Update on Aerogel Square Tilling

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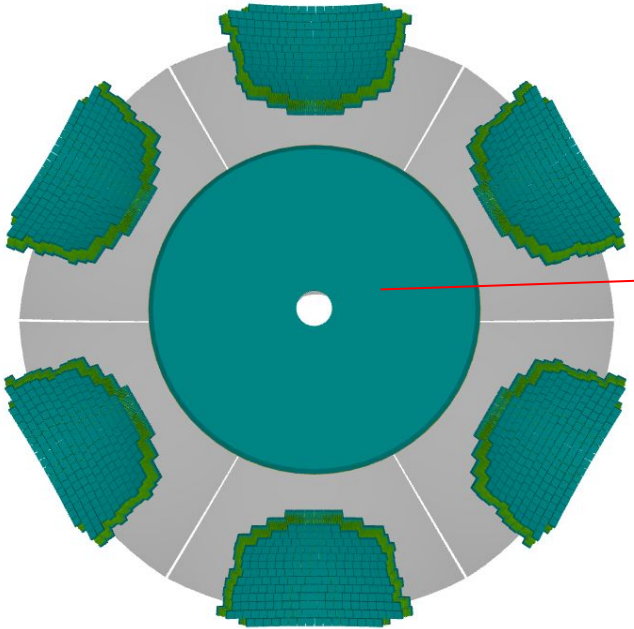
Aerogel tiling

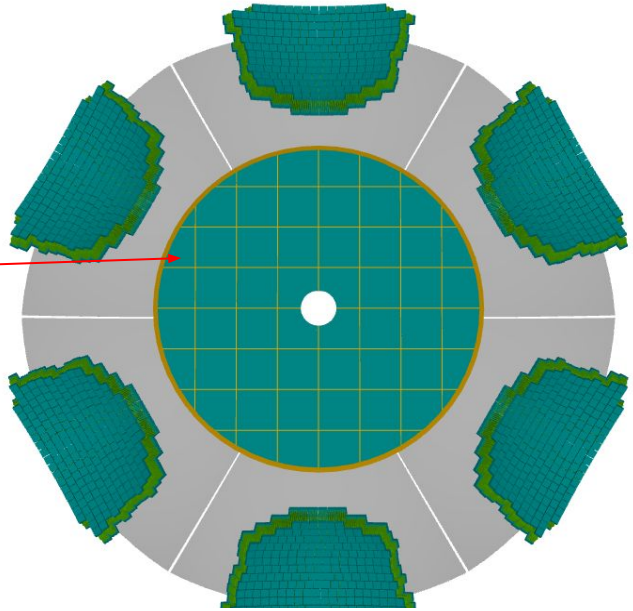
- Aerogel structure:
  (a) Disk type
  (b) Square tiling
  (c) Trapezoidal tiling

Why tiling matters?

- **To prevent surface effect (surface deformation).**
- **Ribs provides structural support to aerogel tiles.**



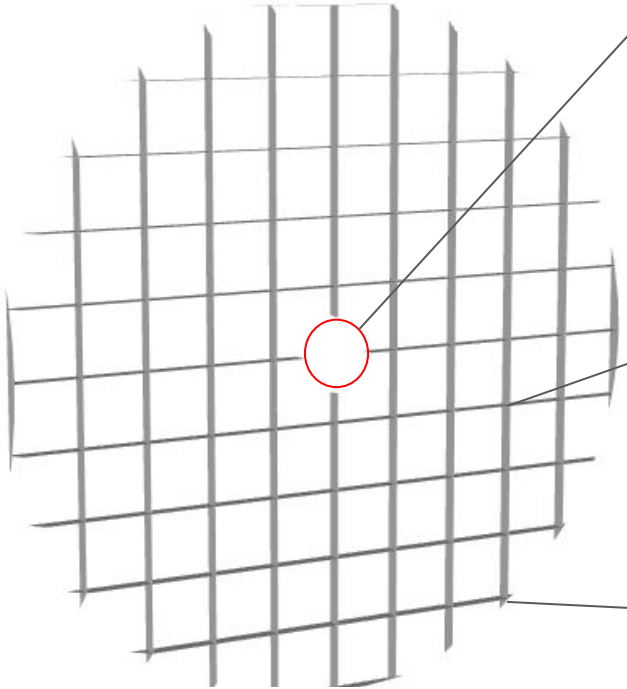
Before tiling



Square tiling

Aerogel layout

*Material used: CarbonFiber_15percent



Rib structure

Inner rim:
- Shape: tube
- Inner radii: raditorRmin - rimwidth (6.62 cm)
- Outer radii: raditorRmin (11.62 cm)

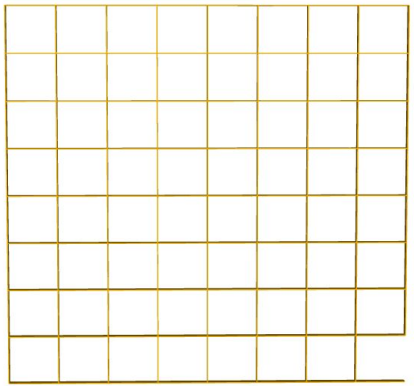
Ribs:
- Union of box
- Rib thickness: 0.05 cm
- Rib length: 17.76 cm (tile size)

Outer rim:
- Shape: tube
- Inner radii: 88.8 cm (2*88.8 = 10*tile size)
- Outer radii: rimwidth + Inner radii (89.8 cm)

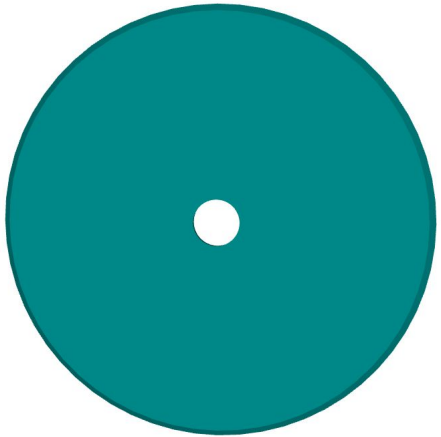
Credit: G.Laishram & T.Tanvi

Intersection of Ribs and aerogel

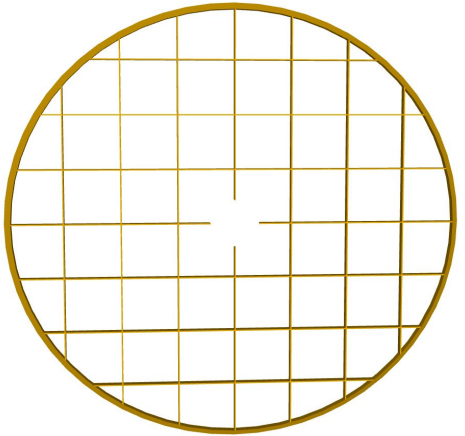
- The final solid is the rib union structure, which is defined by the intersection of the aerogel shape with the rib geometry.
- A tube solid as a rim structure is added to the final rib intersection solid.



Shape1: Union rib solid



Shape2: Aerogel Cone solid

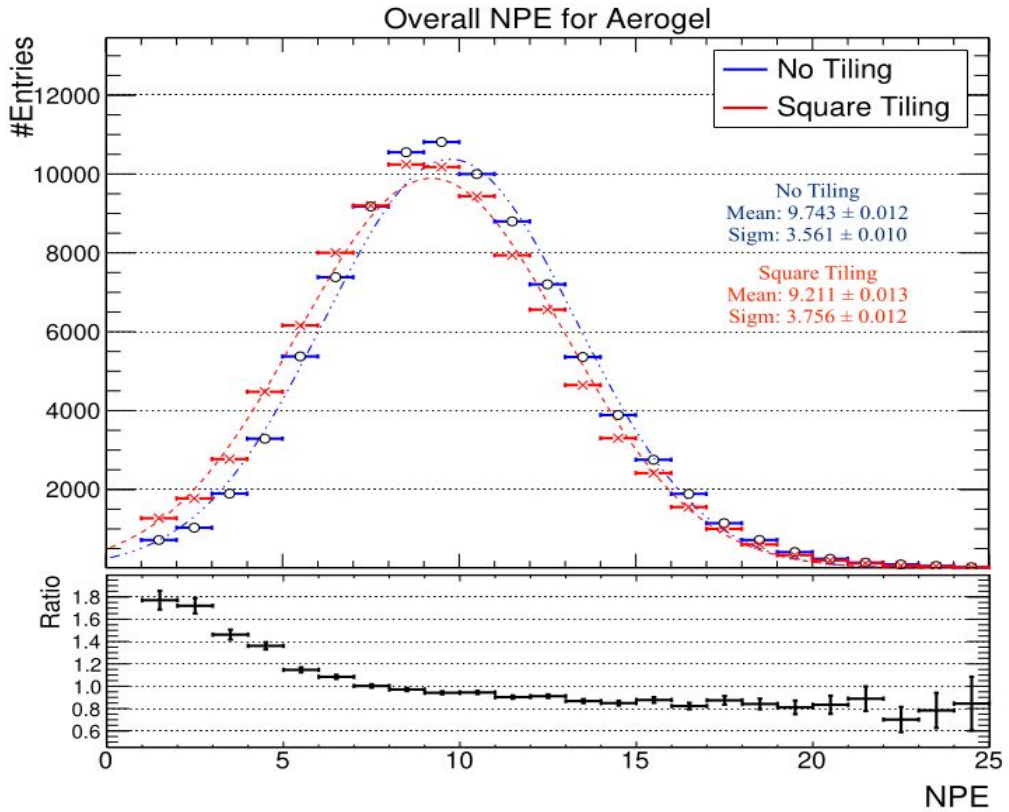


Intersection of Shape1 & Shape2

Data set:

- Thrown particle is π+ of momentum value 20 GeV/c
- Covering whole phase space eta range (1.5-3.5) and phi range (0-2π)
- Total of 100K events (0.1 million)

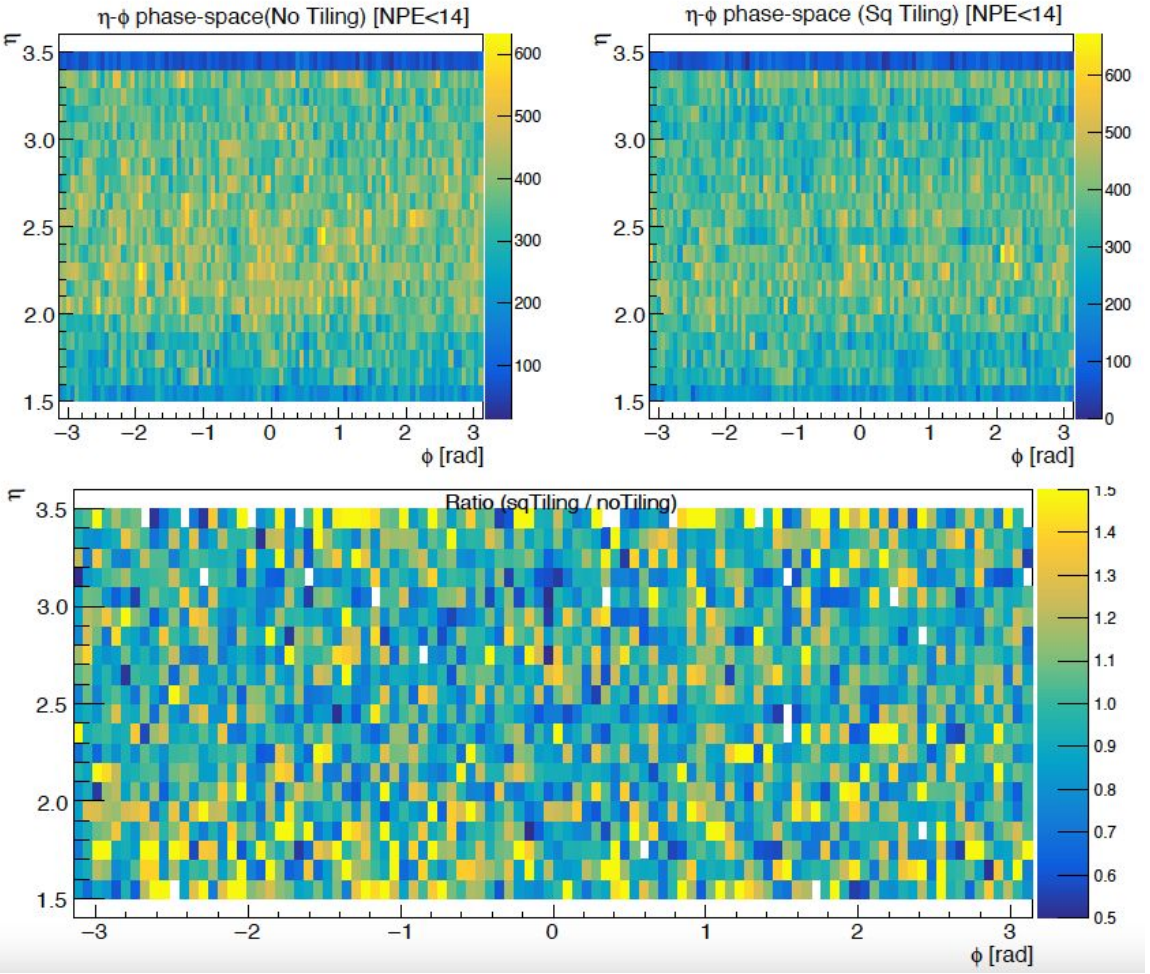
Thanks to FARM@INFN facility



- In case of square tiling, peak broadens (little) and mean shifts towards low NPE.

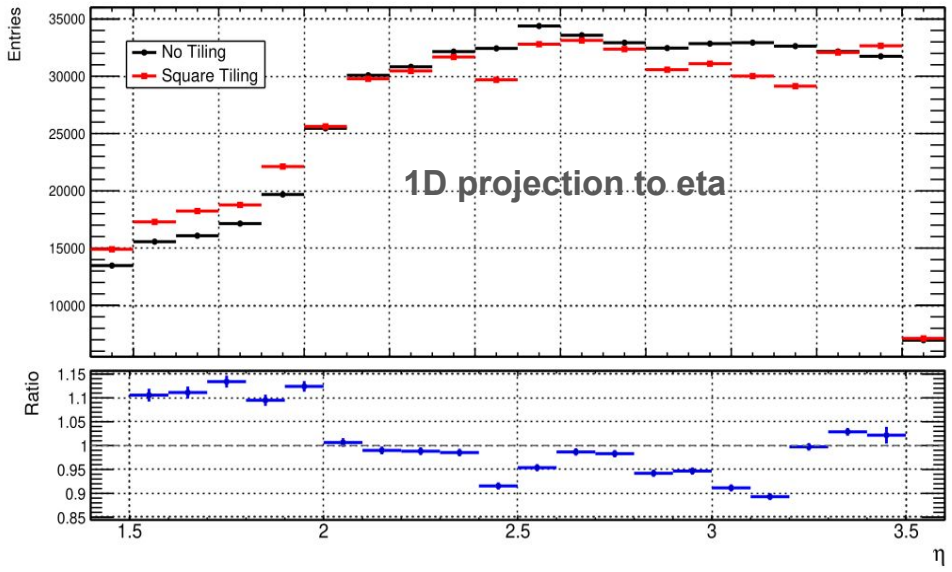
Eta & phi space

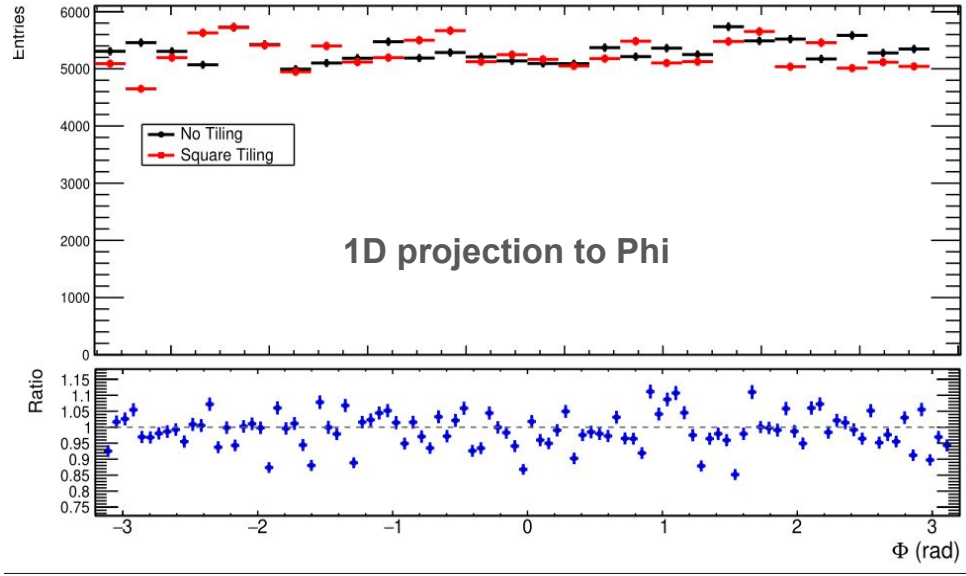
- Storing NPE entries in eta & phi space with different cuts on it
- Cuts on NPE: [5,7,9,10,12,13,14]
- 1D-Projection on eta and phi can be taken



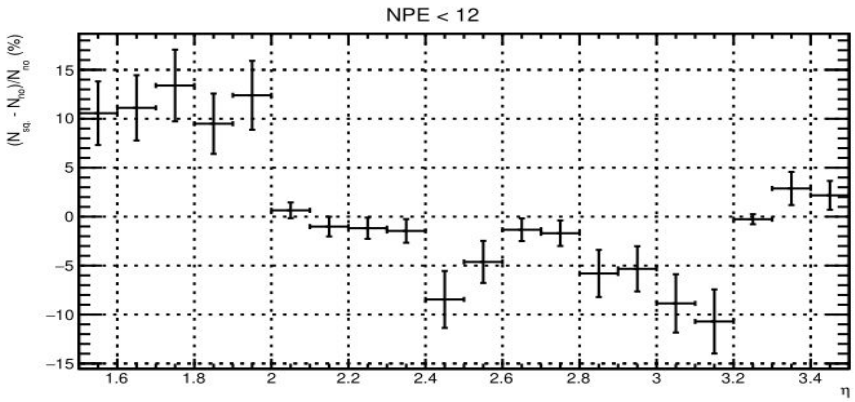
Eta and Phi distribution at cut NPE < 12 :

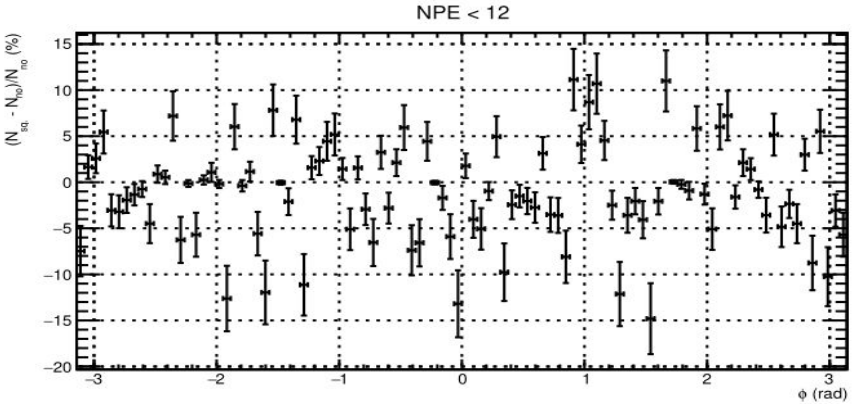
- Showing 1-D projection to eta and Phi with NPE cut < 12
- Comparing square tiling with no tiling
- Taking ratio of square tiling with no tiling to show suppression in entries

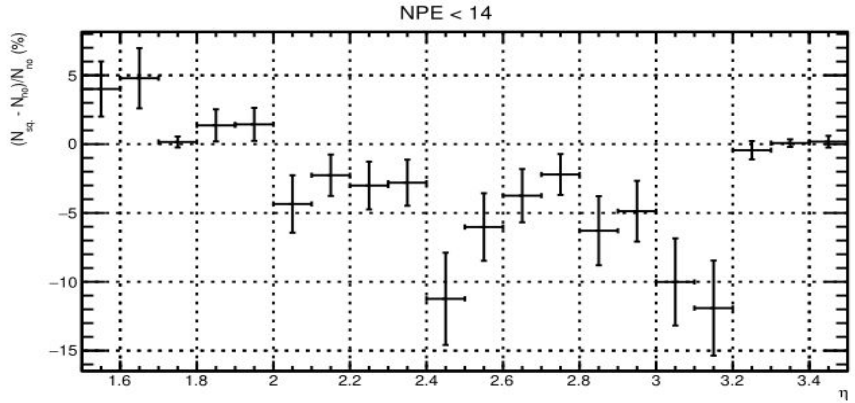


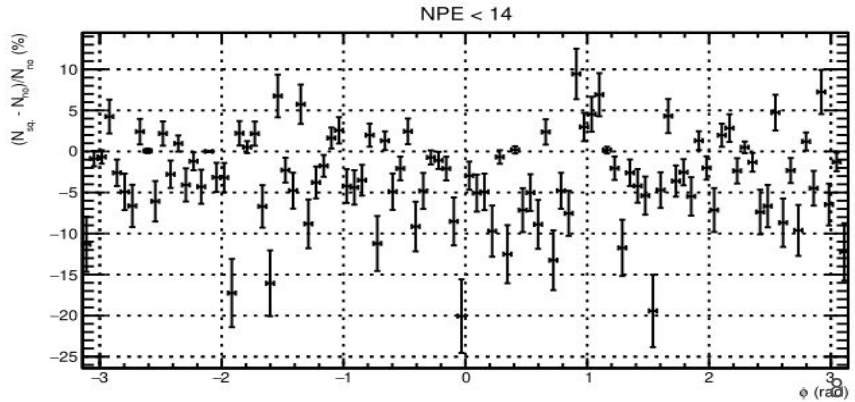


Showing relative % entries with square tiling to without tiling

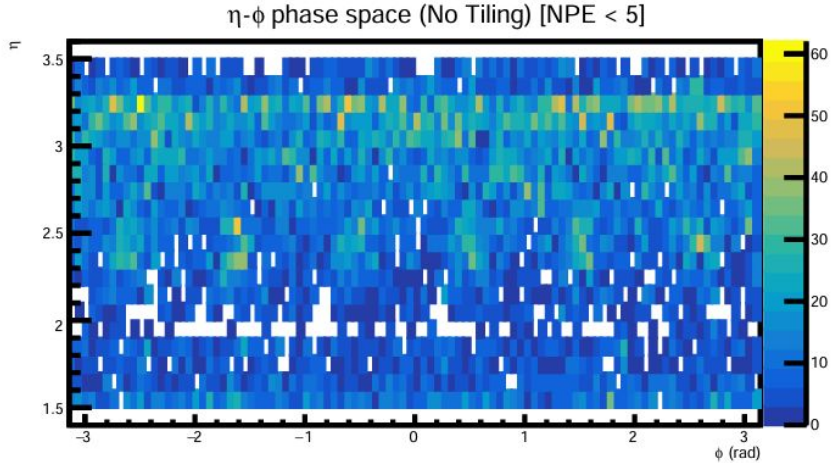


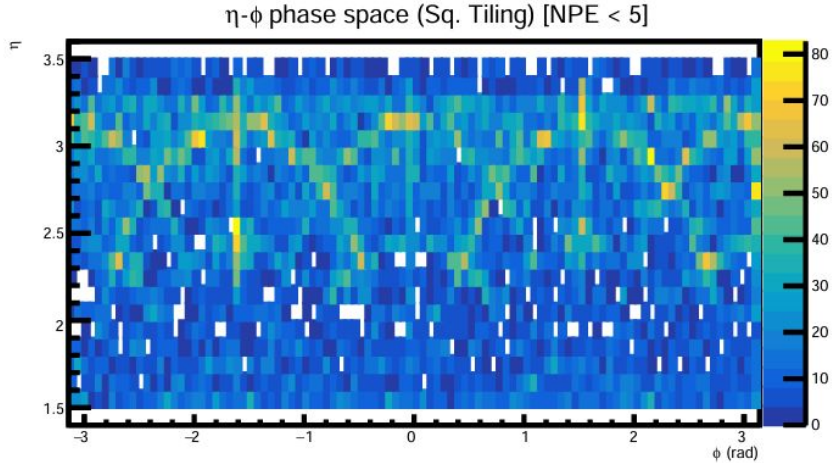


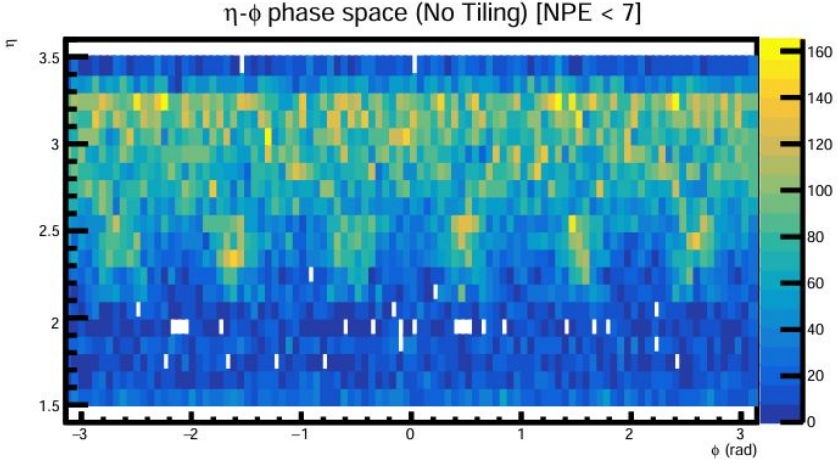


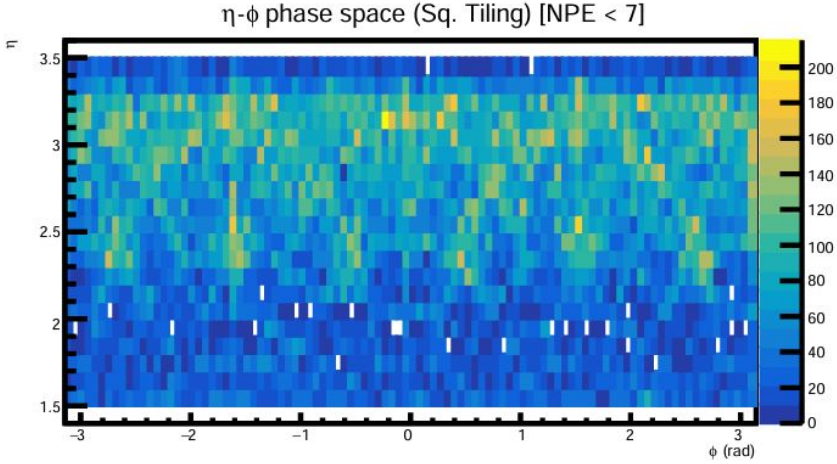


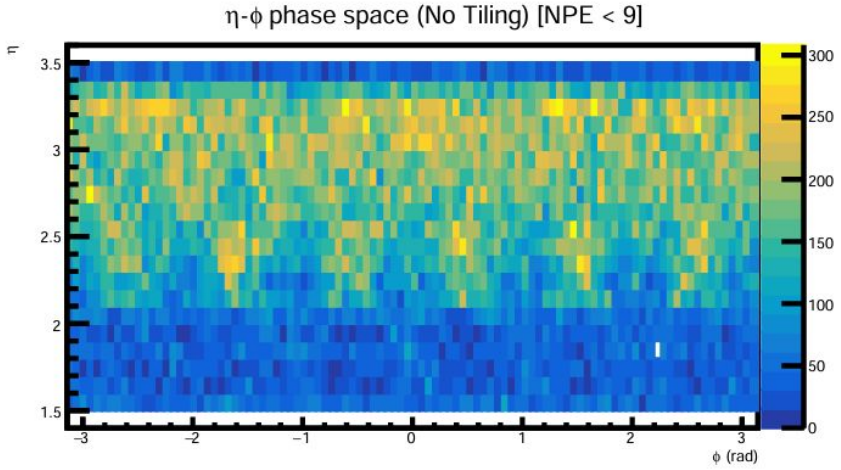
More Eta and Phi distributions with different NPE cuts

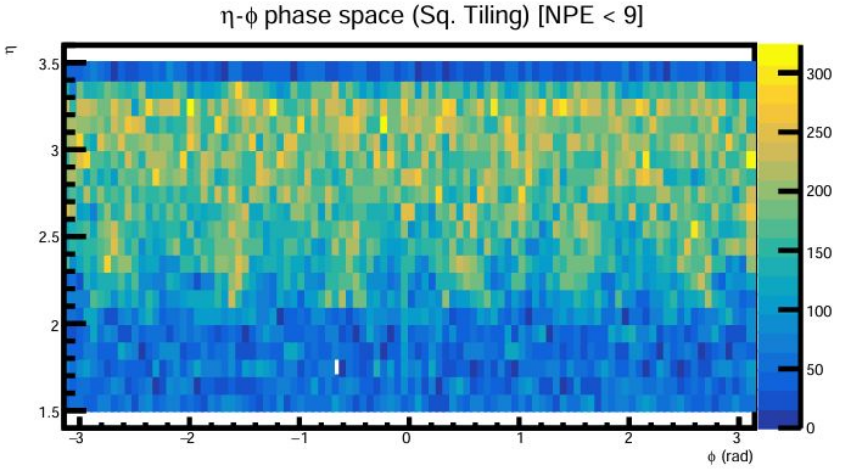


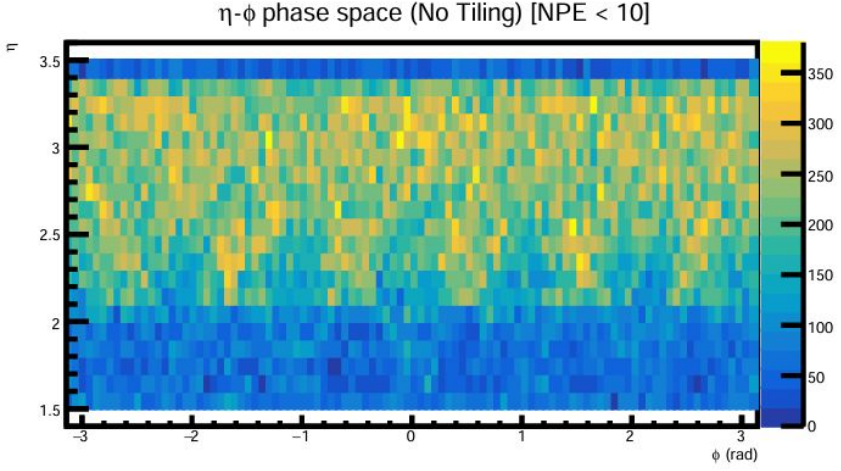


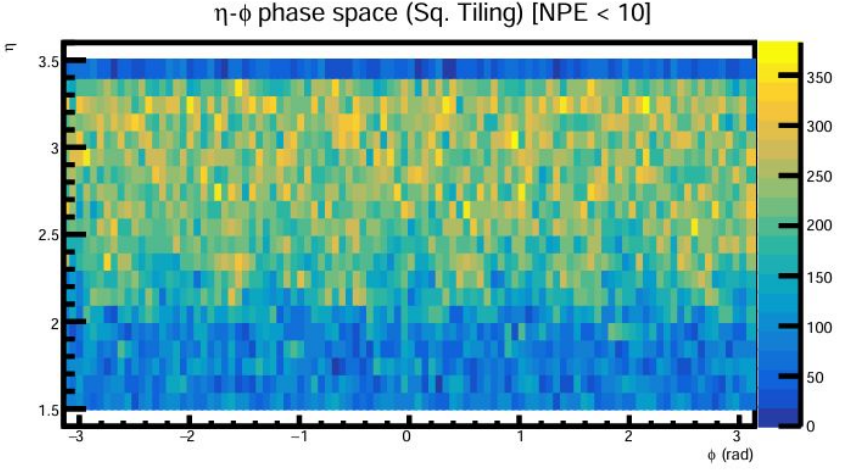


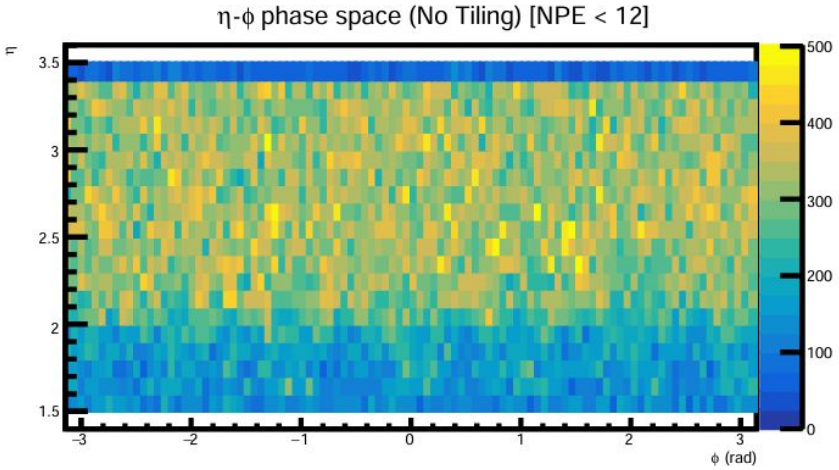


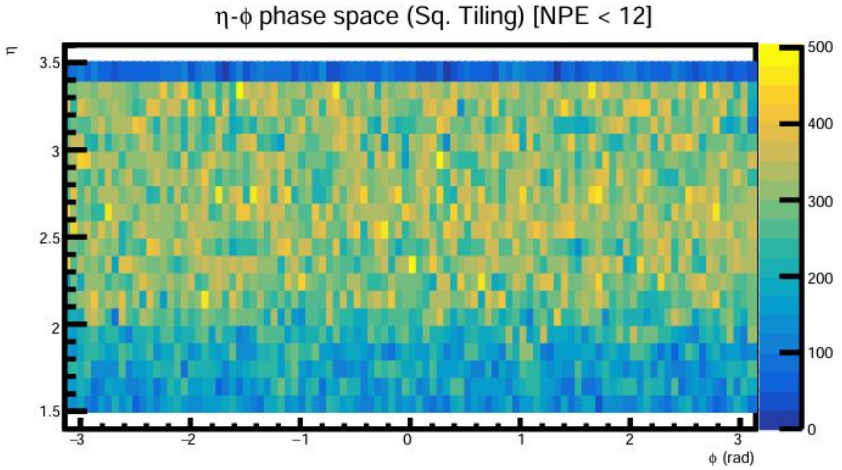

η-ϕ phase space (No Tiling) [NPE < 9]
η
ϕ (rad)

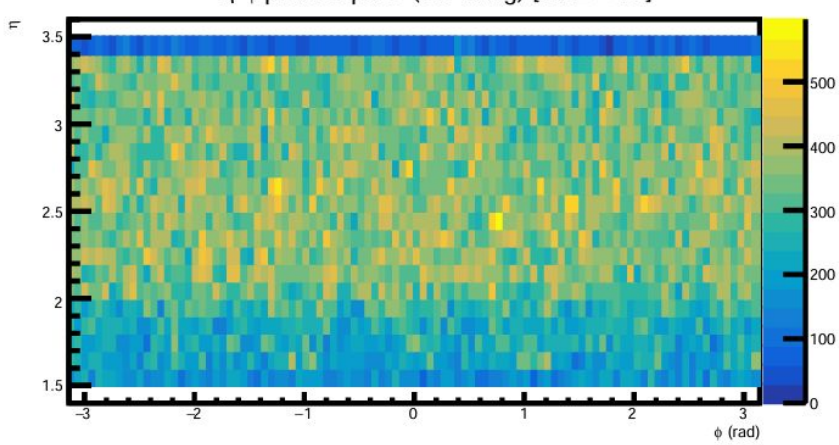

η-ϕ phase space (Sq. Tiling) [NPE < 9]
η
ϕ (rad)

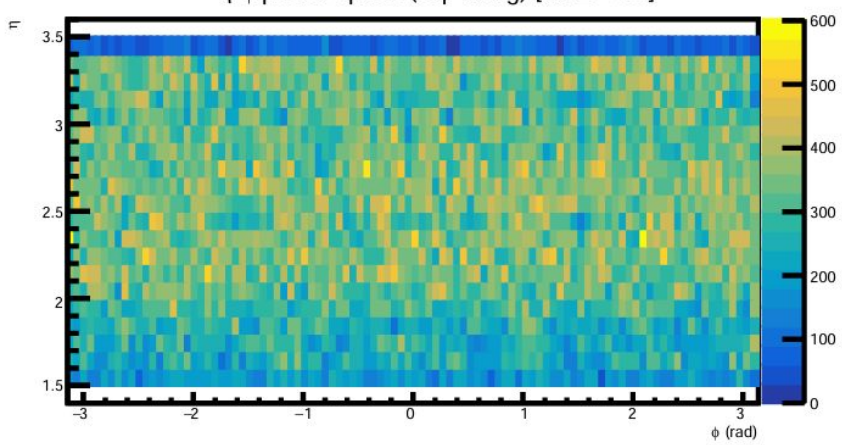

η-ϕ phase space (No Tiling) [NPE < 10]
η
ϕ (rad)

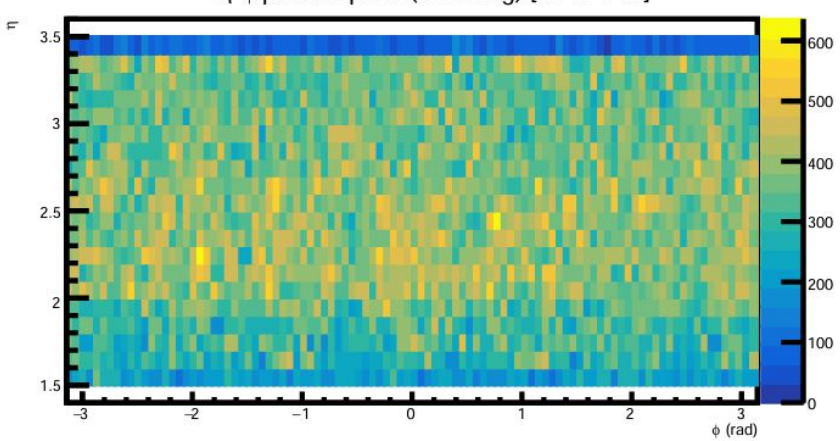

η-ϕ phase space (Sq. Tiling) [NPE < 10]
η
ϕ (rad)

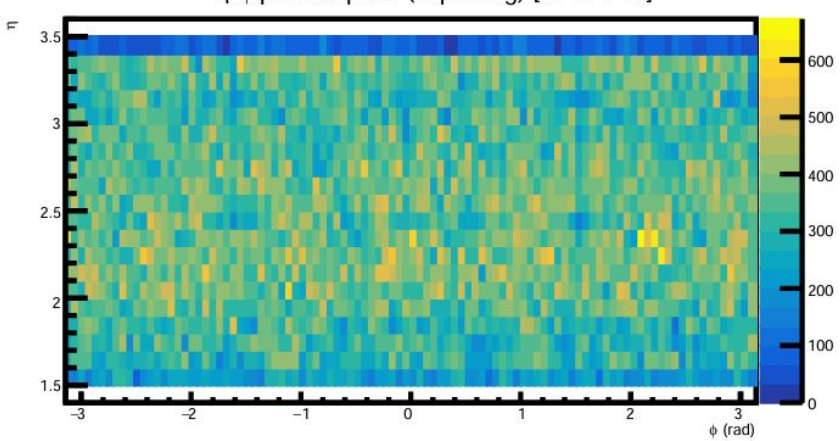

η-ϕ phase space (No Tiling) [NPE < 12]
η
ϕ (rad)


η-ϕ phase space (Sq. Tiling) [NPE < 12]
η
ϕ (rad)


η-ϕ phase space (No Tiling) [NPE < 13]
η
ϕ (rad)


η-ϕ phase space (Sq. Tiling) [NPE < 13]
η
ϕ (rad)


η-ϕ phase space (No Tiling) [NPE < 14]
η
3.5
3
2.5
2
1.5
−3
−2
−1
0
1
2
3
ϕ (rad)
600
500
400
300
200
100
0


η-ϕ phase space (Sq. Tiling) [NPE < 14]
η
3.5
3
2.5
2
1.5
−3
−2
−1
0
1
2
3
ϕ (rad)
600
500
400
300
200
100
0

Summary:

- Preliminary study on effect of aerogel square tiling.
- The data set used for simulation covered the whole eta range (1.5-3.5) and Phi range (0-2π), using Pion+ (momentum 20 GeV/c) particles for a total of 100K events
- Early studies showed effect of tiling in terms of NPE. We are aiming to study the effect further (e.g. in terms of pion-kaon separation).

THANK YOU

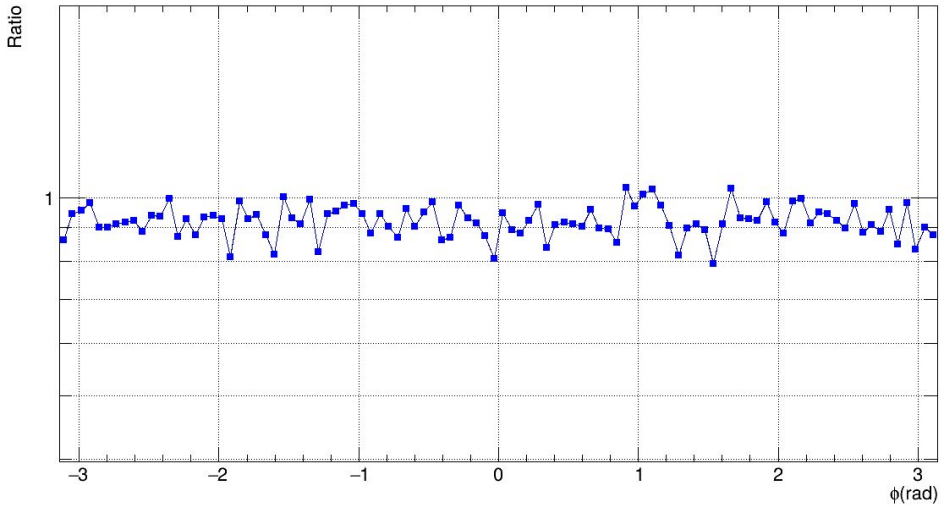
Backup

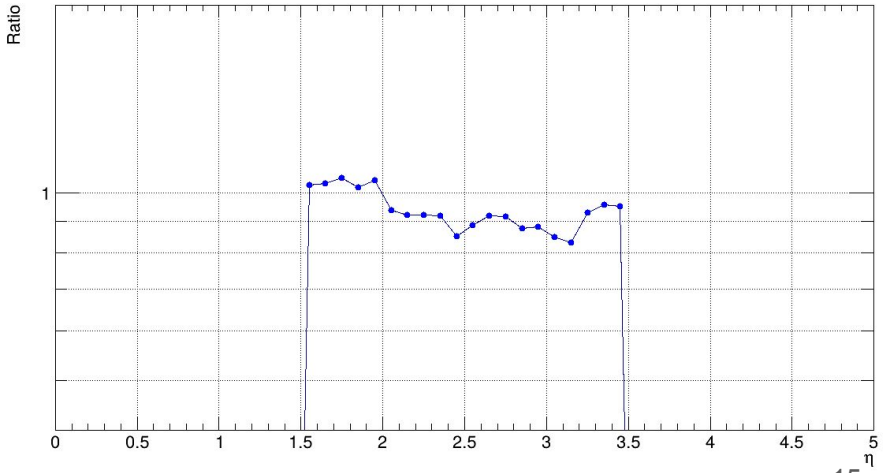
```
// rib structure
float originalSideLength = 2 * (radiatorRmax);
int nTilesX = 70;
int nTilesY = 10;
float tileSize = originalSideLength / nTilesX;
float ribThickness = 0.05;

double rib_effective = originalSideLength - 5;
double AT = 2*10*0.05+rib_effective - 10*10*0.05*0.05;
cout << "Dead area of tiles" << " " <<AT << "cm2" << endl;
cout << " Tile Size " << tileSize << endl;
cout << " Inner rim radii " << radiatorRmax << endl;
cout << " outer rim radii " << outerRmaxBack << endl;
cout << " Inner rim radii (check) " << outerRmaxBack - rimWidth << endl;
//cout << <<
auto ribMat = desc.material("CarbonFiber_15percent");
//auto filterVis = desc.visAttributes(filterElem.attr<std::string>(_Unicode(vis)));

// Define rib solids once, outside the loop
Box aerogelRibSolidX(ribThickness / 2, tileSize / 2, aerogelThickness / 2);
Box aerogelRibSolidY(tileSize / 2, ribThickness / 2, aerogelThickness / 2);

// Create a union of all ribs and rims
Solid ribUnionSolid = nullptr;
bool firstRib = true;

// Build the union of ribs (same as your existing code)
// Build the union of ribs
for (int i = 0; i < nTilesX; i++) {
    for (int j = 0; j < nTilesY; j++) {
        float xPos = -((nTilesX - 1) * tileSize / 2) + i * tileSize;
```

Code for storing eta and phi of track

```
271   //added
272   auto R_eta = part->GetEta(); // track eta
273   auto R_phi = part->GetPHI(); // track Phi
274
275   m_particleEta_vs_particlePhi_Nocut->Fill(R_phi, R_eta);
276
277   if (cherenkov_pid.getNpe() < 5) {
278       m_particleEta_vs_particlePhi_1->Fill(R_phi, R_eta);
279    }
280
```

Log plots

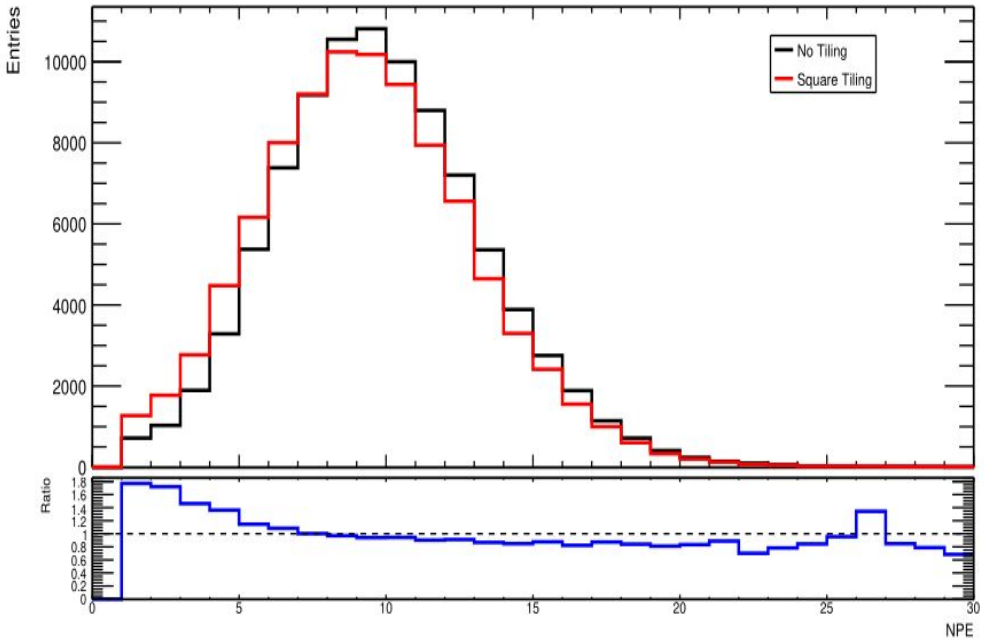




Data set:

Covering whole eta range (1.5-3.5) & Phi range (0-2π), Pion+ 20GeV/c
Total of 100K events.

Overall NPE distribution for aerogel (1.026)



Mean and sigma of fit:
9.42 ± 0.08 red
3.07 ± 0.01 red

9.82 ± 0.05 black
3.134 ± 0.008 black

Eta and Phi distribution at cut NPE < 12 :