PXD Efficiency Studies

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Belle II PXD Workshop
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PXD Efficiency Estimates

- Phase 3 data, experiment 8 (proc9)
- Using tracks with:

$|d_0| < 0.3$cm
$|z_0| < 1$ cm
$p_T > 0.6$ GeV
N(tracks) = 2
N(SVD hits) ≥ 6
N(CDC hits) ≥ 10

Goal:

- Measure efficiency of each layer
- Compare performance of the two layers

Reconstruction:

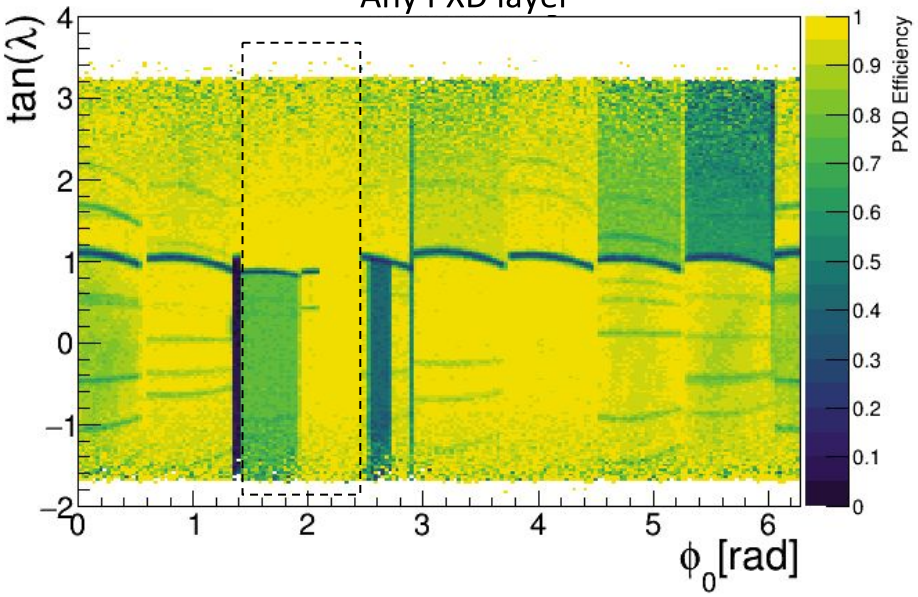
- Default
- Ignoring the first PXD layer
- Ignoring the second PXD layer

Continuation of studies performed by Cyrille: talk

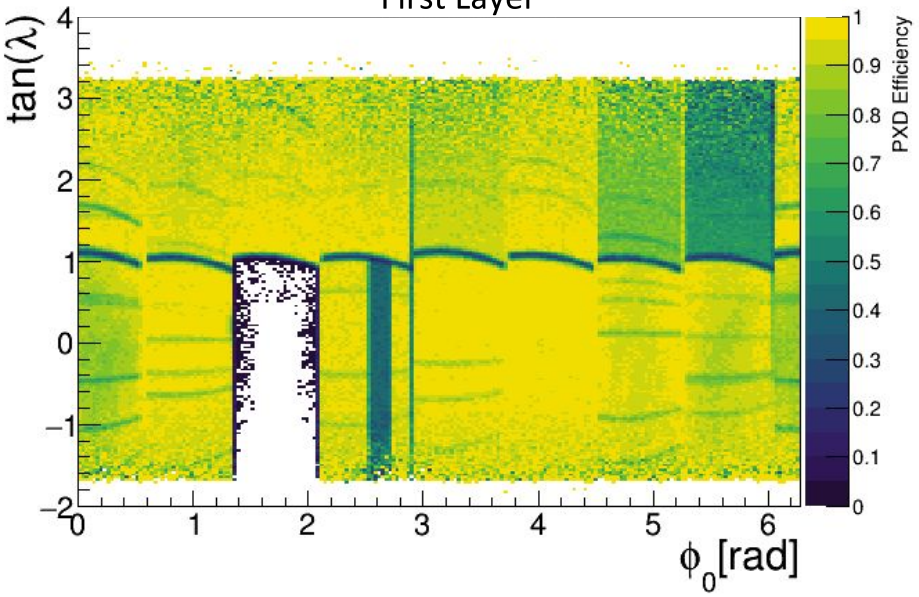
Caveat: these efficiencies also include the matching efficiencies.

PXD Efficiencies

Tracks with a hit in
Any PXD layer



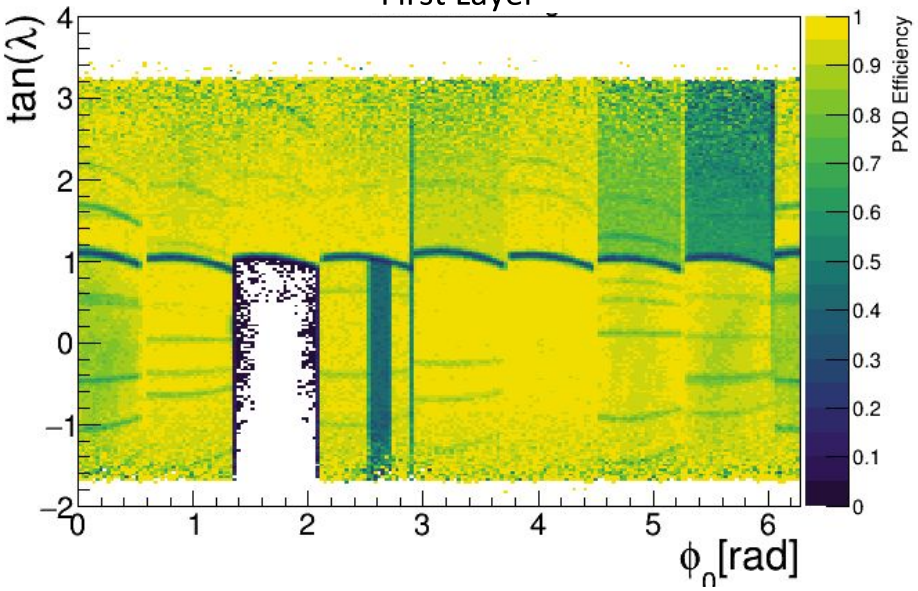
Tracks with a hit in the
First Layer



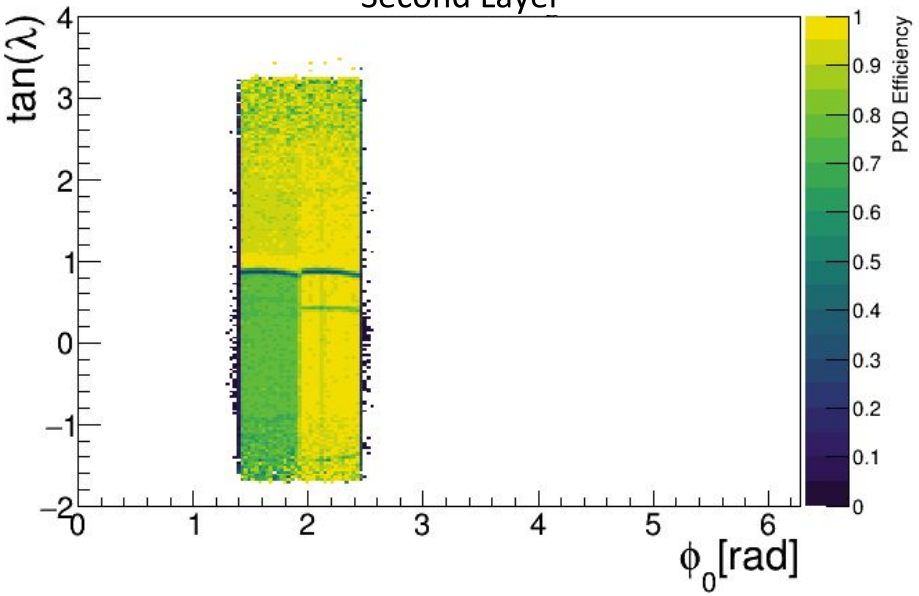
Visible improvement in the overlapping region

PXD Layer Efficiencies

Tracks with a hit in the First Layer



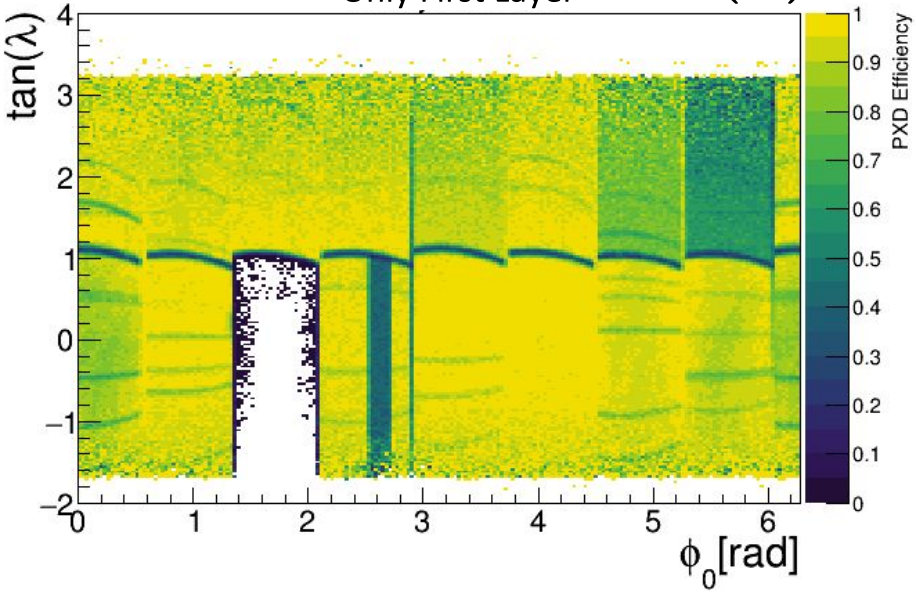
Tracks with a hit in the Second Layer



These are not “pure” efficiencies since there are likely hits on other layer as well

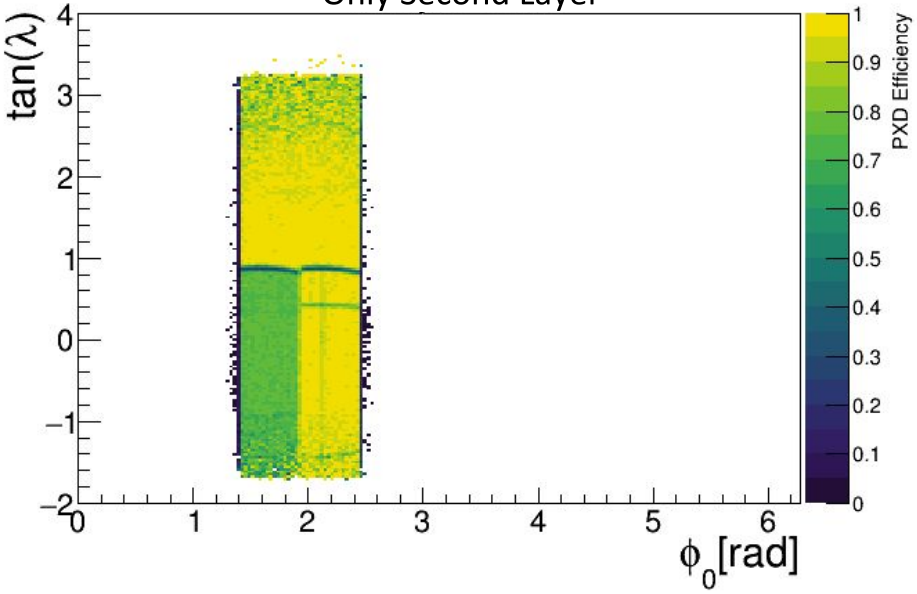
PXD “pure” Layer Efficiencies (custom tracking)

Tracks with a hit in the Only First Layer $\epsilon(1)$



Ignoring the 2nd PXD layer during reco

Tracks with a hit in the Only Second Layer $\epsilon(2)$

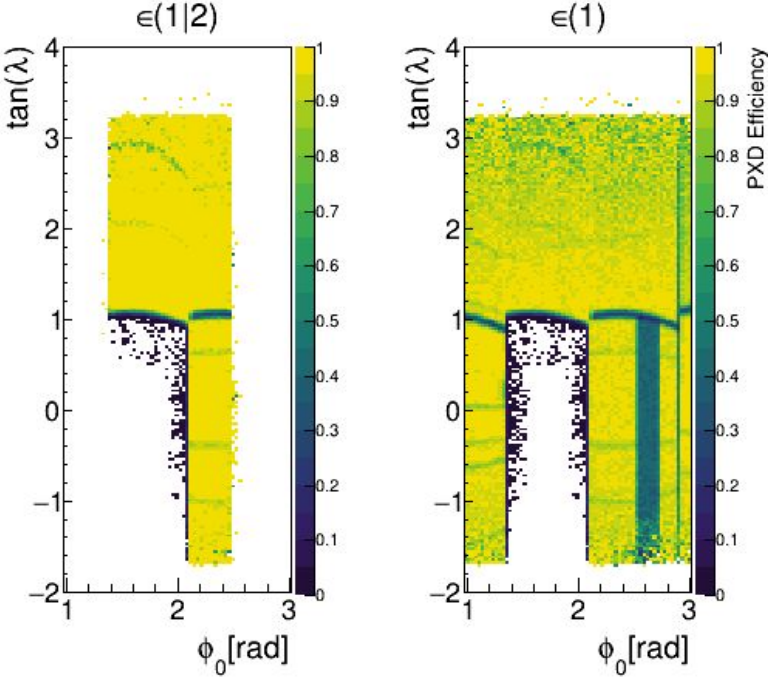


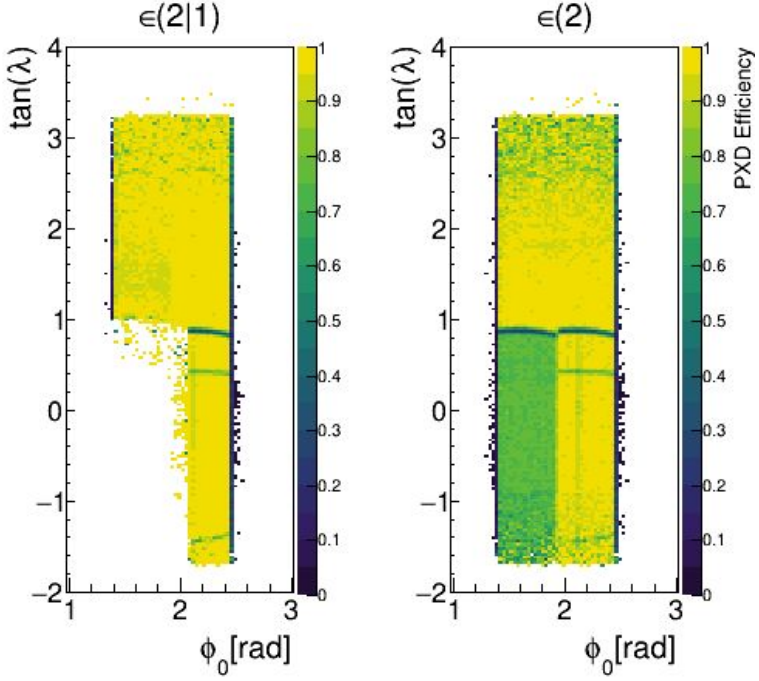
Ignoring 1st PXD layer during reco

“Conditional” Efficiencies

$$\epsilon(1|2) = \frac{N_{hits}(layer\ 1\ and\ 2)}{N_{hits}(layer\ 2)}$$

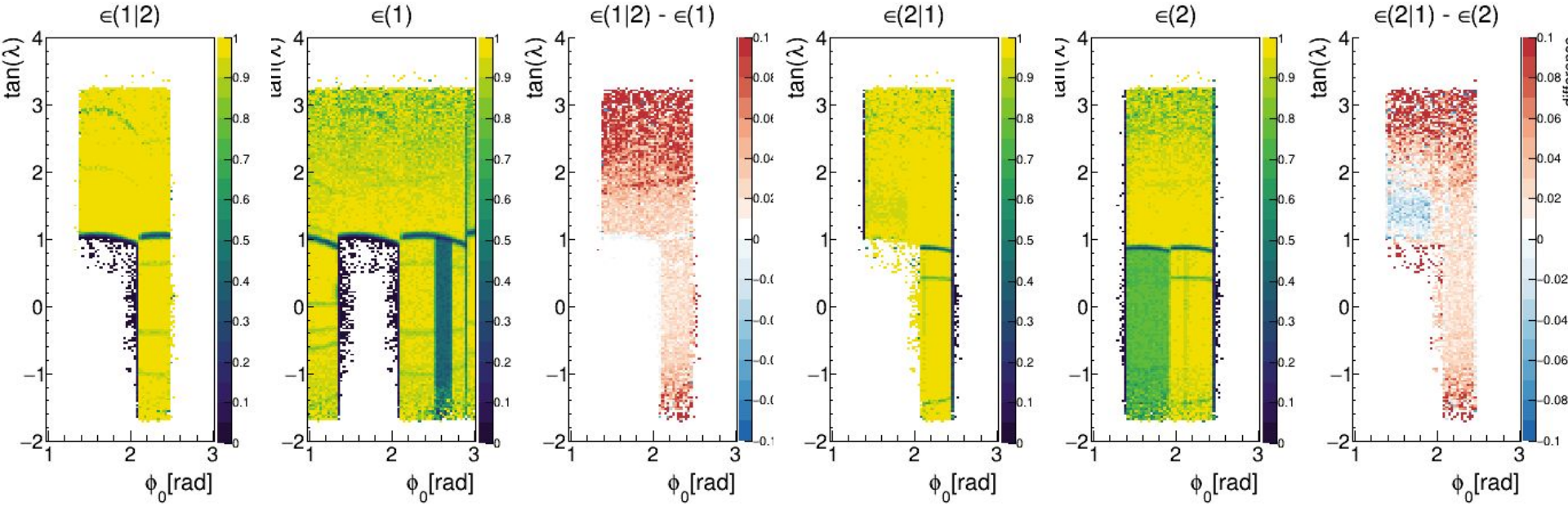
$$\epsilon(2|1) = \frac{N_{hits}(layer\ 1\ and\ 2)}{N_{hits}(layer\ 1)}$$



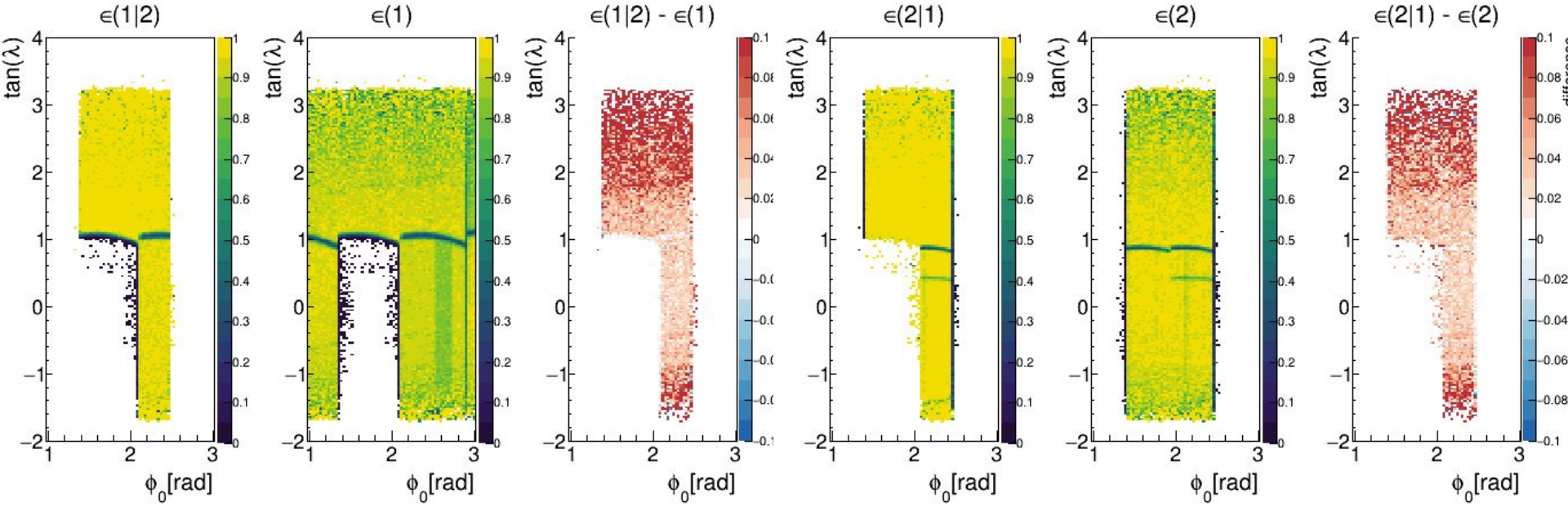


“Conditional” Efficiencies

$$\epsilon(1|2) = \frac{N_{hits}\,(layer\ 1\ and\ 2)}{N_{hits}\,(layer\ 2)} \qquad \epsilon(2|1) = \frac{N_{hits}\,(layer\ 1\ and\ 2)}{N_{hits}\,(layer\ 1)}$$

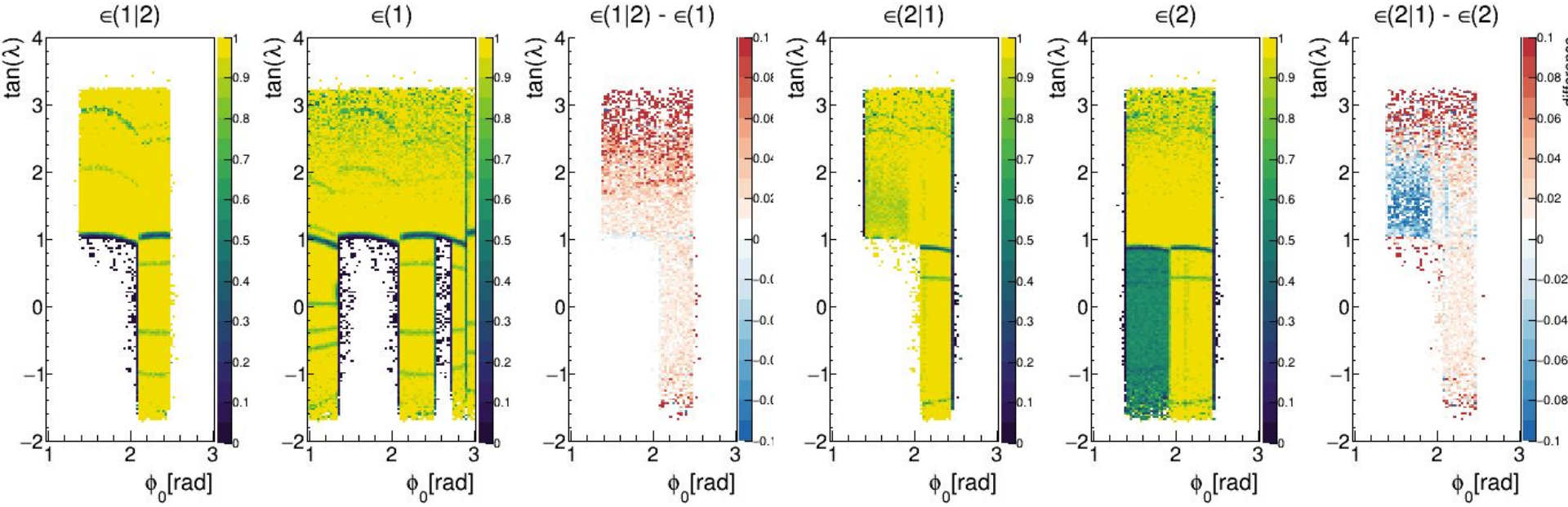


“Conditional” Efficiencies (Runs 44 to 2060)

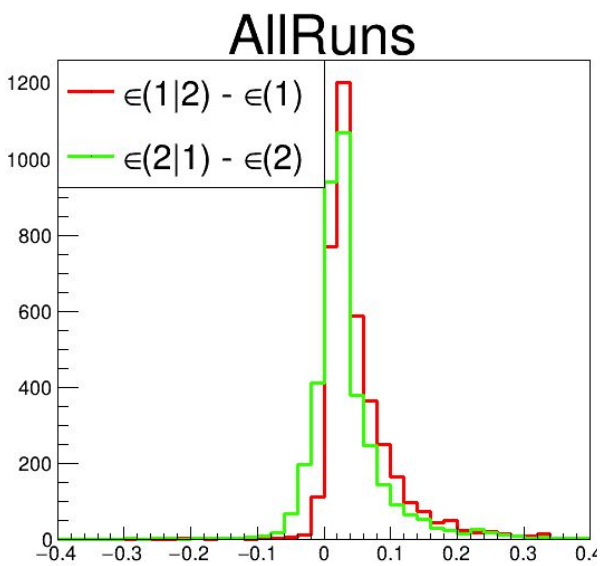


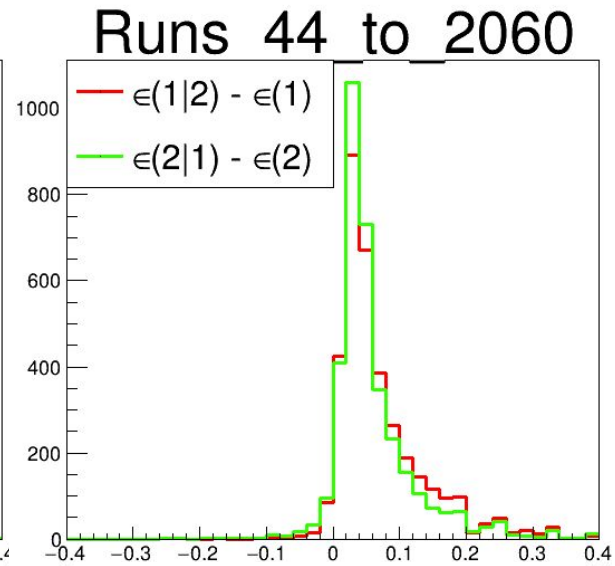
“Conditional” Efficiencies (Runs 2069 to 3124)

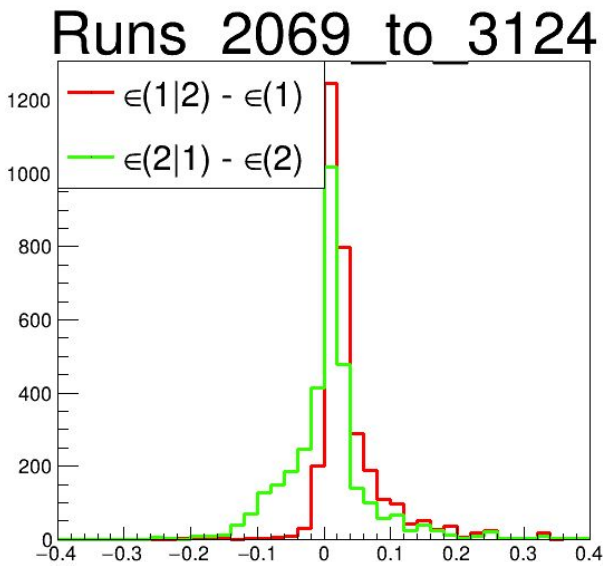
Parts of 2nd layer start to perform worse in the presence of 1st layer!



Distribution of the differences







Still unclear...

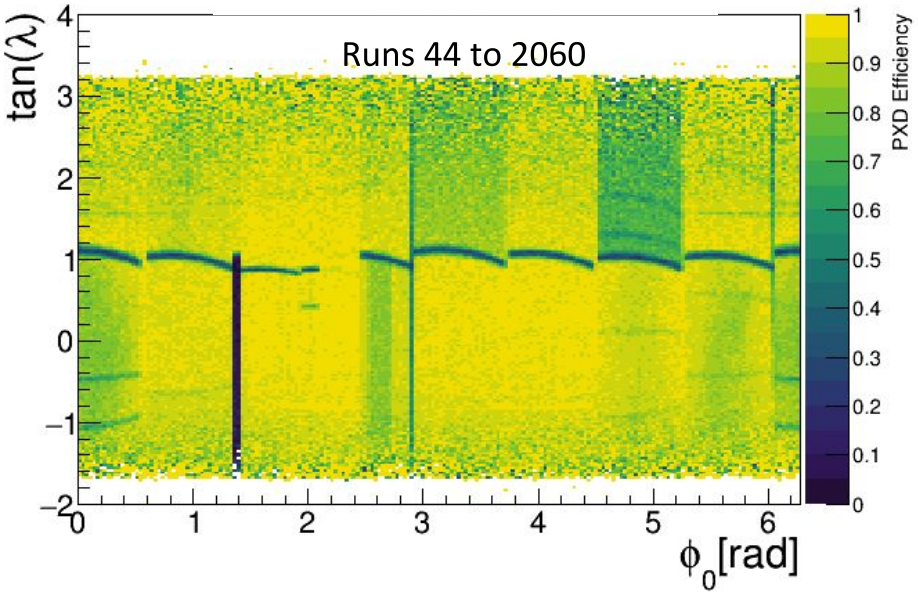
- Is the effect related to the beam incident?
- Could it be due to misalignment? (but why only part of module?)
- Something in the SVD?
- Matching Inefficiency?

...any ideas?

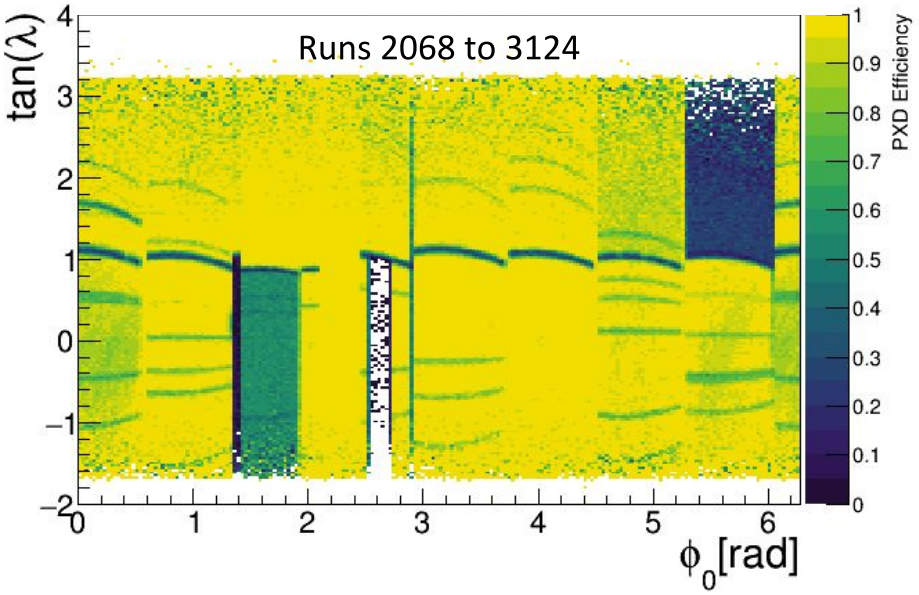
Back up

PXD Efficiencies, Split by Run

Tracks with a PXD hit

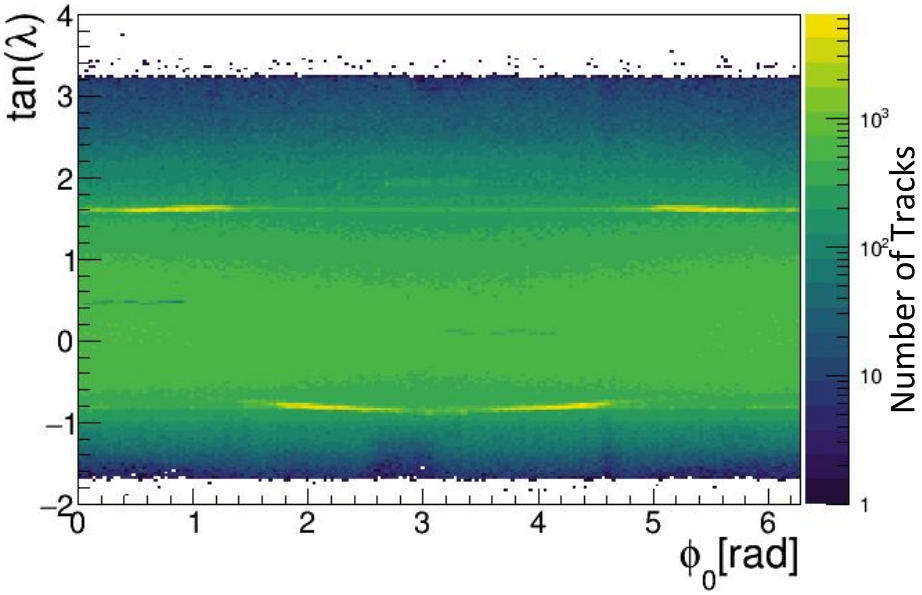


Tracks with a PXD hit

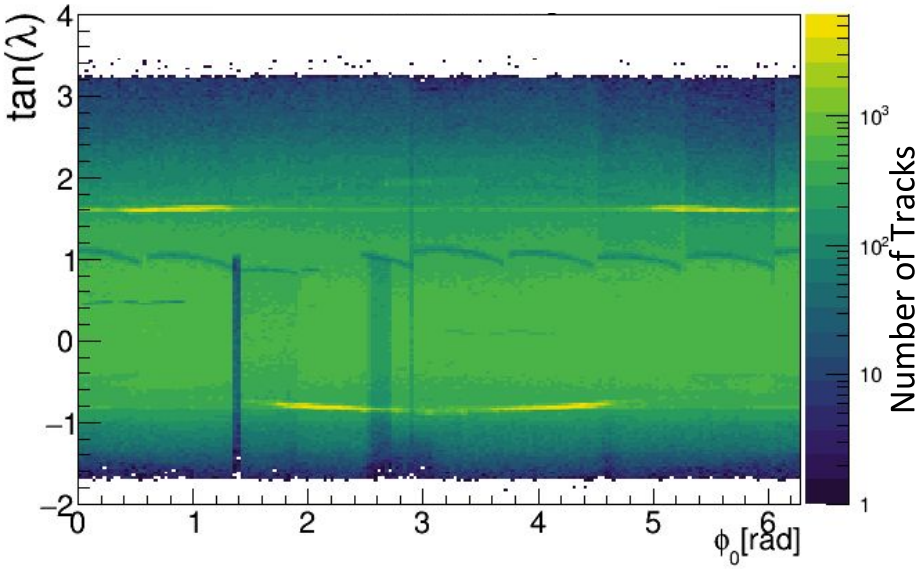


PXD Hit Estimates

All Tracks

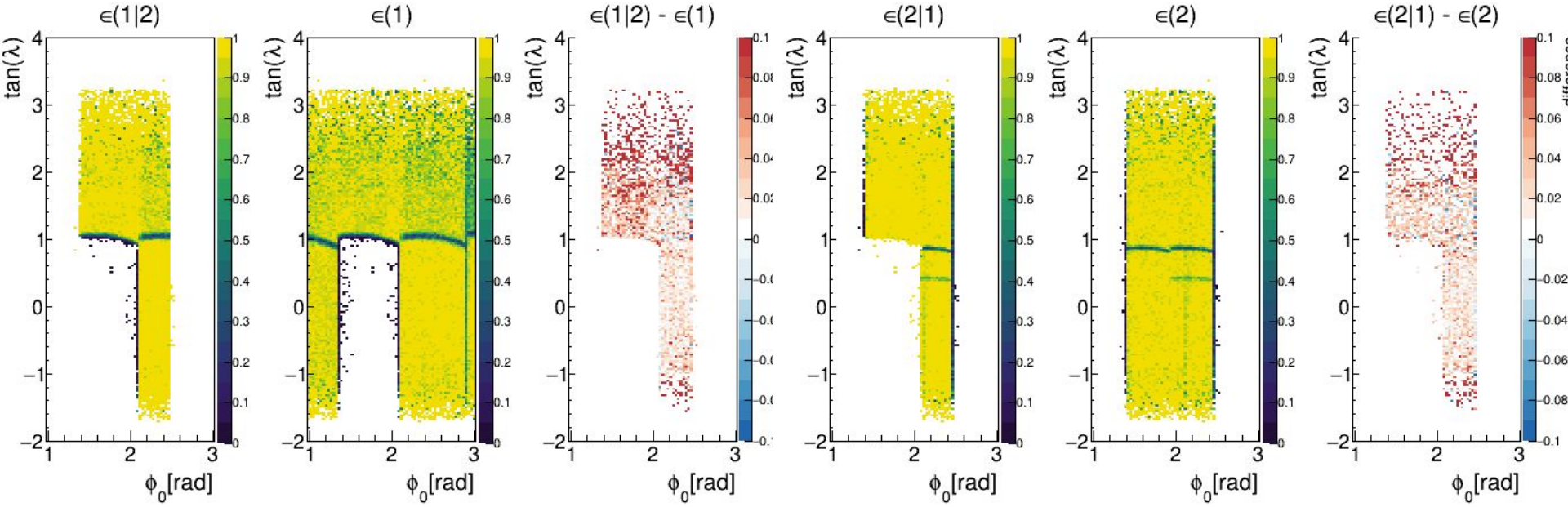


Tracks with a PXD hit

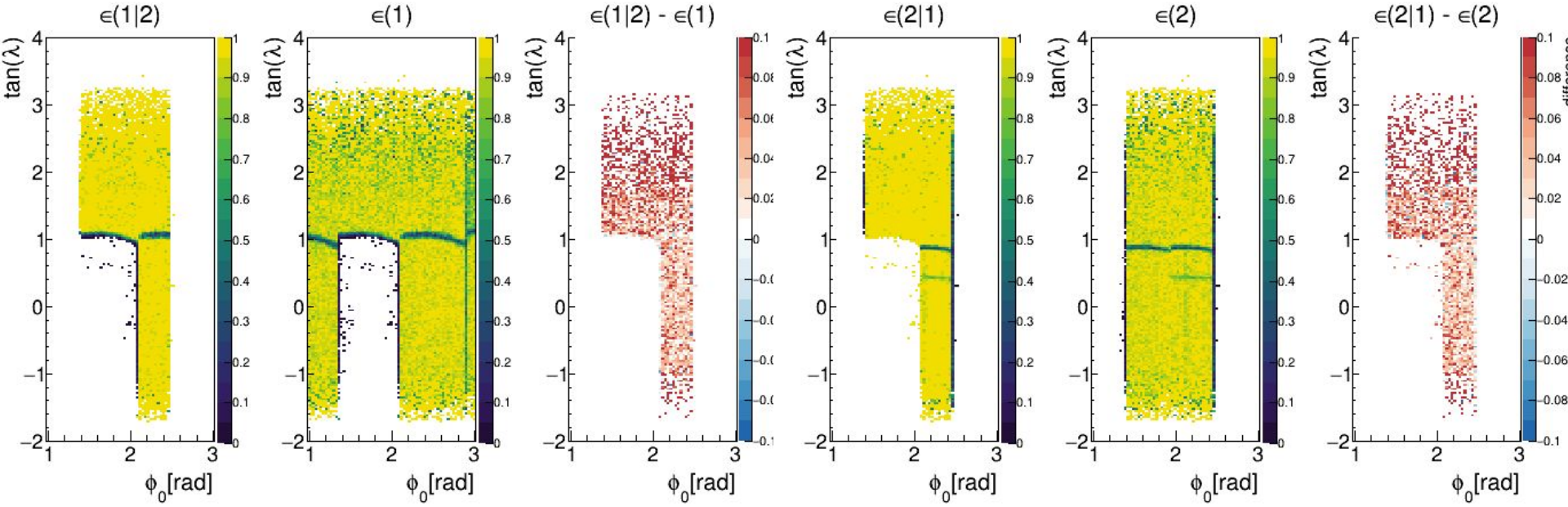


Run Dependance

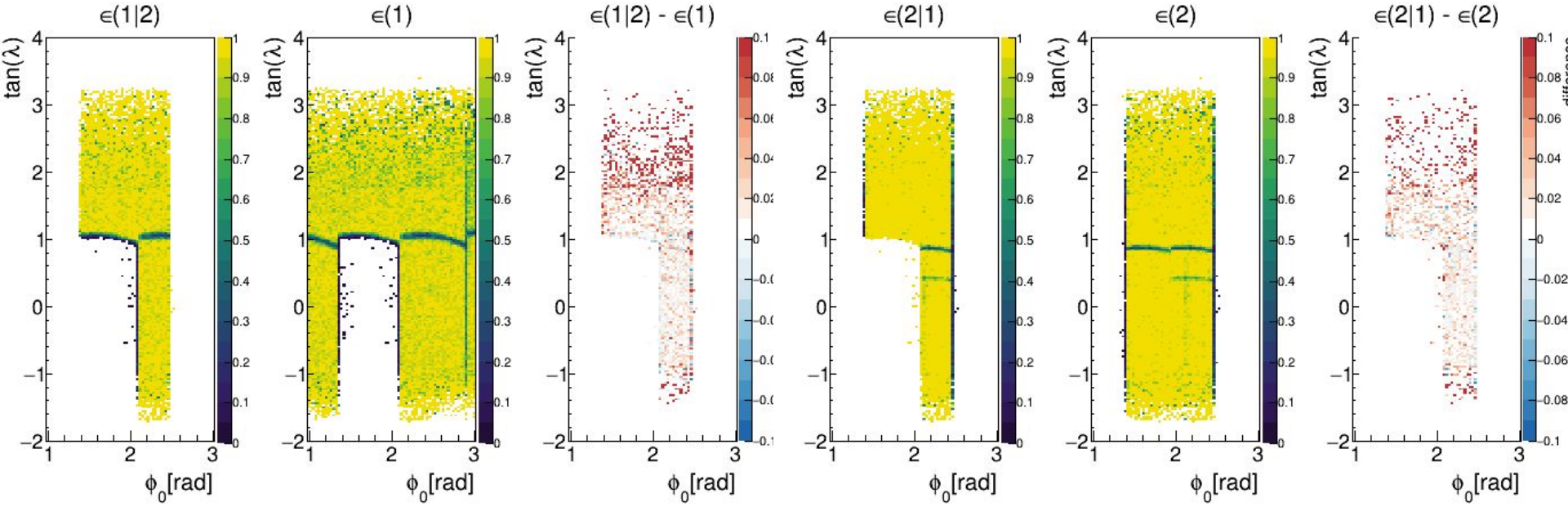
Runs_44_to_367



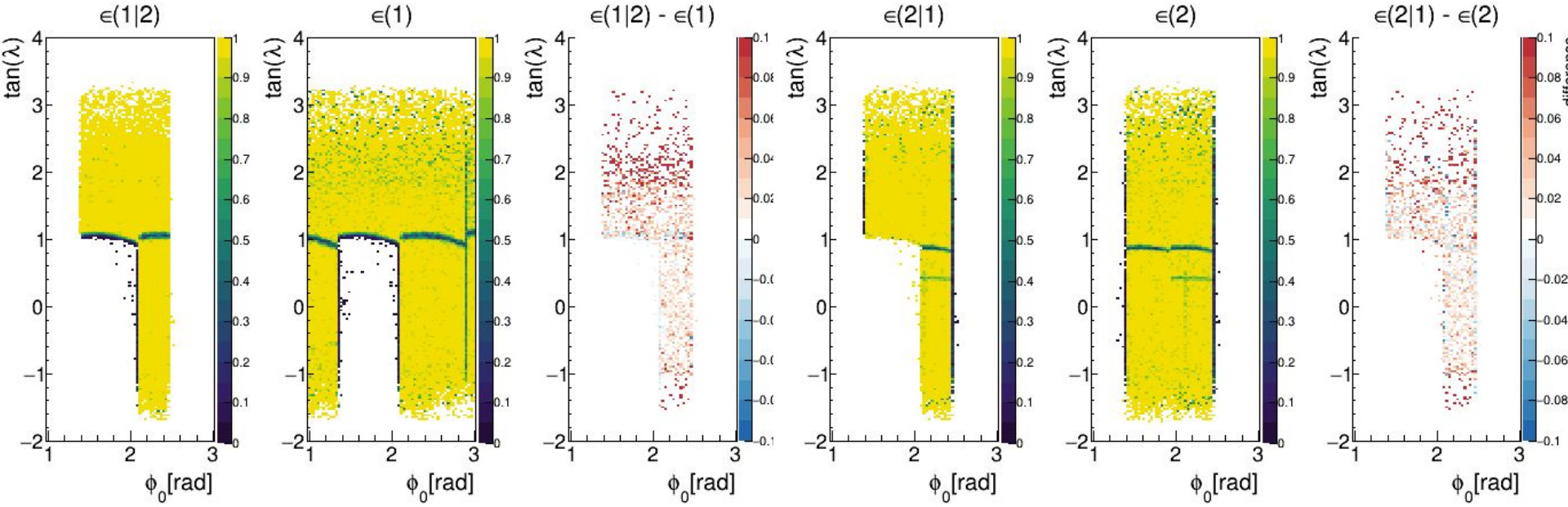
Runs_368_to_1062



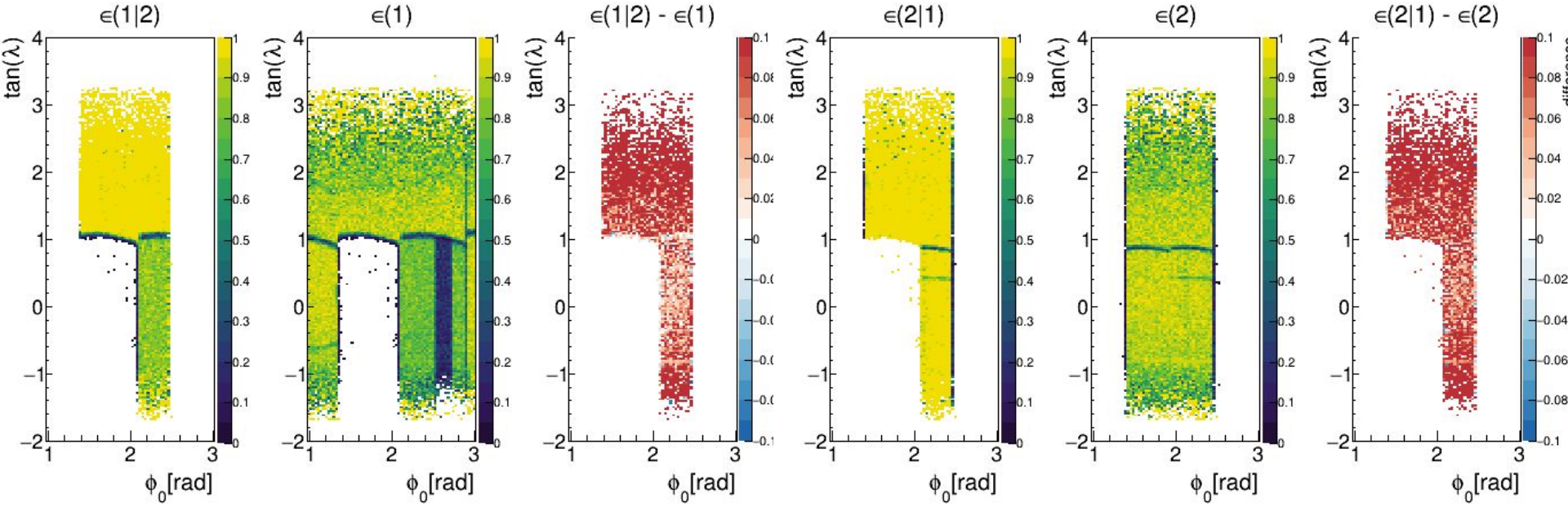
Runs_1065_to_1243



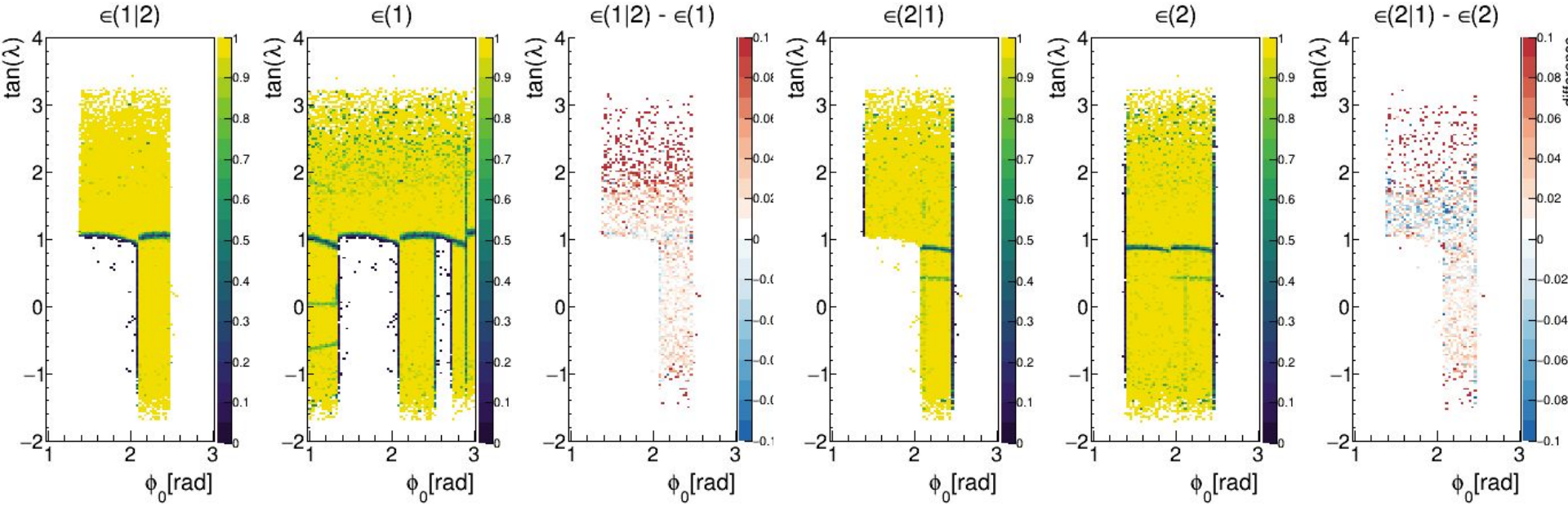
Runs_1246_to_1540



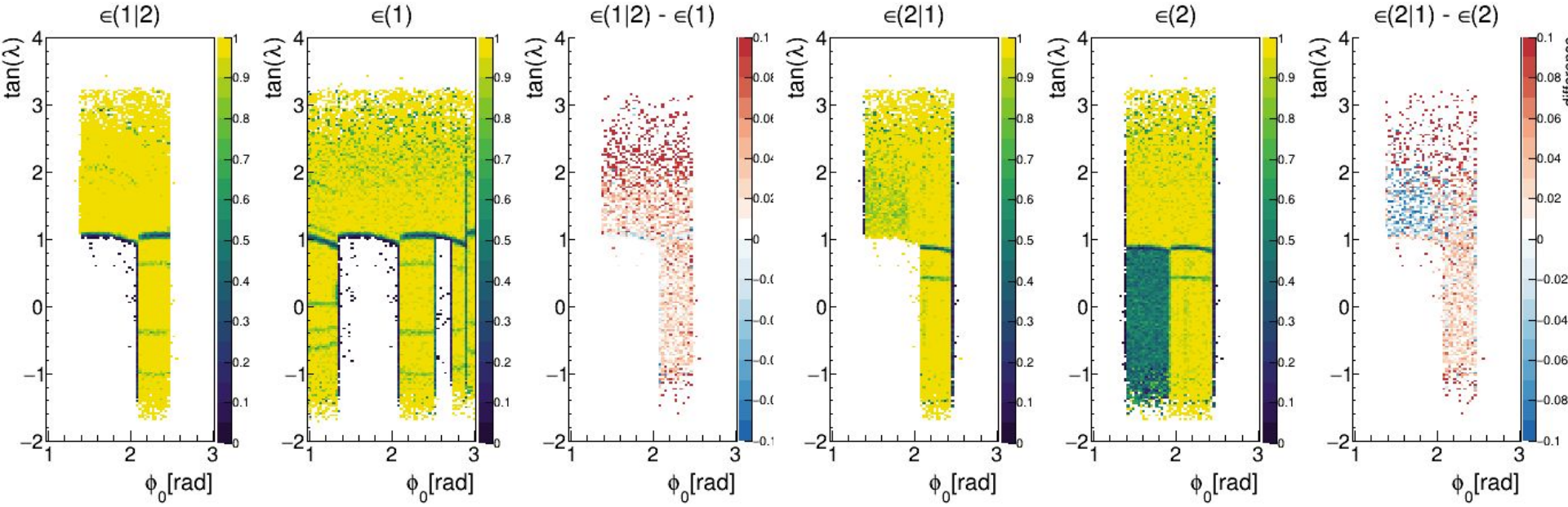
Runs_1541_to_2068



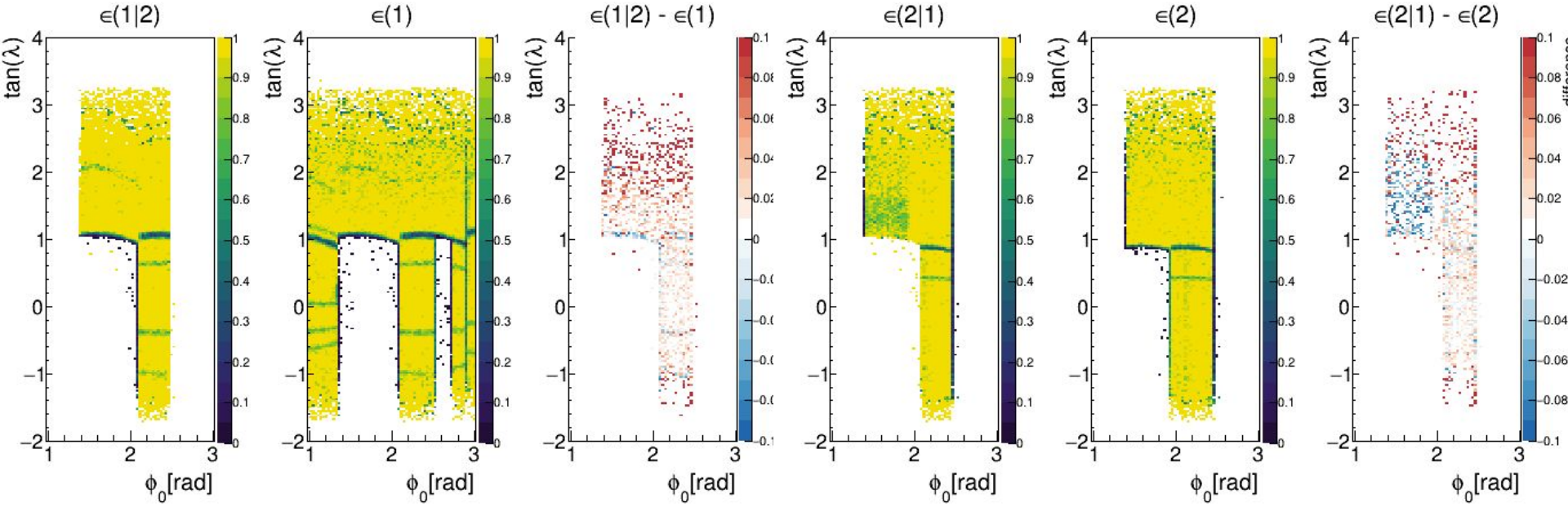
Runs_2069_to_2250



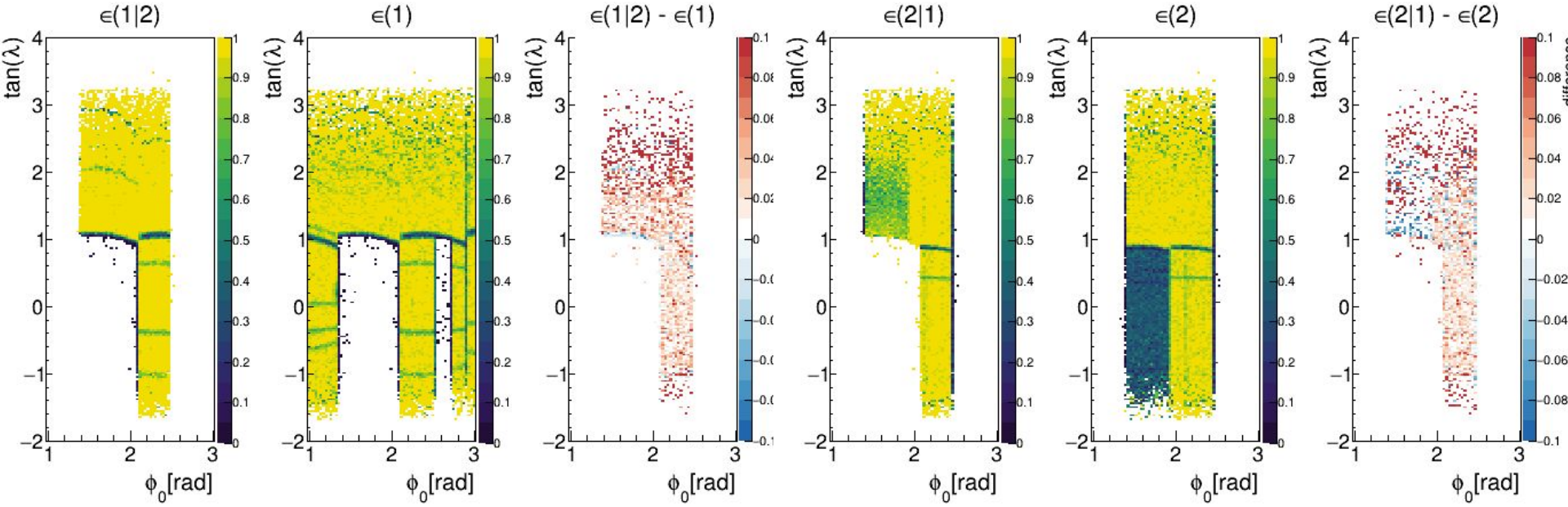
Runs_2251_to_2576



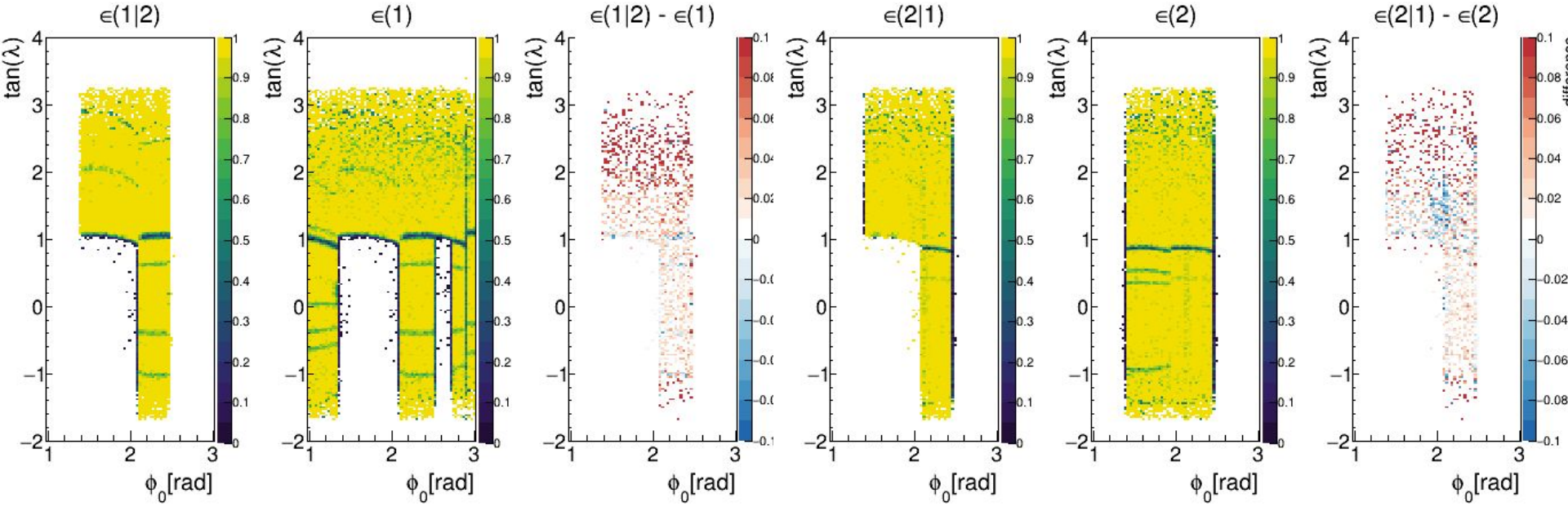
Runs_2579_to_2633

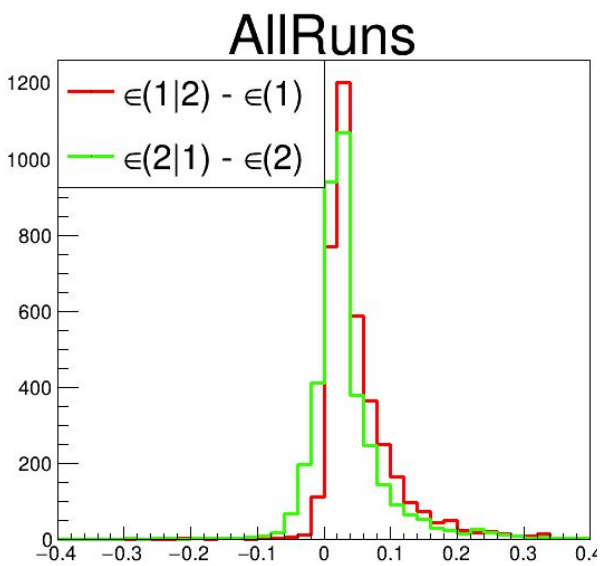


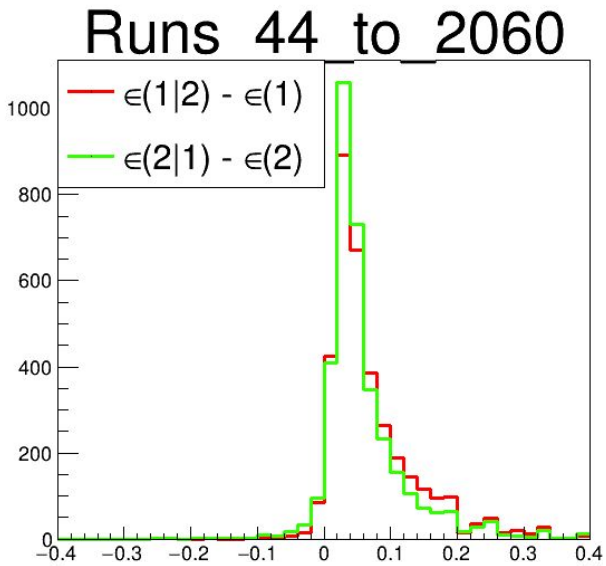
Runs_2634_to_2786

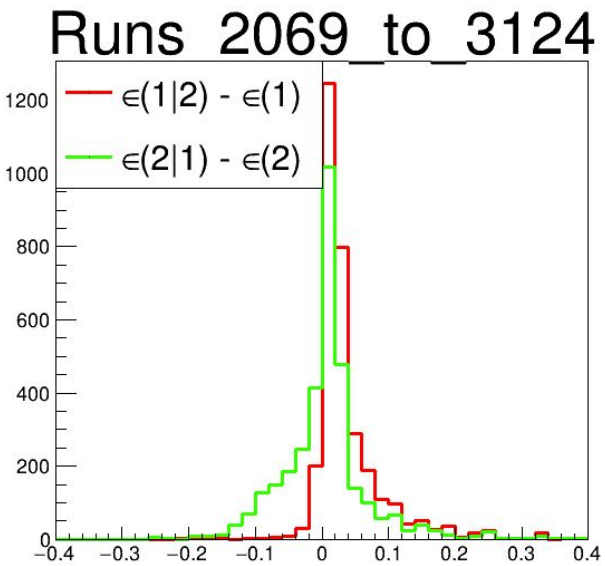


Runs_2787_to_3124




AllRuns
∈(1|2) - ∈(1)
∈(2|1) - ∈(2)
difference


Runs_44_to_2060
∈(1|2) - ∈(1)
∈(2|1) - ∈(2)
difference


Runs_2069_to_3124
∈(1|2) - ∈(1)
∈(2|1) - ∈(2)
difference

Ignore PXD Layer Hack

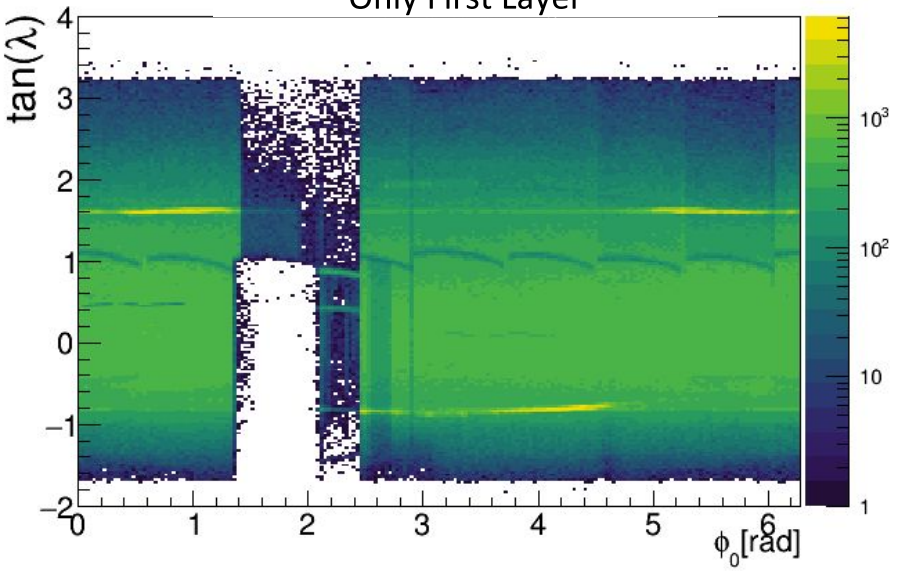
```
void PXDSpacePointCreatorModule::event()
{

  for (unsigned int i = 0; i < uint(m_pxdClusters.getEntries()); ++i) {
    const PXDCluster* currentCluster = m_pxdClusters[i];

    if ( m_pxdLayerIgnore != 0 ){
        if (currentCluster->getSensorID().getLayerNumber() == m_pxdLayerIgnore) {
          continue;
        }
    }
    SpacePoint* newSP = m_spacePoints.appendNew((currentCluster));
    newSP->addRelationTo(currentCluster);
  }
```

PXD Hitmaps

Tracks with a hit in
Only First Layer



Tracks with a hit in
Only First Layer