeV/c
46.23	88.80	90.92
45.47	87.99	93.27
46.08	88.10	91.24
42.55	85.55	90.29
33.12	73.64	86.95

Conclusions

- To do:
  - Tests with real pattern recognition
  - Tests with MVD + STT + GEM detectors



- Work in progress:
  - Tracking TDR
- Done:
  - poster presented at the conference *Frontier detectors for Frontier Physics (La Biodola, May 09)*
    → *The Straw Tube Tracker of the PANDA experiment*,
    article in press on NIM A Proceedings
    (doi:10.1016/j.nima.2009.06.105)