Aerogel tiling

dRICH simulation meeting 17/04/2025

Luisa Occhiuto, Annalisa De Caro, Salvatore Fazio

My Charge

Chandradoy Chatterjee
a Salvatore, me, Annalisa

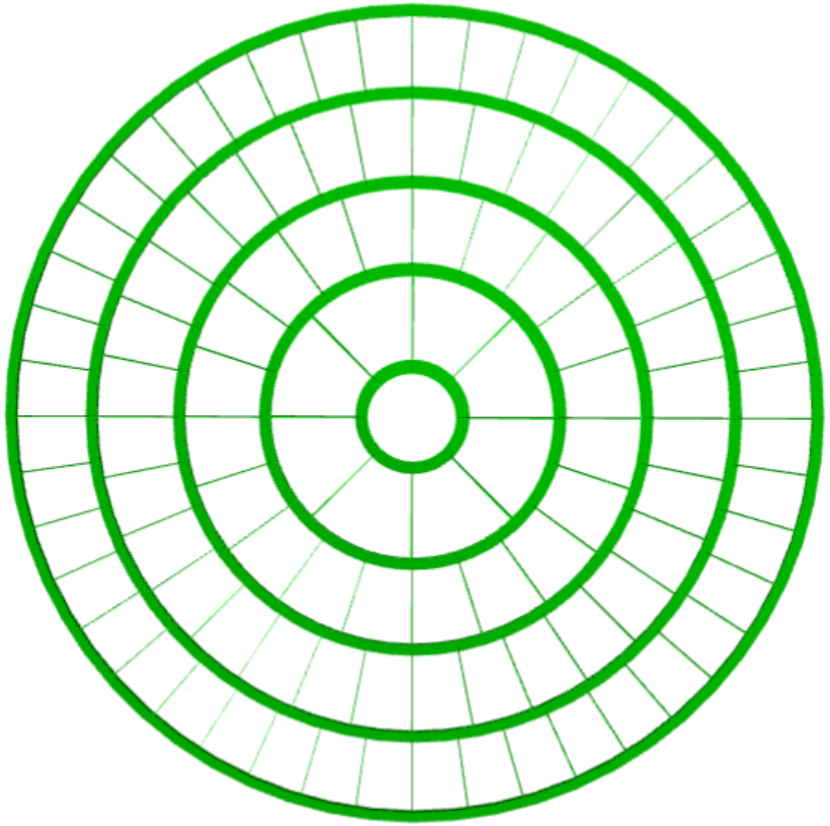
Traduci in italiano

Hi Salvatore,
actually Luisa can do the following studies with her trapezoidal aerogel tiles:
1) Optimal tile size both radially outward and along phi direction
-a) Number of optimal tiles
-b) Number of optimal ribs
2) Optimal thickness of the ribs.
- a) Do we improve anything if the ribs are partially covering the edges of the aerogel?
3) Implementing multiple layers of aergel
-a) Flat aerogel surfaces.
-b) Implementing needed changes into the reconstruction to account multiple layers of aerogel
-c) Optimal staggering.
-d) Taking the parameters from Marco, introduce some surface impurity (curvature)
so that multiple layers don't match perfectly.

Then, to repeat the same exercise with different refractive index of the aerogels to account for the dead-areas, photon absorption so on.
This can be her task.

Goal: Create a structure with user-tunable parameters, mainly from the drich.xml file

Work done so far



Parameters	
Thickness (crowns and segments)	1 mm
# Crowns	5
# radial segments	{8, 20, 32, 44}
square's dimension	20 cm

Goal: Create a structure with user-tunable parameters, mainly from the drich.xml file

Structure similar to the one we will later insert into the experiment!

How does this code work?

1. I created **crowns** by calculating the radius for each of these.
2. After that I insert the **sectors** between each crowns.
3. I joined the crowns and segments into a single solid using the **Union** function.
4. I subtracted, through the **Subtraction** function, the solid just created from the aerogel solid. This is to avoid having overlapping materials.
5. I then inserted the **carbon fiber structure** into the "hole“.

```
46
47
48   <constant name="DRICH_corona_thickness" value="1*mm"/>
49   <constant name="DRICH_num_coronas" value="5"/>
50   <constant name="DRICH_d_square" value="200*mm"/>
51   <constant name="DRICH_d_square2" value="120*mm"/>
52
53
```

From drich.xml

```
140   <aerogel
141     material="Aerogel_DRICH"
142     vis="DRICH_aerogel_vis"
143     thickness="DRICH_aerogel_thickness"
144     />
145   <coronas
146     thickness="DRICH_corona_thickness"
147     num="DRICH_num_coronas"
148     material="CarbonFiber_15percent"
149     vis="DRICH_filter_vis"
150     d= "DRICH_d_square"
151     d2= "DRICH_d_square2"
152     />
```

Known Visualization issue in Geant4

Due to the well known Geant4 display issues with Boolean operations, the subtraction of the two solids operation cannot be visualized.

Boolean operation - subtract volumes

Geometry, Fields and Transportation

3.5k views 1 link

evc Sep 2019

Dear Manuel,

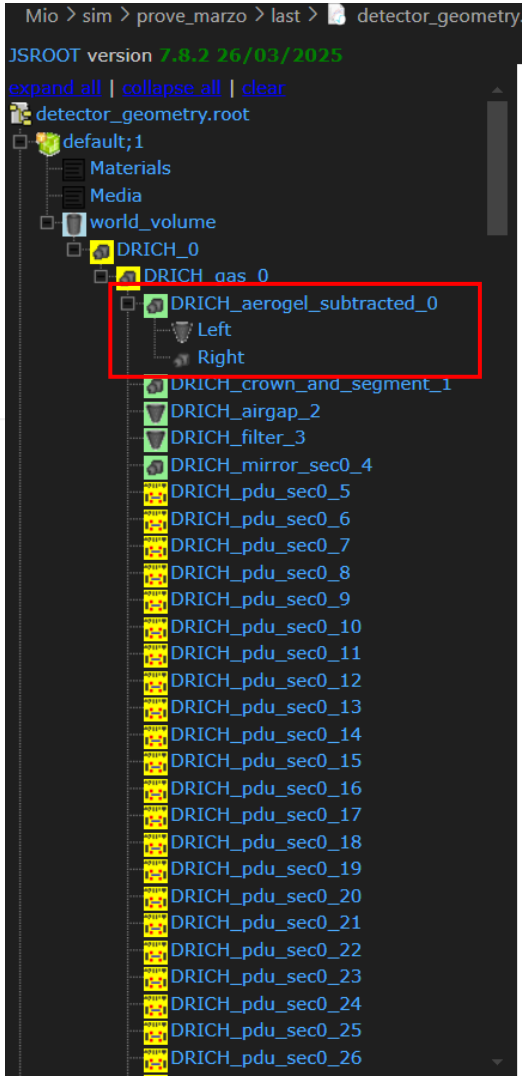
It is a known problem in Geant4 visualization. You can get a correct image by using the RayTracer, which is based on the tracking algorithms of Geant4. For details please see the Geant4 Book for Application Developers, section Visualization.

However, it should be noted that a better way to define such kind of geometry is to define the smaller box (the hole) as a daughter volumes of the bigger box, instead of a Boolean subtraction.

Alternatively, in this particular case, you can also use G4Polyhedra.

Regards,
Evgueni

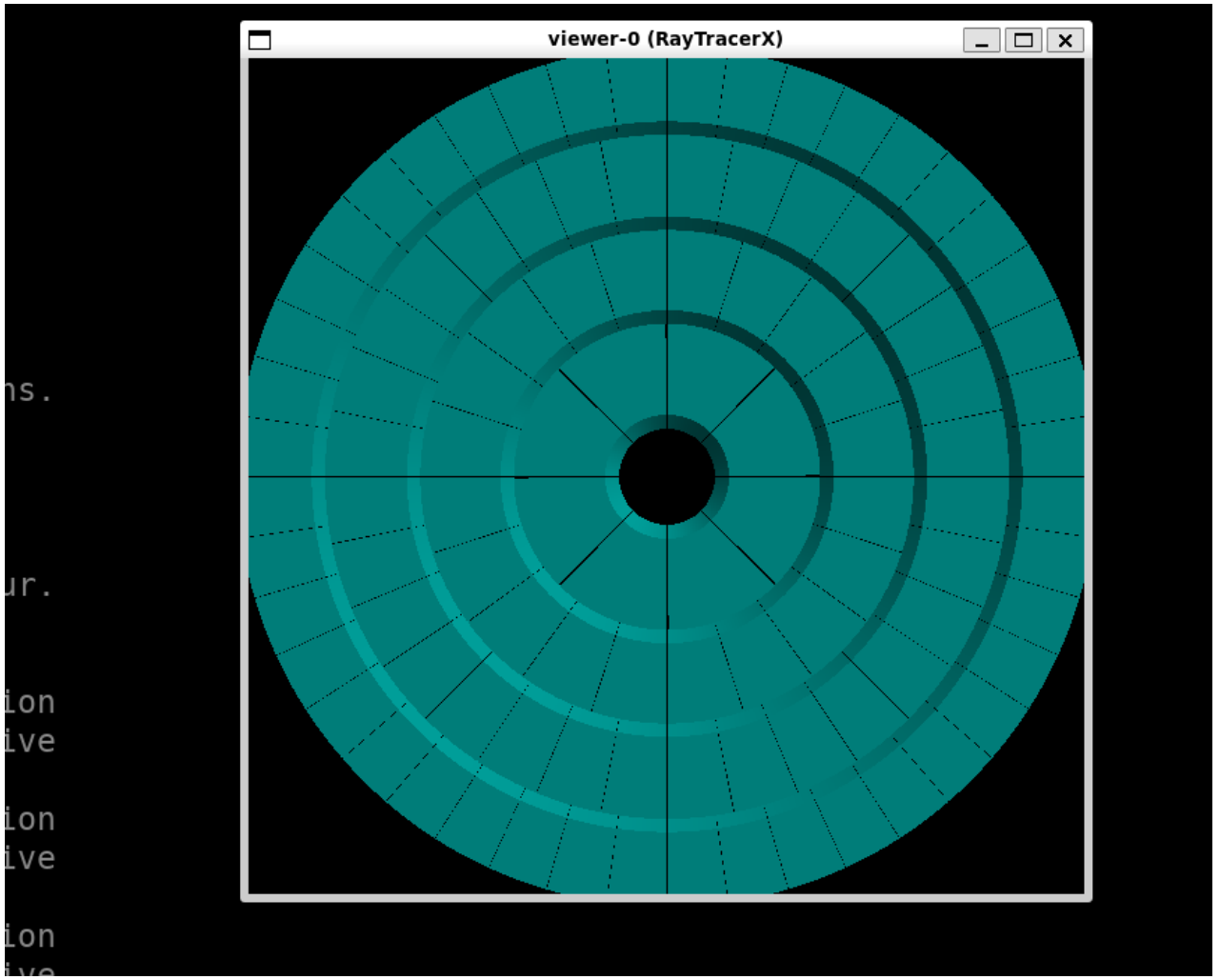
From Geant4 forum: https://geant4-forum.web.cern.ch/t/boolean-operation-subtract-volumes/863



Known Visualization issue in Geant4

However, the RayTracer viewer is able to display this!!!!!!

So, NO PROBLEM here!



No overlaps (checked)!

I have also checked the overlaps, and since there are none, the structure seems solid!

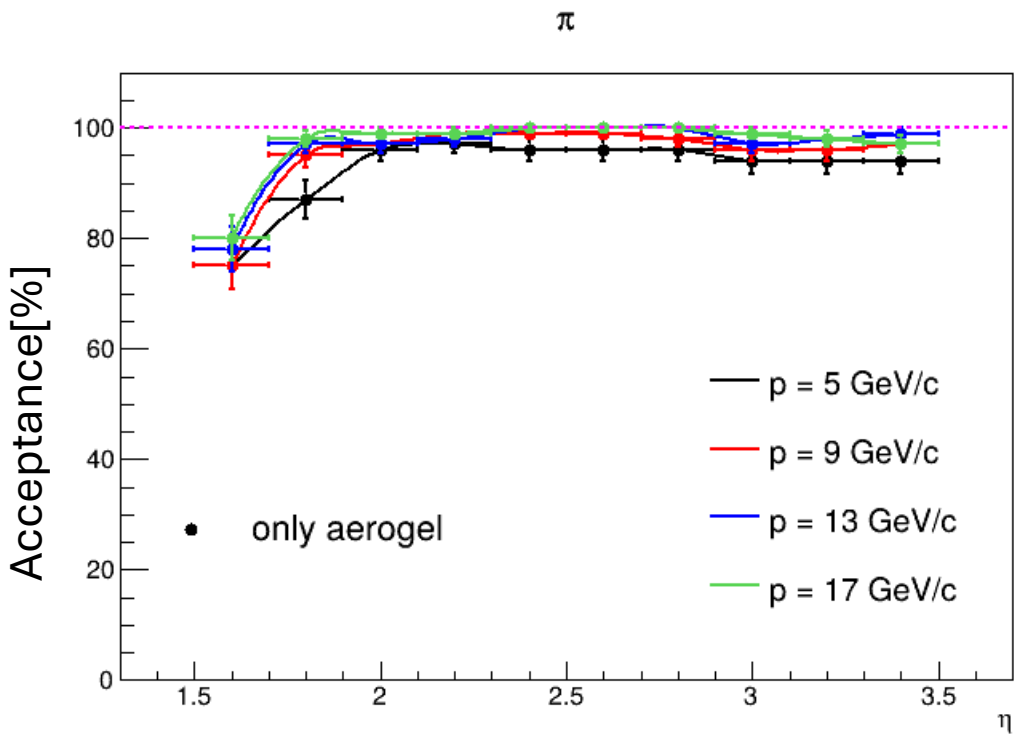
```
Geant4UI         INFO  +++ Geant4RunManager> Install Geant4 control directory:/ddg4/Geant4RunManager/
Geant4RunManager WARN  +++ Configured run manager of type: G4RunManager.
Geant4Kernel     WARN  +++ Multi-threaded mode requested, but not supported by this compilation of Geant4.
Geant4Kernel     WARN  +++ Falling back to single threaded mode.
Geant4Exec       WARN  +++ Only 1 subdetectors present. You sure you loaded the geometry properly?
Geant4UI         INFO  +++ DetectorConstructionAction> Install Geant4 control directory:/ddg4/DetectorConstructionAction/
Geant4Exec       WARN  +++ Building default Geant4DetectorConstruction for single threaded compatibility.
Geant4UI         INFO  +++ PhysicsList> Install Geant4 control directory:/ddg4/PhysicsList/
G4PhysListFactory::GetReferencePhysList <QGSP_BERT>  EMoption= 0
<<< Geant4 Physics List simulation engine: QGSP_BERT


UserInitialization INFO  +++ Executing Geant4UserActionInitialization::Build. Context:0x560009d37510 Kernel:0x560009cddef0 [-1]
Geant4Converter  INFO  +++  Successfully converted geometry to Geant4. [  0.267 seconds]
Geant4UI         INFO  +++ ConstructGeometry> Install Geant4 control directory:/ddg4/ConstructGeometry/

 hInelastic QGSP_BERT  Thresholds:
    1) between BERT  and FTF/P over the interval 3 to 6 GeV.
    2) between FTF/P and QGS/P over the interval 12 to 25 GeV.
  -- quasiElastic: 1 for QGS  and 0 for FTF
### Adding tracking cuts for neutron  TimeCut(ns)= 10000  KinEnergyCut(MeV)= 0
UI               INFO  ++ Executing pre-run statement: /geometry/test/resolution 10000
UI               INFO  ++ Executing pre-run statement: /geometry/test/tolerance 0.1
UI               INFO  ++ Executing pre-run statement: /geometry/test/verbosity 0
UI               INFO  ++ Executing pre-run statement: /geometry/test/run
Running geometry overlaps check...
Geometry overlaps check completed !

Geant4Kernel     INFO  ++ Terminate Geant4 and delete associated actions
```

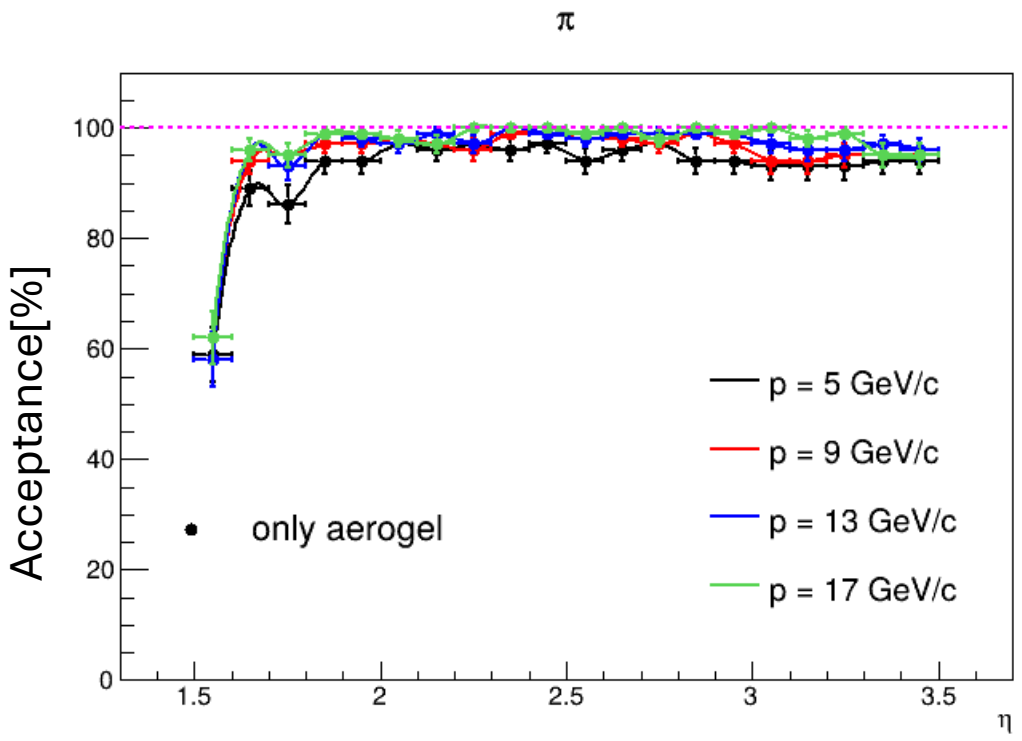
Some simulation tests



Gun events
100 events with only one pion

Some simulation tests

Finer eta bins



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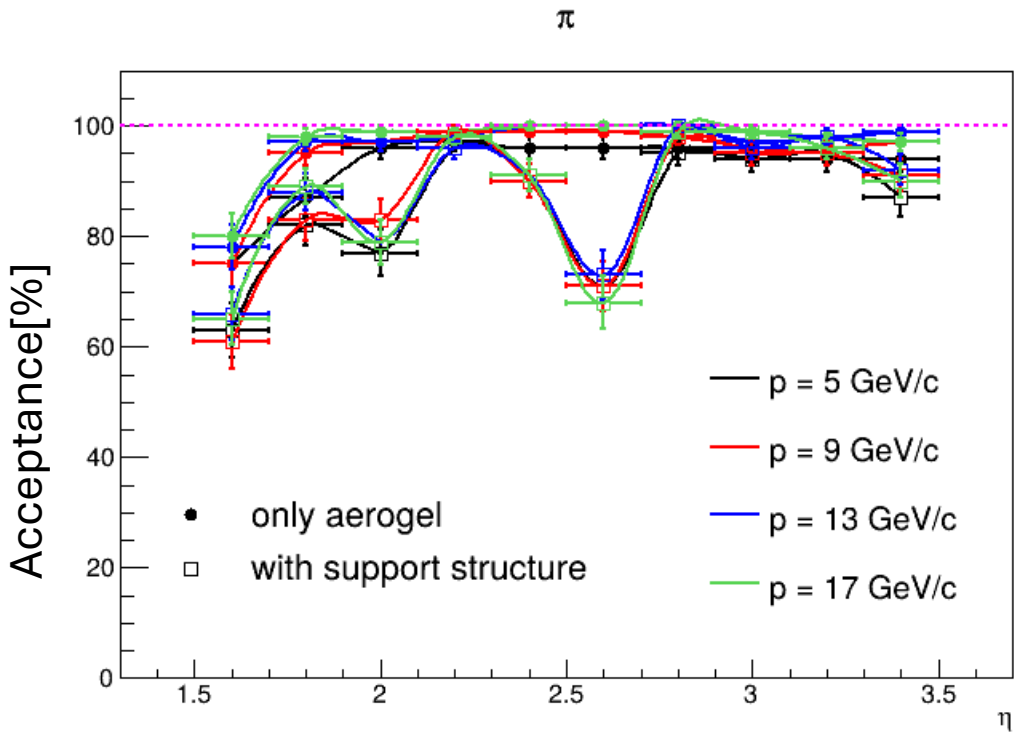
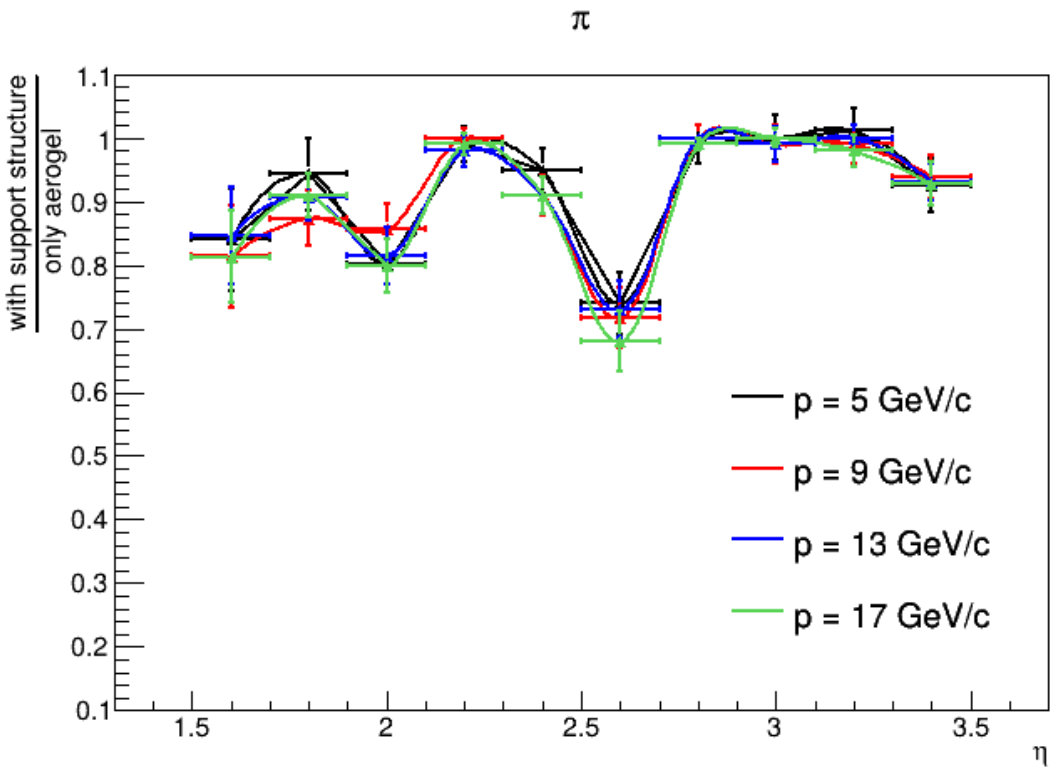
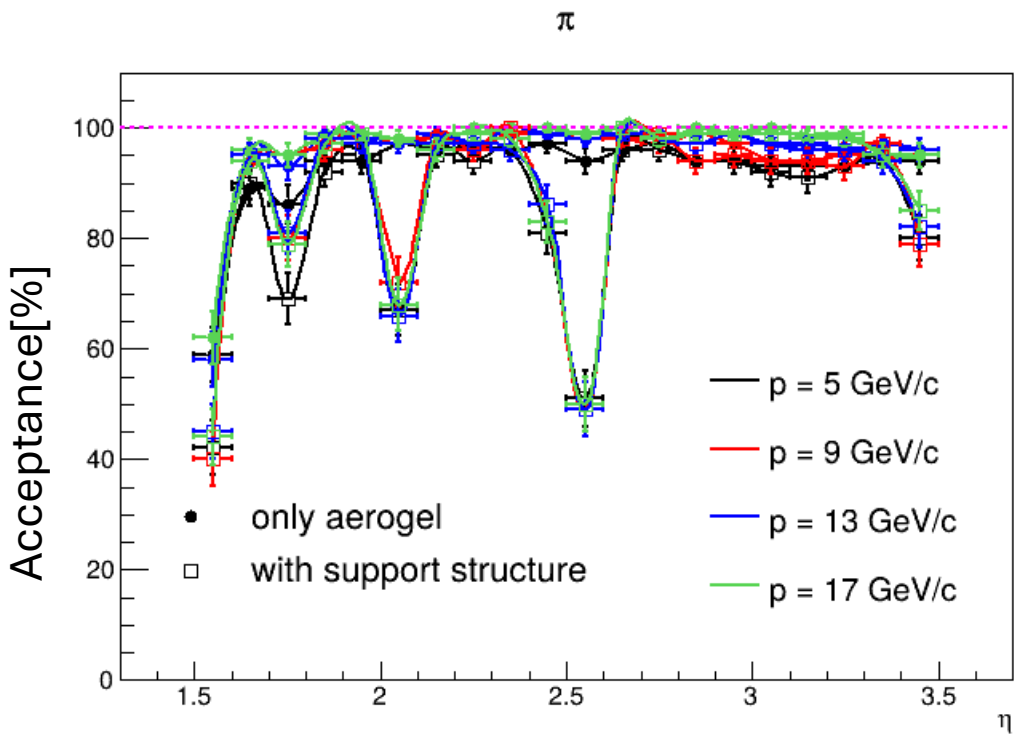


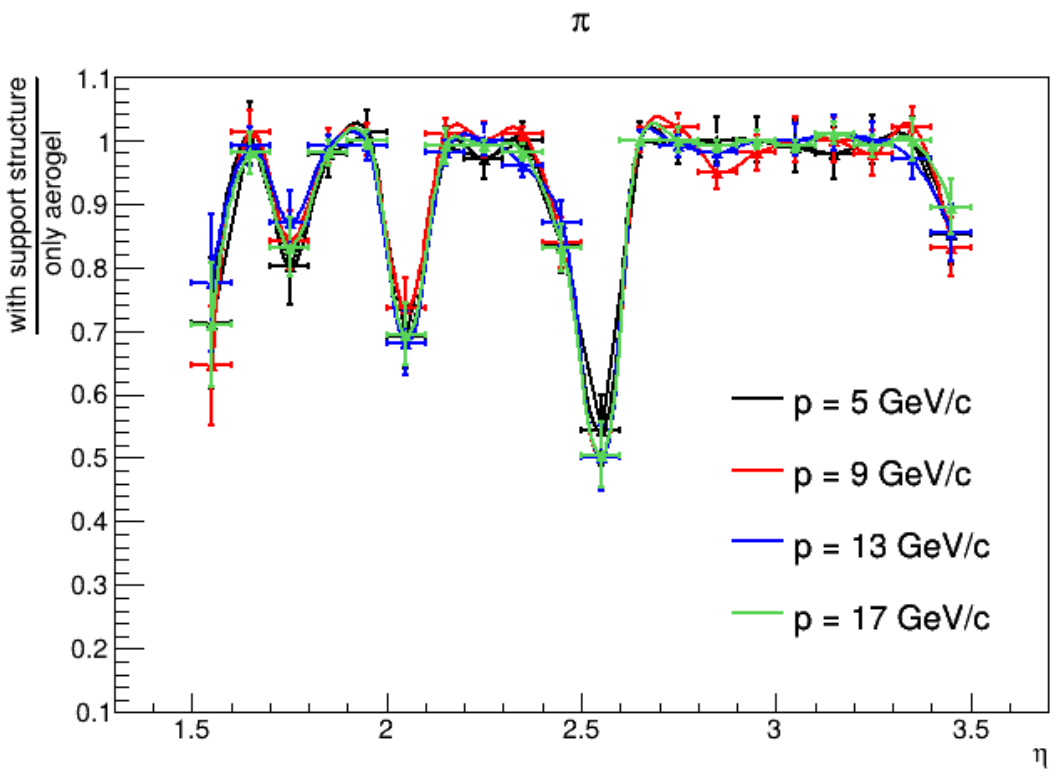


Maximum reduction of acceptance in the 2.5 pseudorapidity range

Some simulation tests

Finer eta bins





Maximum reduction of acceptance in the 2.5 pseudorapidity range

Next steps

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Thank you for your attention!

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