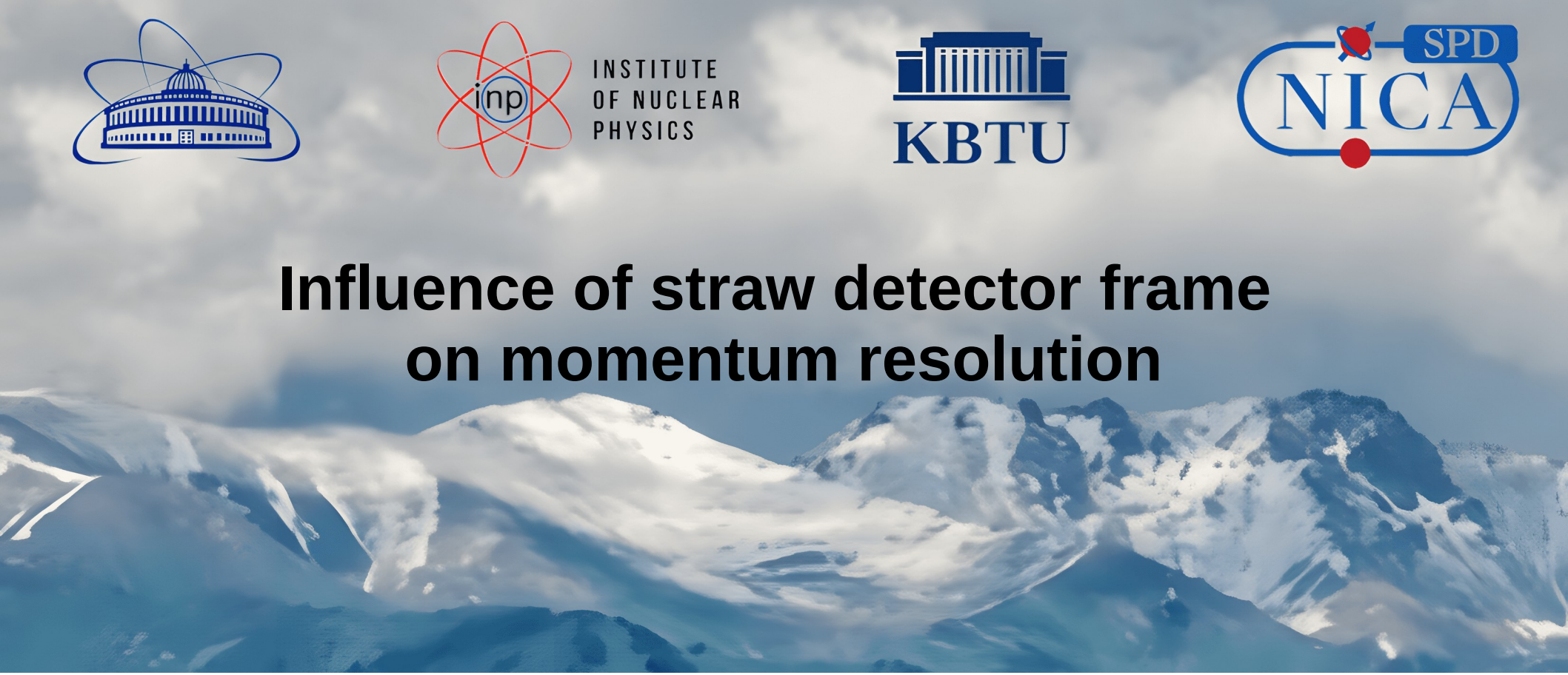

Influence of straw detector frame on momentum resolution

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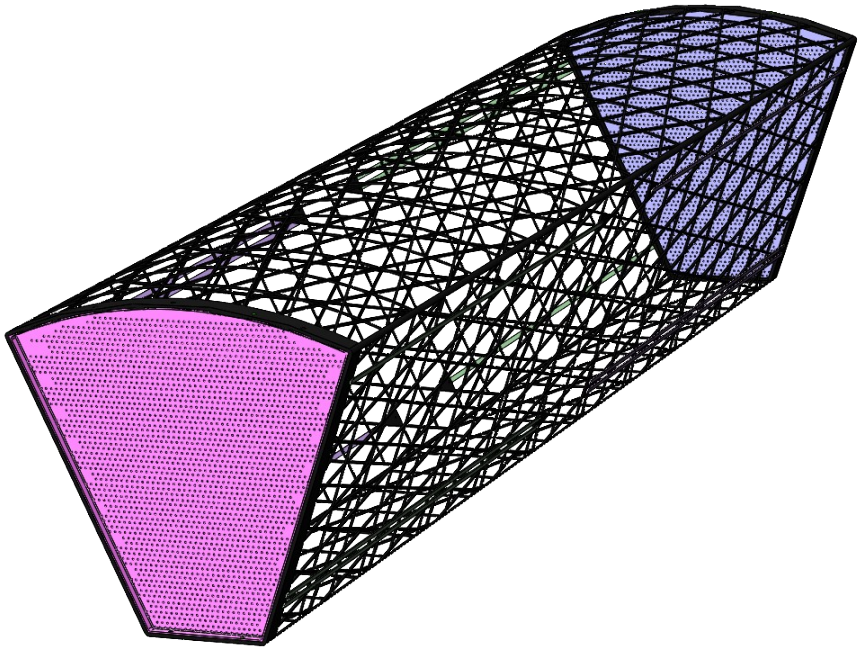
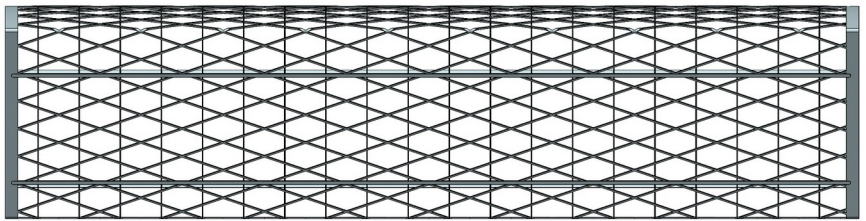
SPD Collaboration Meeting
24 May 2024

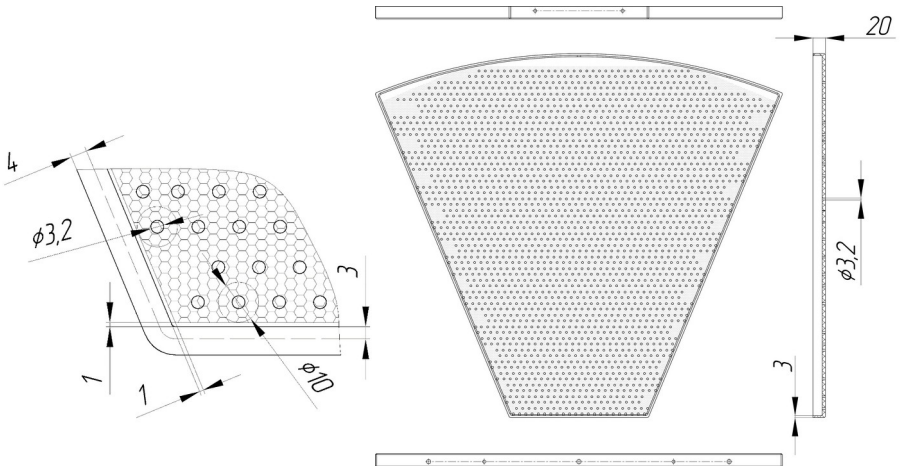
Introduction

- Currently, tracking detectors (including the straw detector) are represented in SpdRoot — our main tool for Monte-Carlo studies — without mechanical supports and other passive elements of the structure.
- For more realistic simulations, and to estimate the negative effects of these parts on tracking performance, they should be incorporated into the geometry description of the detectors.
- In this report, I present a step in this direction: addition of power frames of straw detector octants.
  Their influence on momentum resolution is estimated.

Straw detector power frame

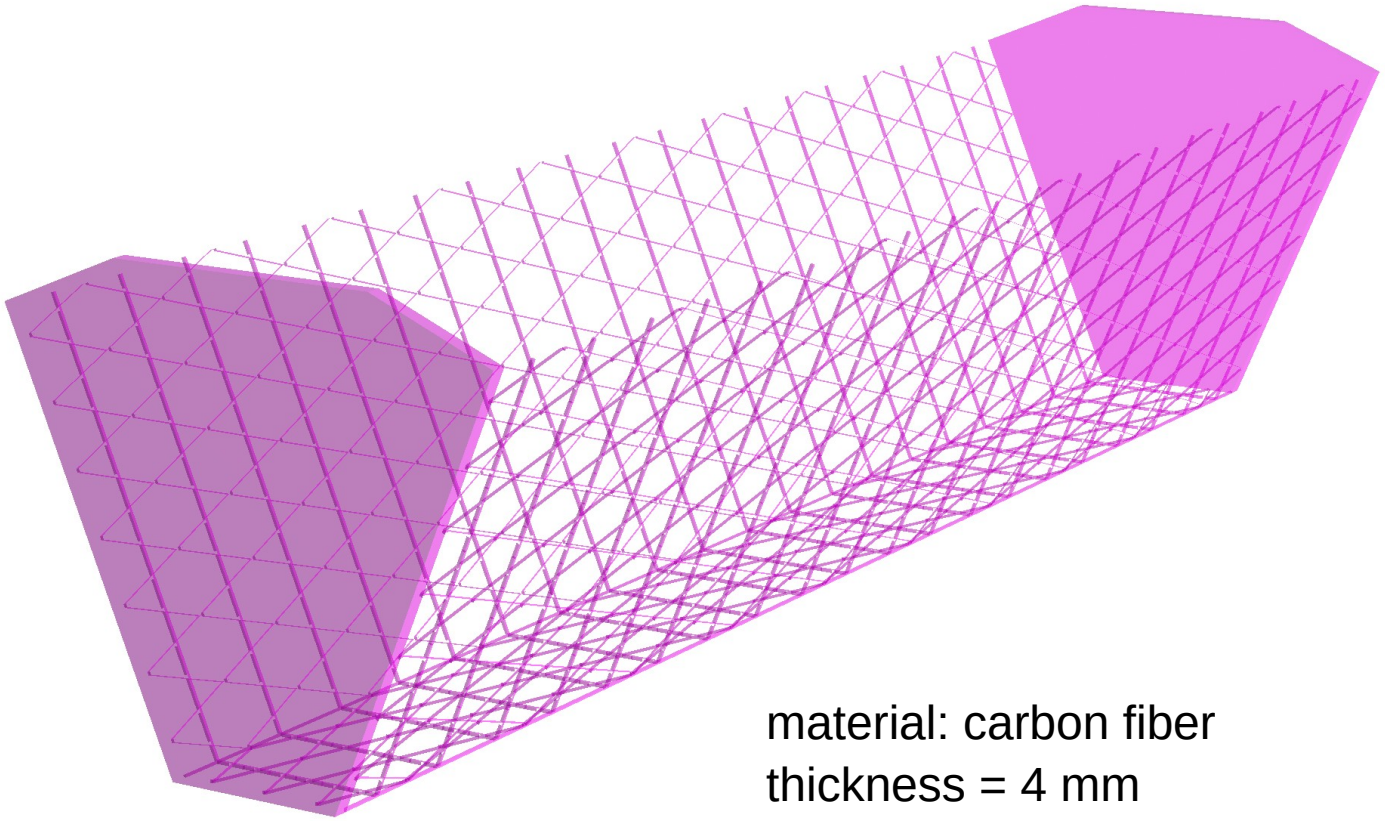






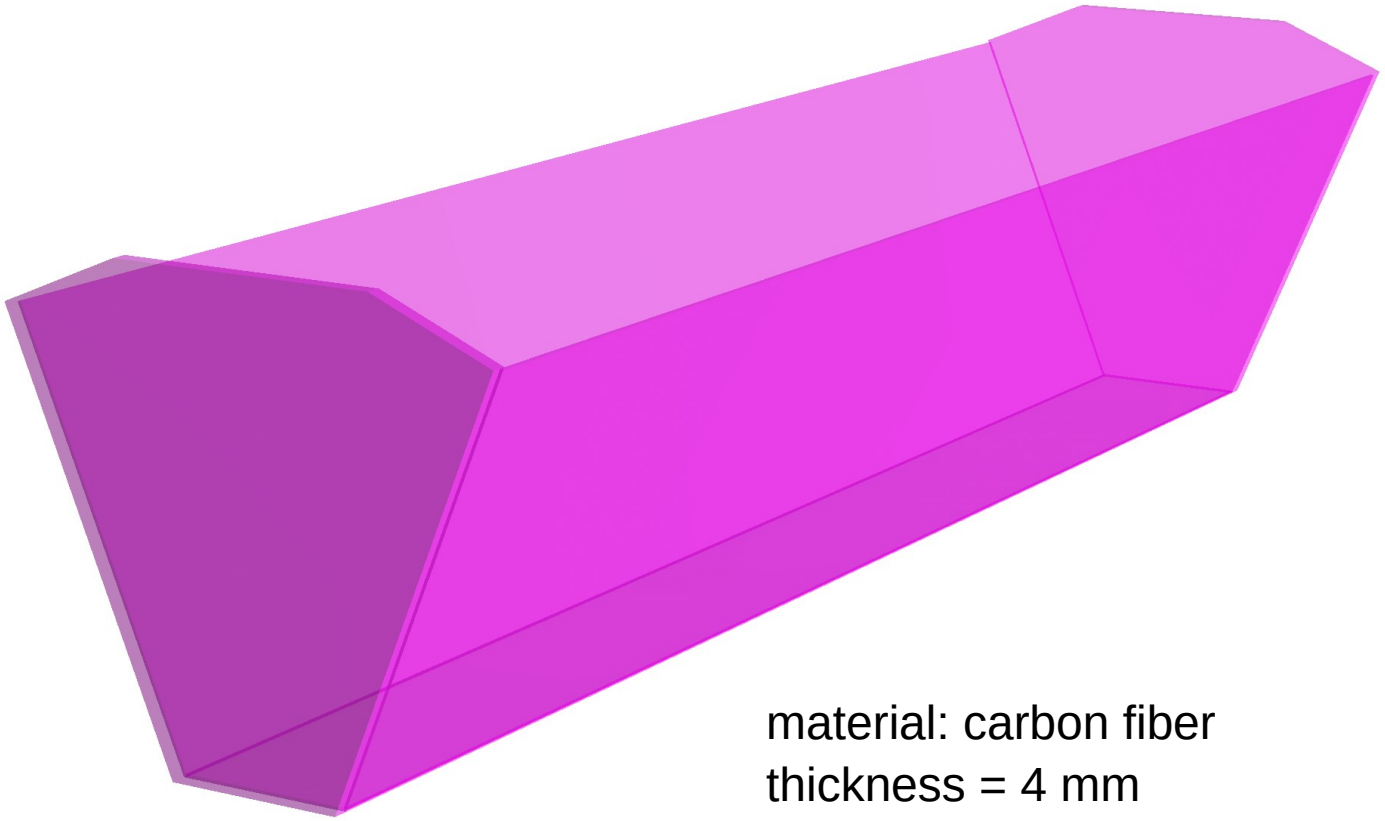
Drawings by CRISM (Khotkovo).

Straw detector frame model for simulations (1)



material: carbon fiber
thickness = 4 mm
thickness of front/back walls = 20 mm

Straw detector frame model for simulations (2)

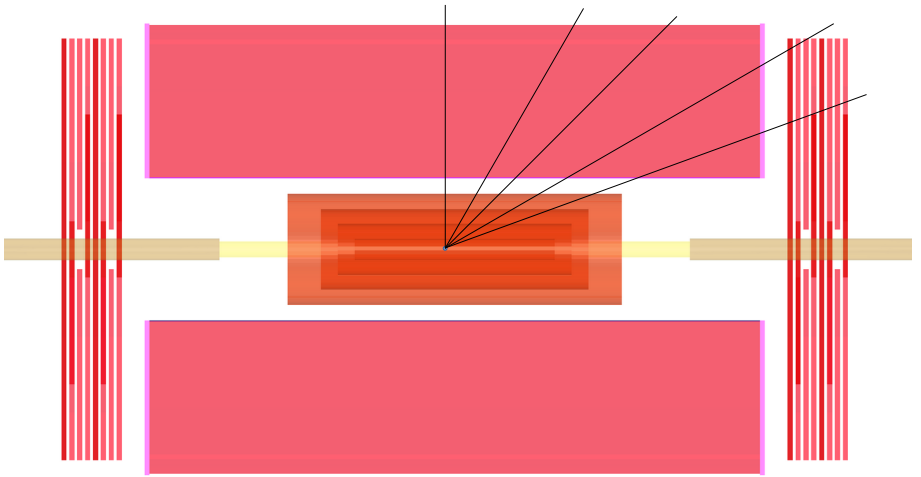


material: carbon fiber
thickness = 4 mm
thickness of front/back walls = 20 mm

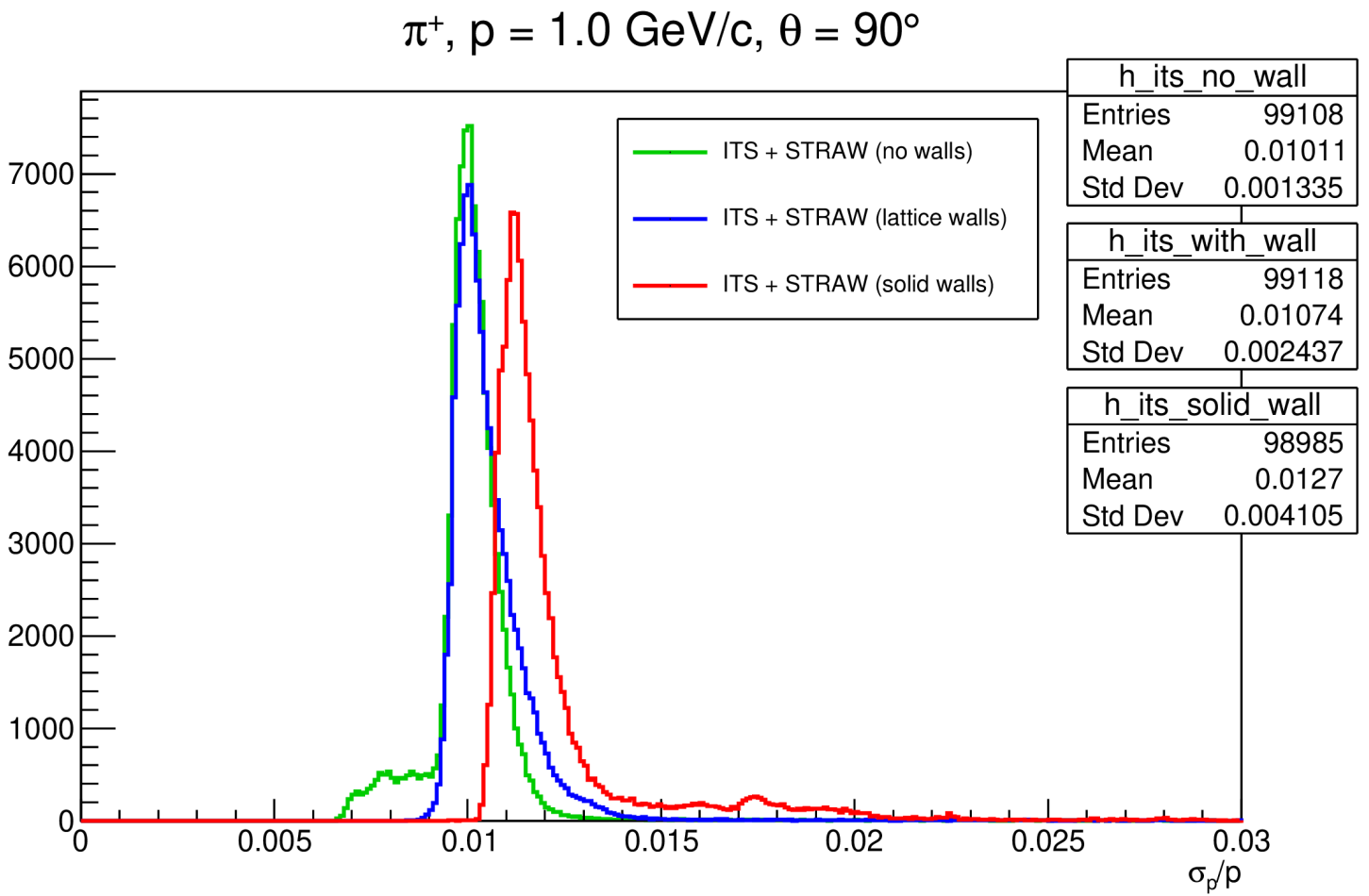
Simulation settings

- SpdRoot: based on development branch (as of March 2024), with ST geometry modifications.
- ITS: MAPS option
- Default reconstruction settings (σ_R = 150 μm)

- Artificial samples of π^+:
  - p = 0.3, 0.5, 0.7, 1.0, 1.5, 2.0 GeV/c
  - θ = 90°, 60°, 45°; 30°, 20° (with δθ = 1°).
  - ϕ_0 uniformly distributed in [0°, 360°].
  - 100k primary particles in each sample.



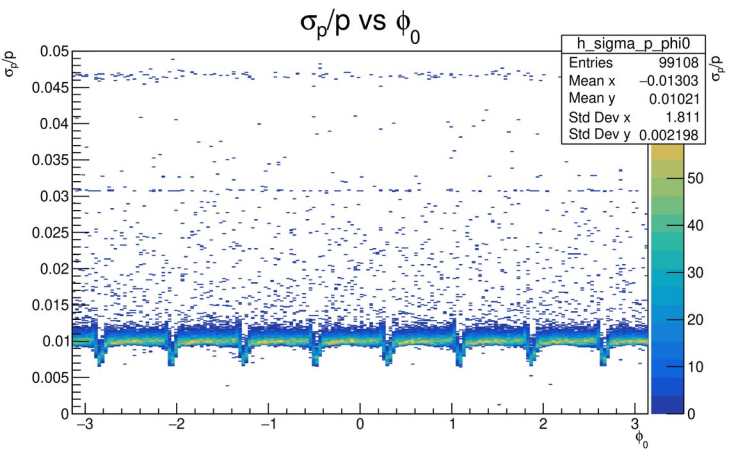
Influence on momentum resolution (σ_p/p)



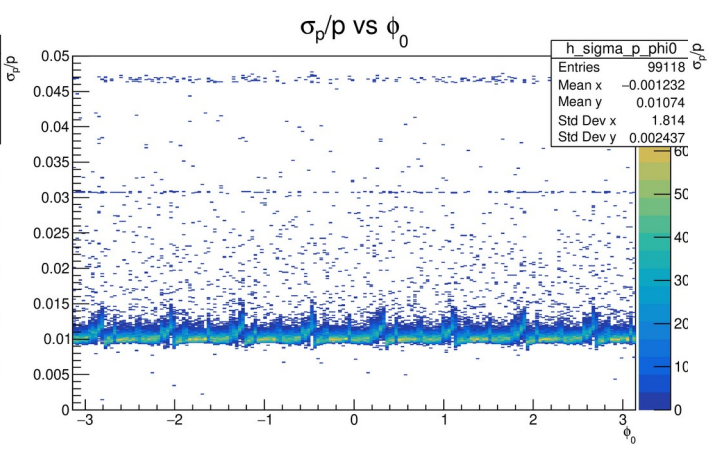
Momentum resolution: ϕ_0 dependence

(p = 1 GeV/*c*, θ = 90°)

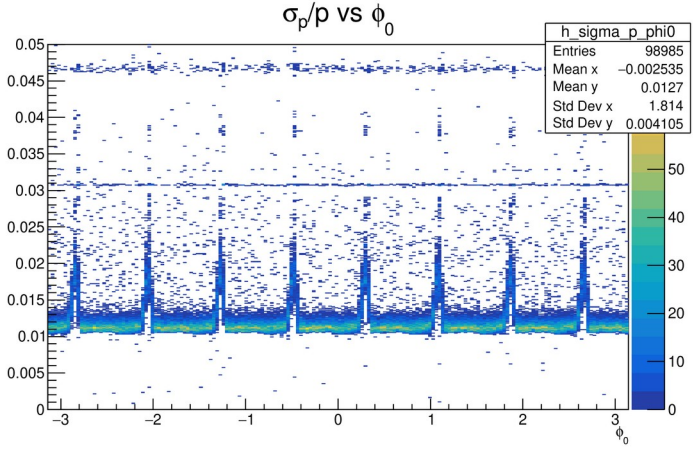
NO WALLS



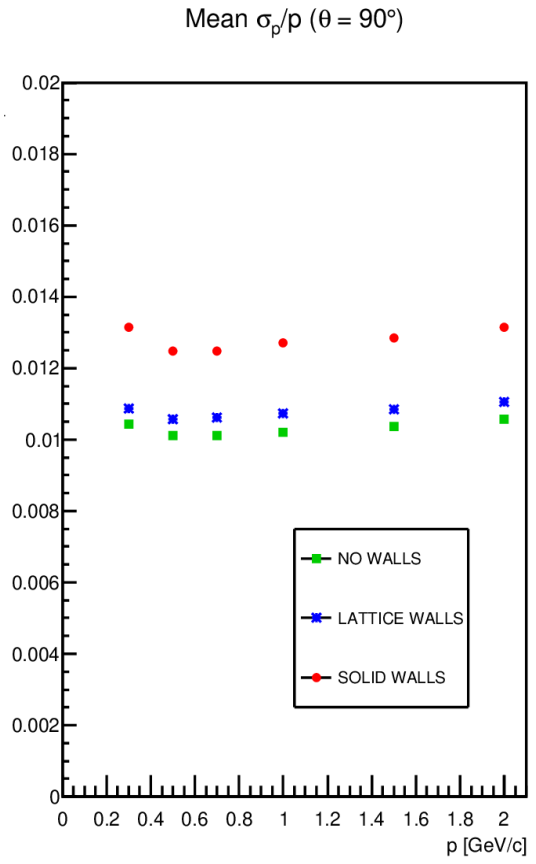
LATTICE WALLS

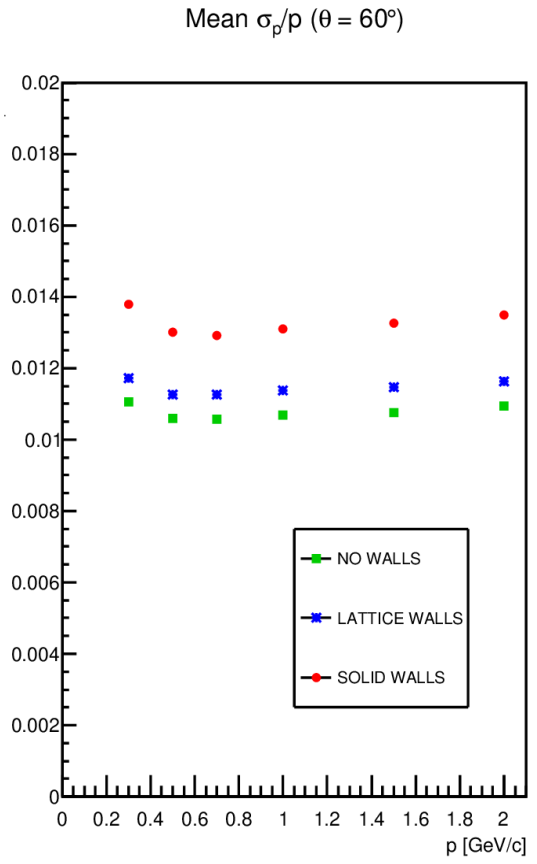


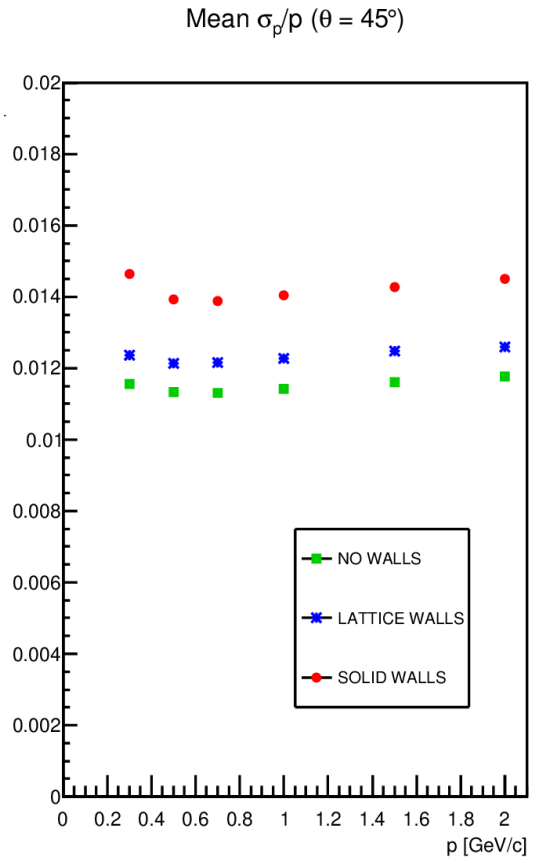
SOLID WALLS



Mean momentum resolution: *p* and θ dependence

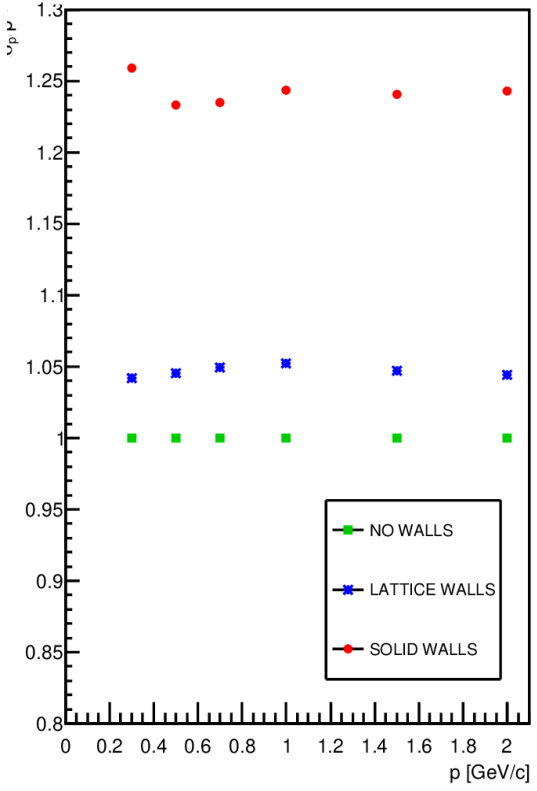




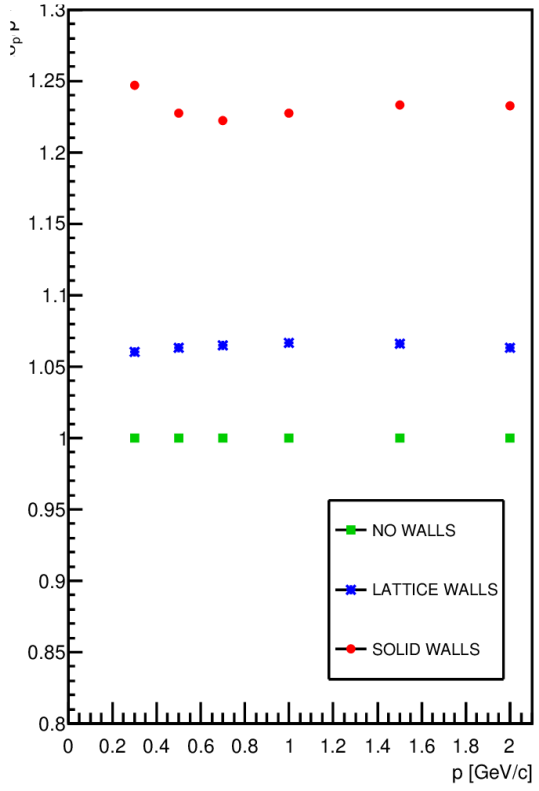


Relative increase in mean σ_p/p

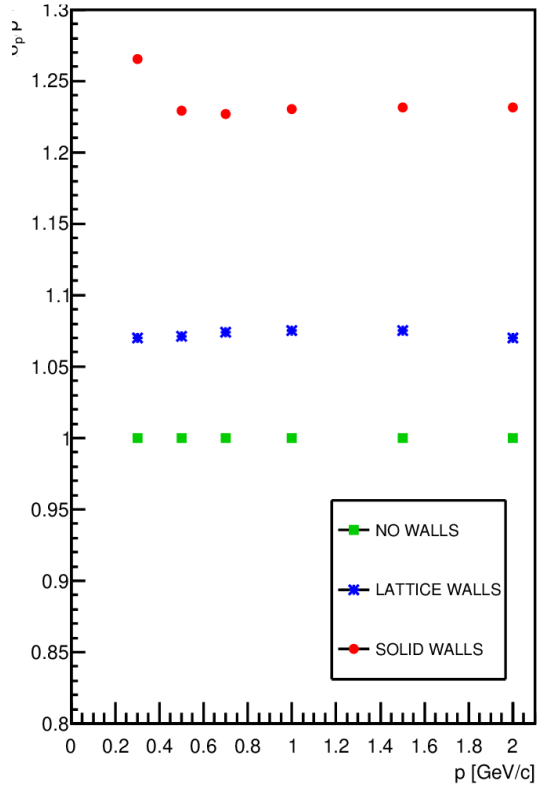
θ = 90°



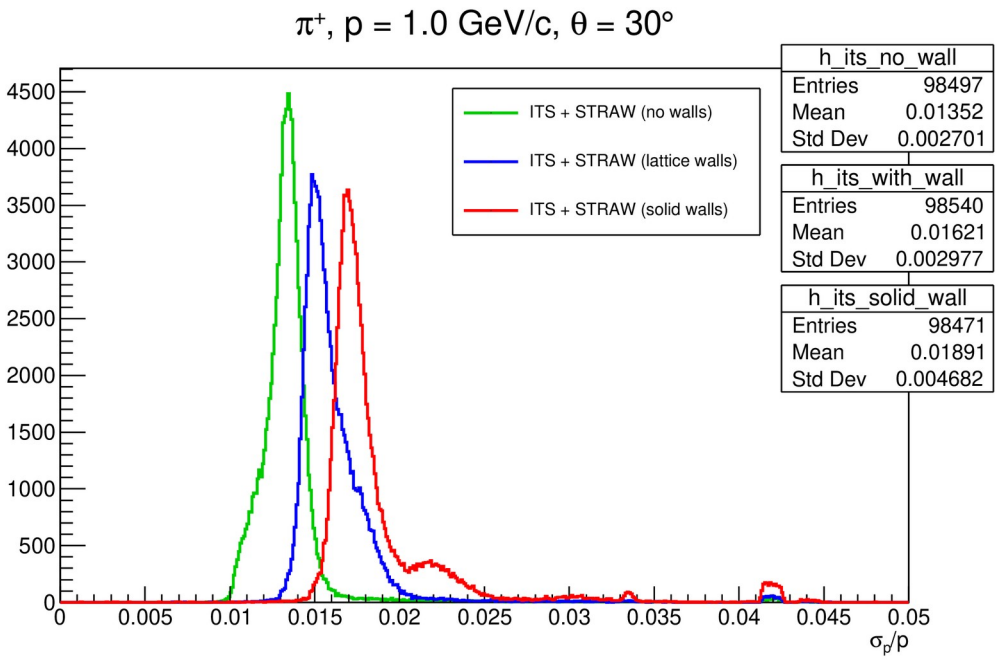
θ = 60°

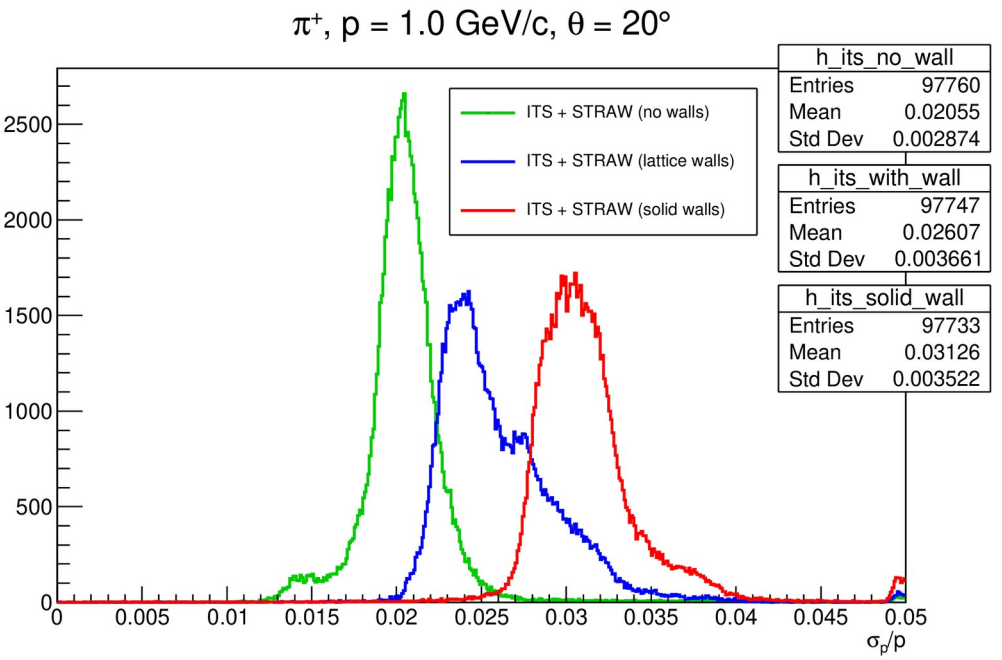


θ = 45°



Influence on momentum resolution: barrel / endcap overlap region





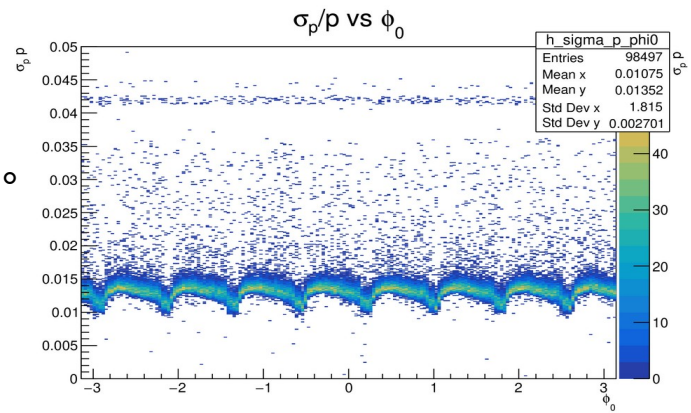
Momentum resolution: ϕ_0 dependence

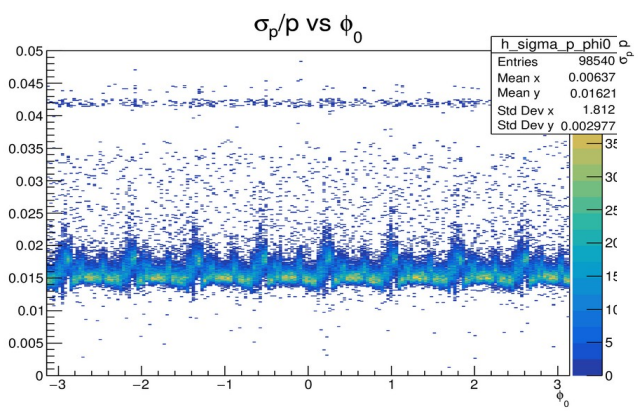
NO WALLS

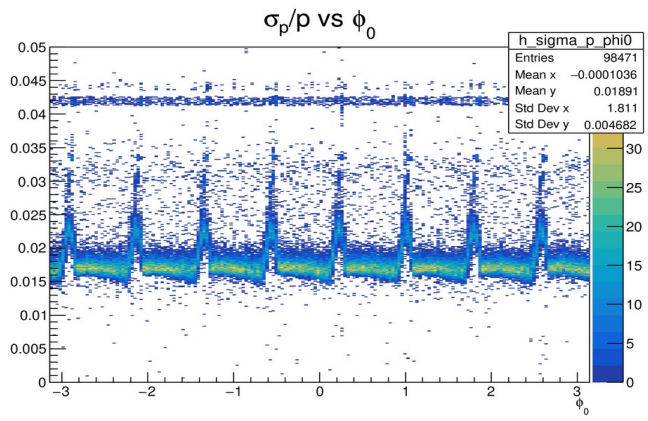
LATTICE WALLS

SOLID WALLS

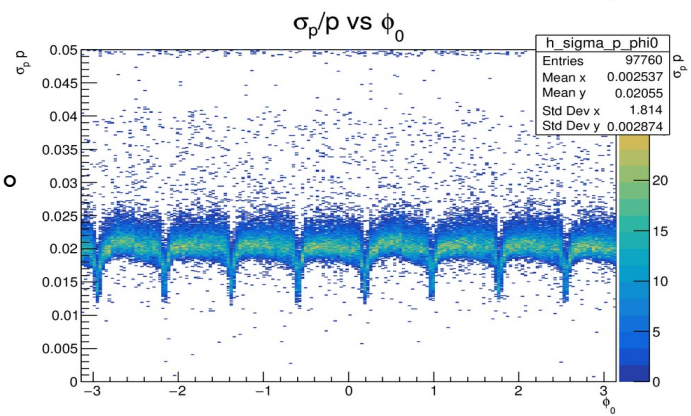
$\theta = 30°$

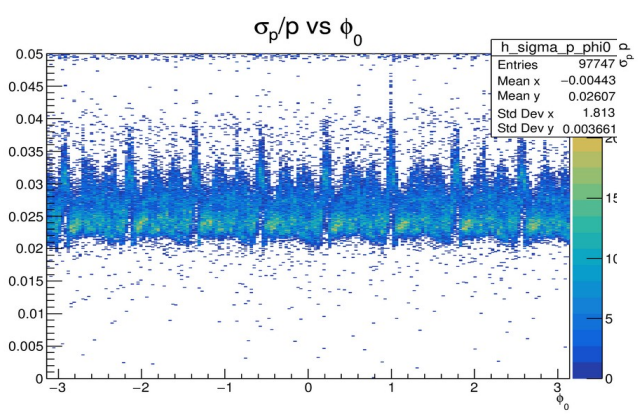


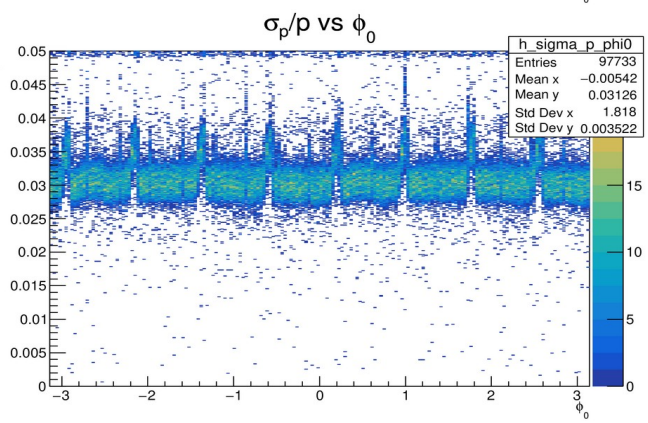




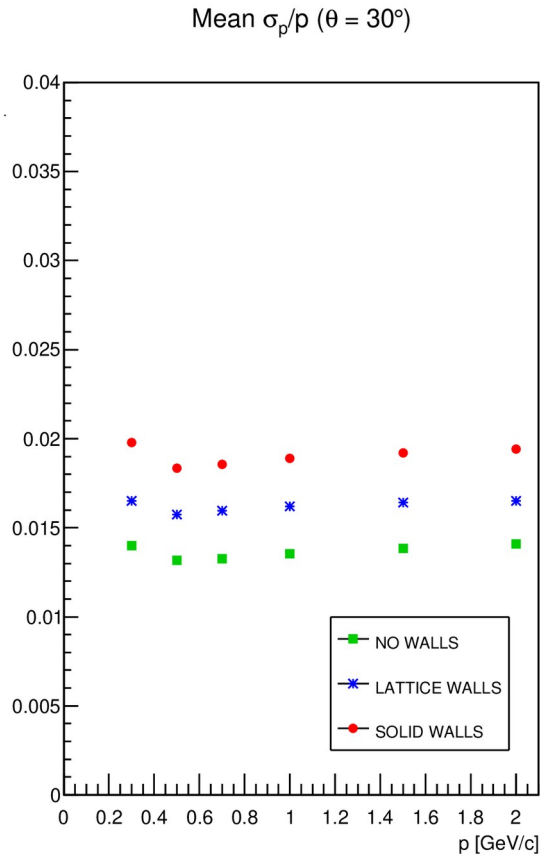
$\theta = 20°$

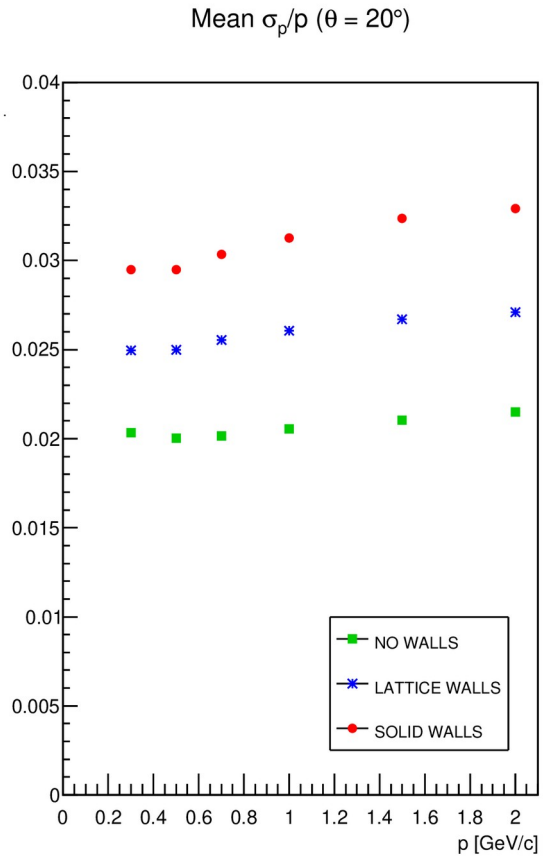




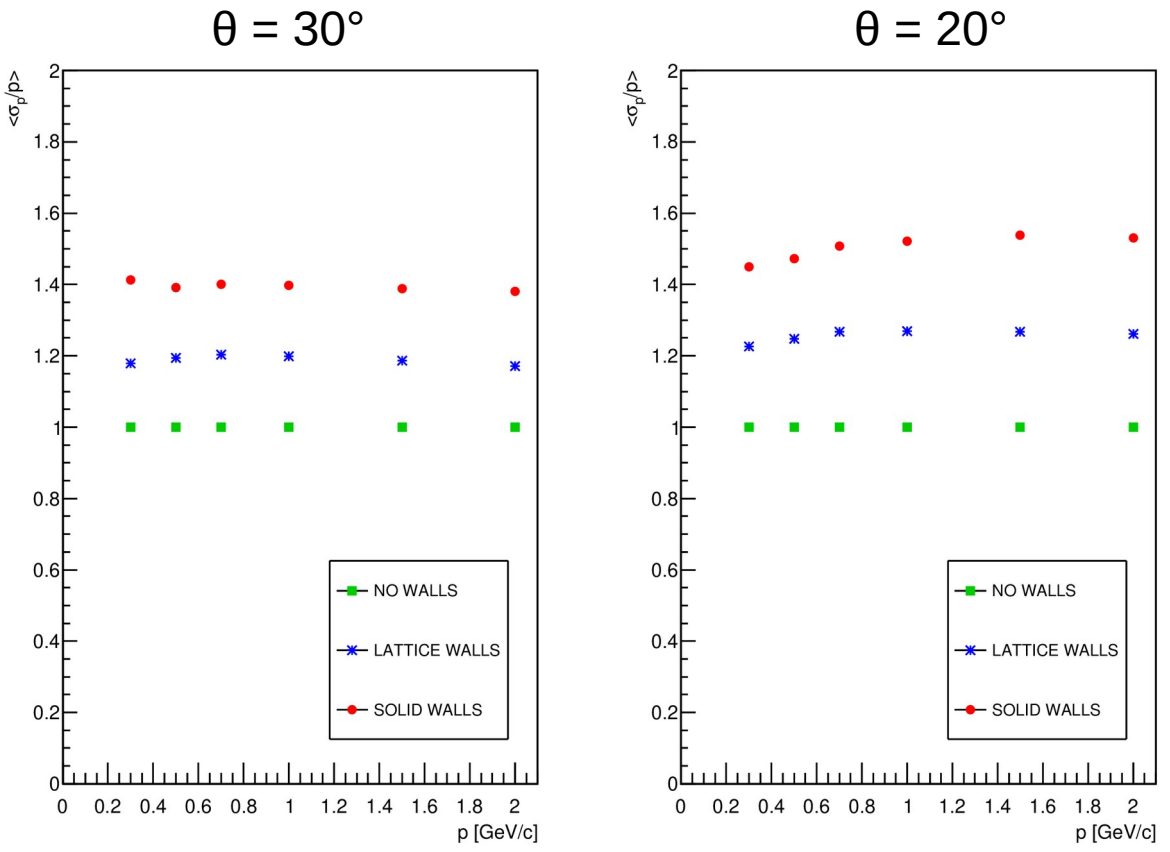


Mean momentum resolution in barrel/endcap overlap region





Relative increase in mean σ_p/p (barrel/endcap overlap region)



Conclusions

- A model of straw detector power frame has been implemented in SpdRoot.
- Analysis of its influence on momentum resolution was performed: σ_p/p increases in 1.05-1.07 for tracks passing through the barrel's sides, and in 1.20-1.25 times for tracks passing through the barrel's ends.
- Overall, the effect is not large. However, more material is still missing from simulation (other parts of mechanical support structures, front-end electronics, etc.), so these figures are to be treated as a preliminary estimate, and the real effect is expected to be somewhat larger.