

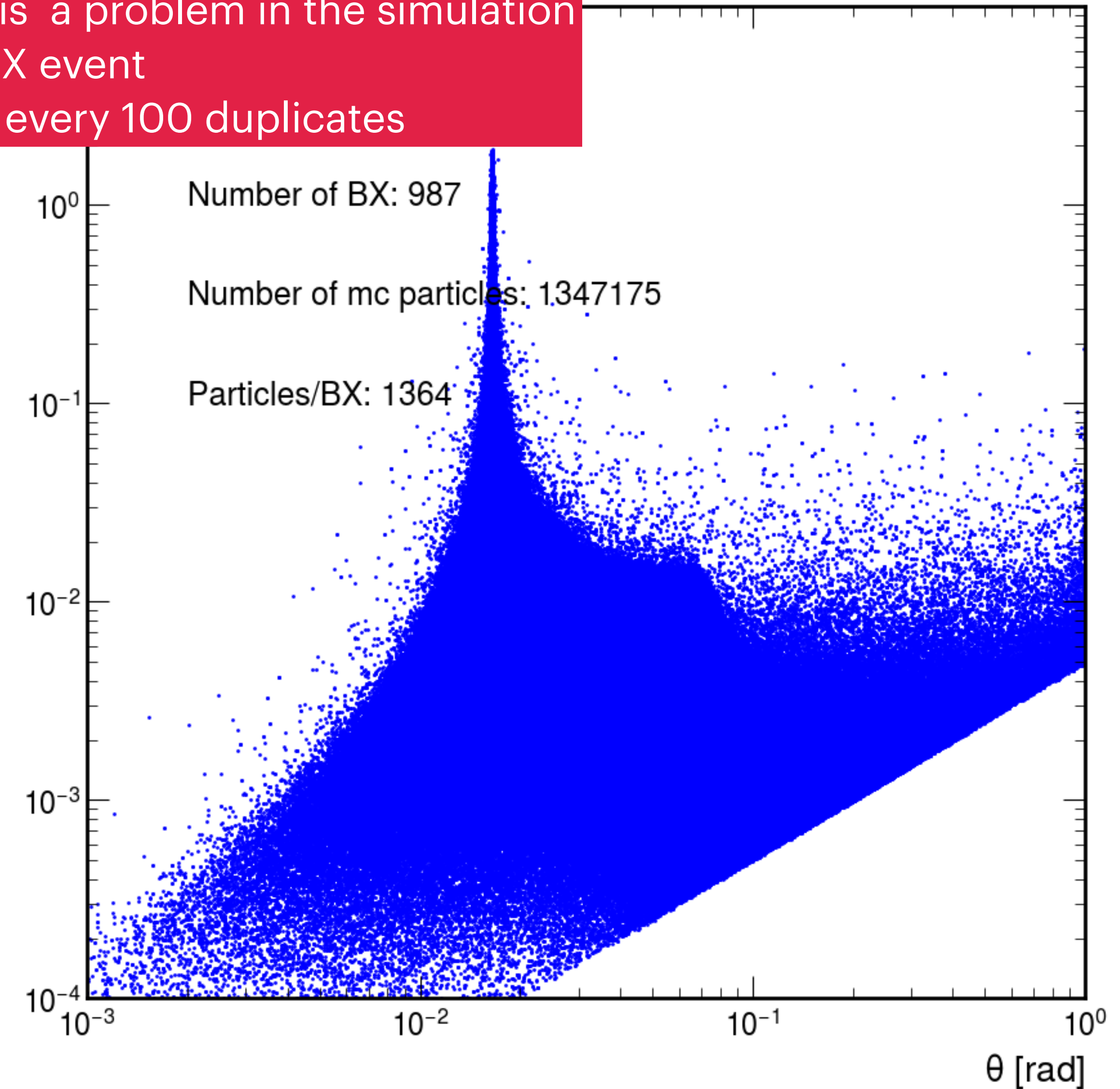
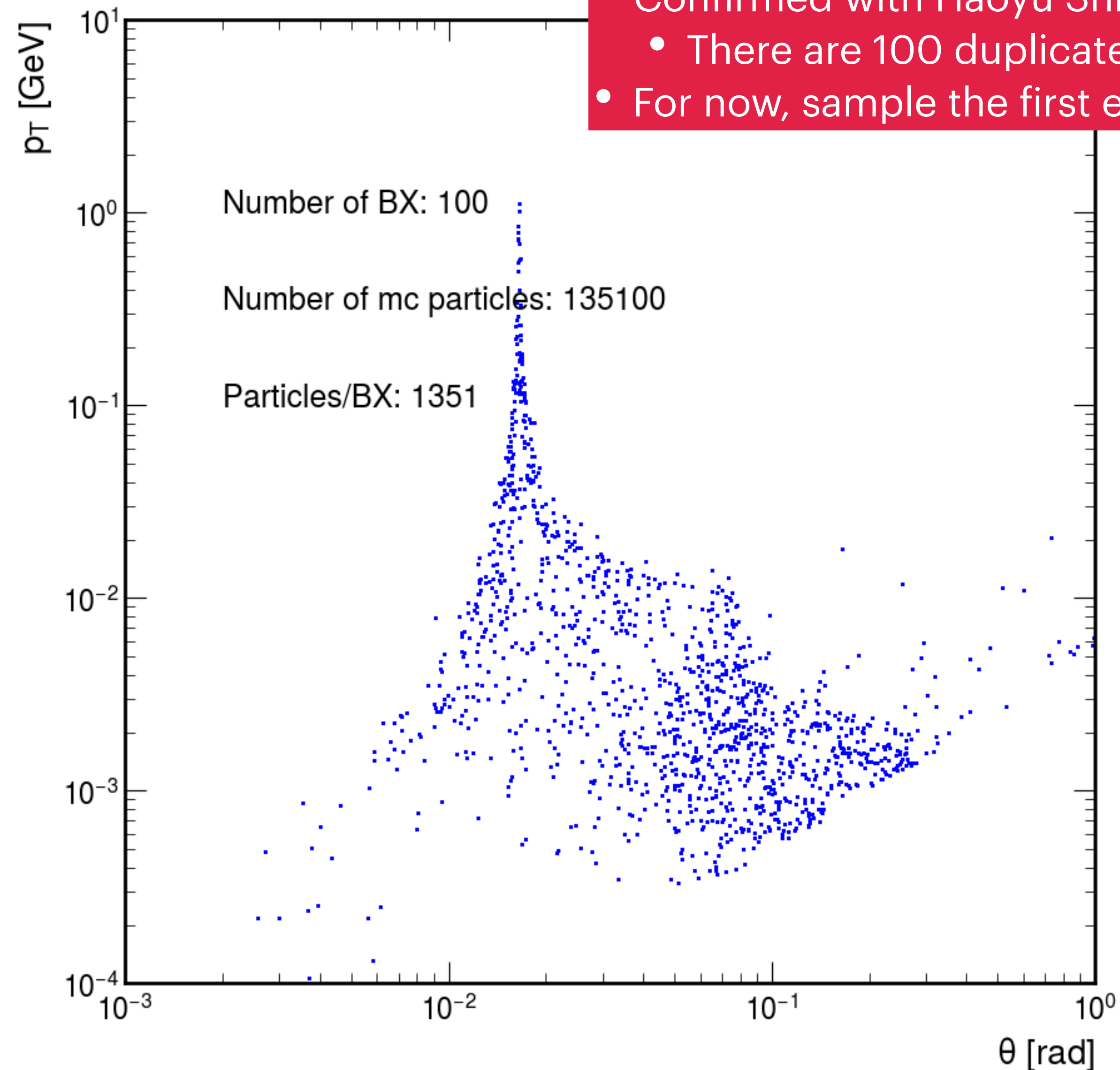
# **Status update**

**Beam background for tracking**

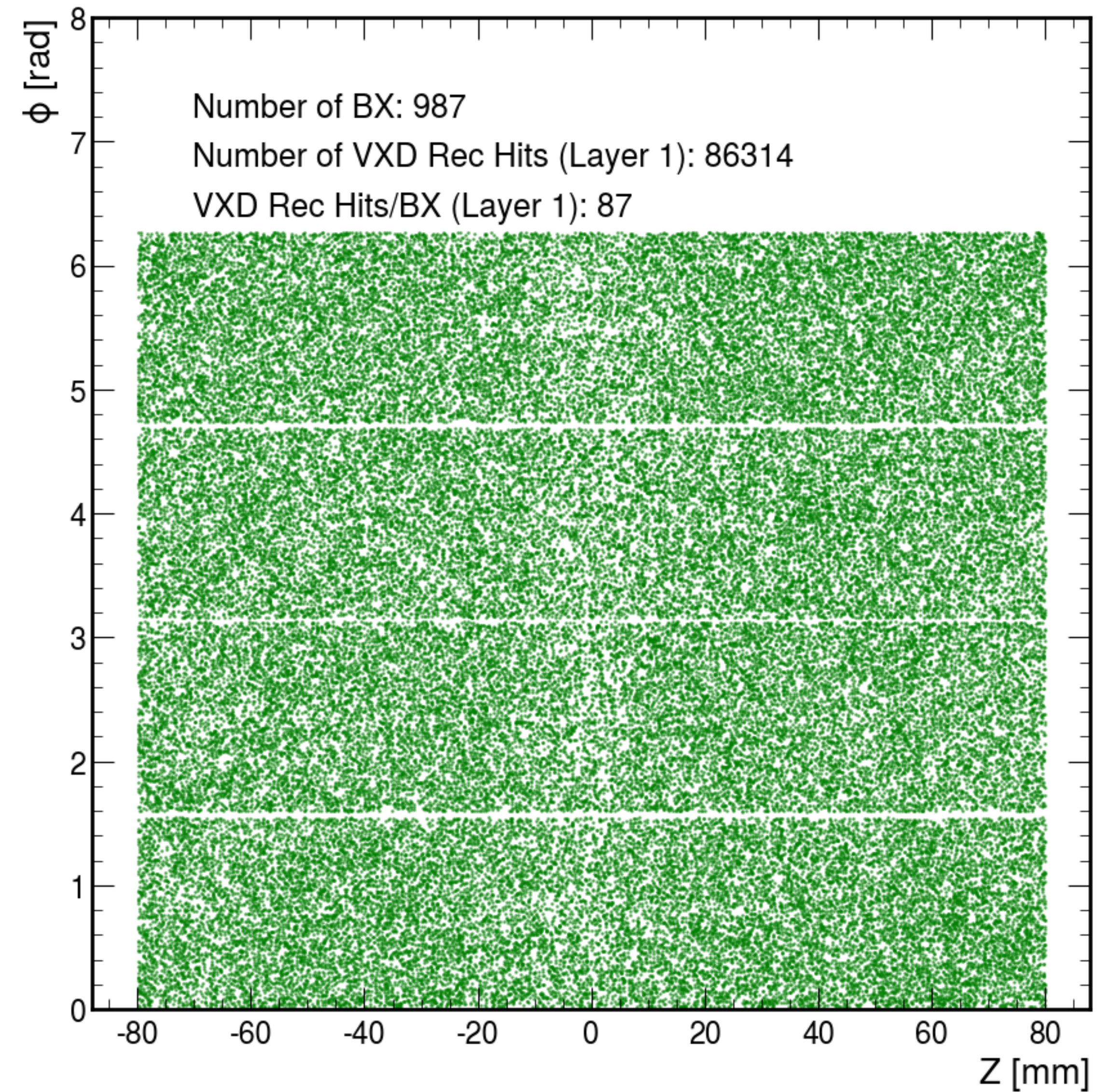
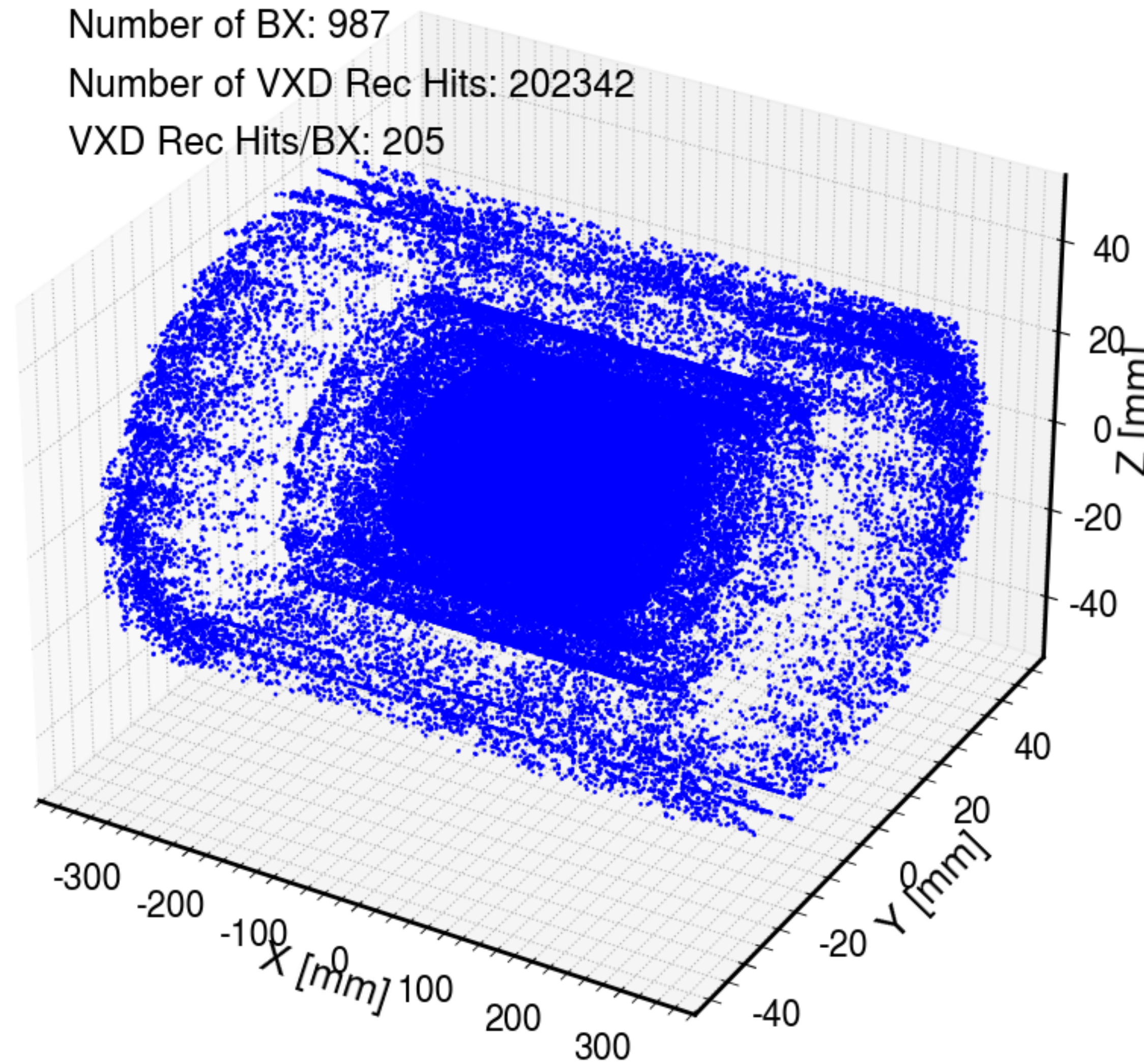
Chenguang Zhang / 21May2025

# Pure Pair-production (MCParticle)

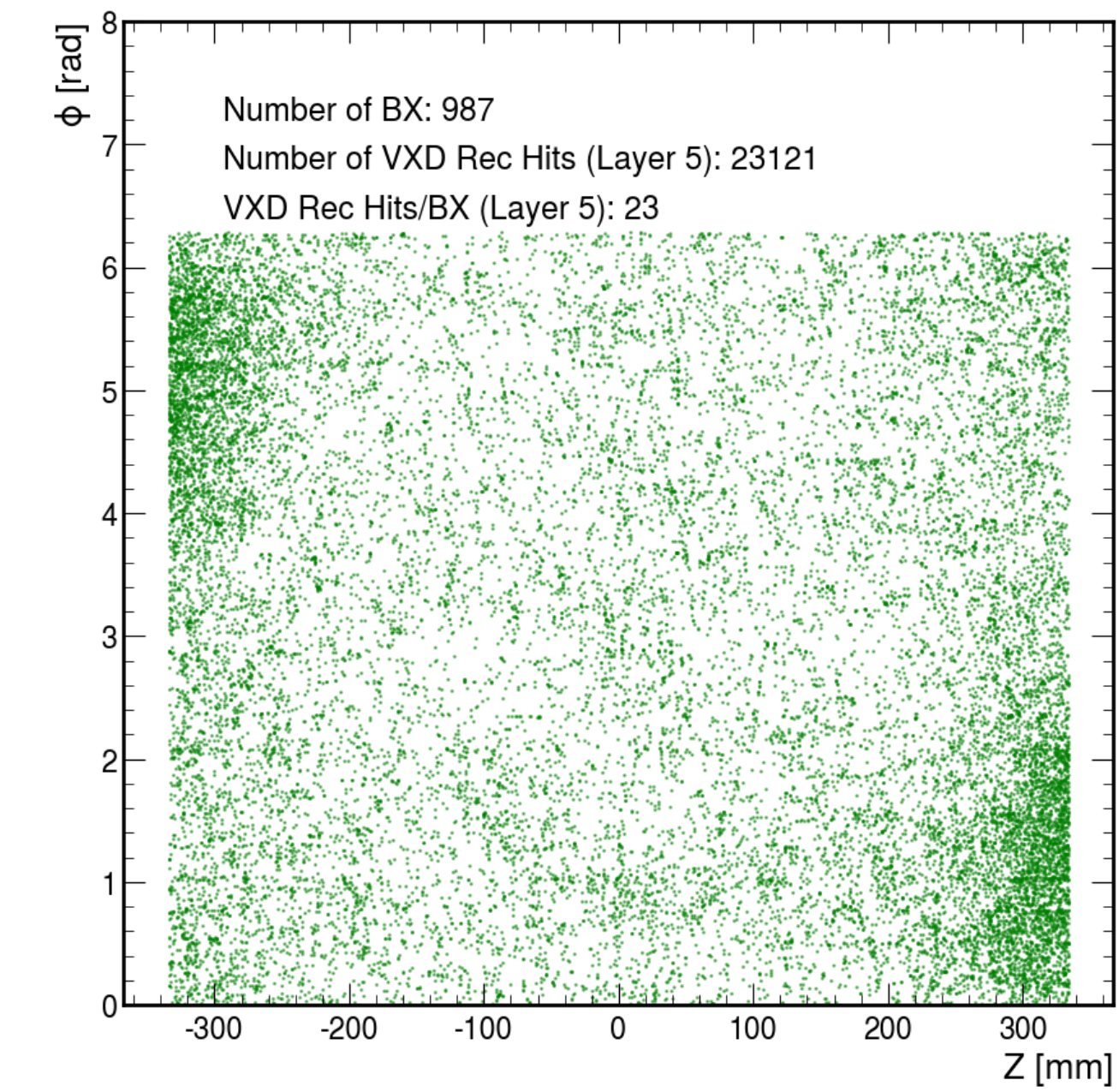
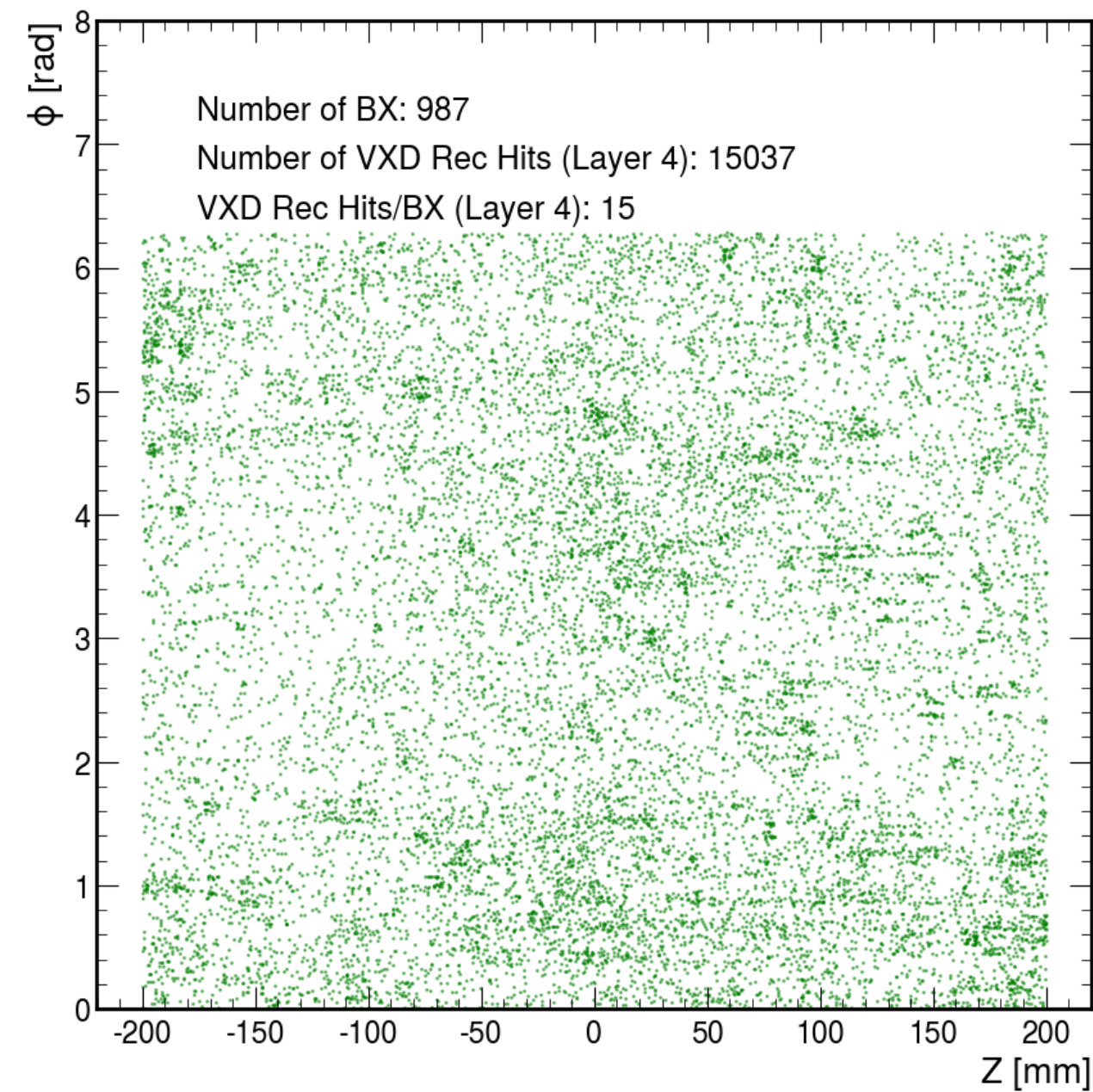
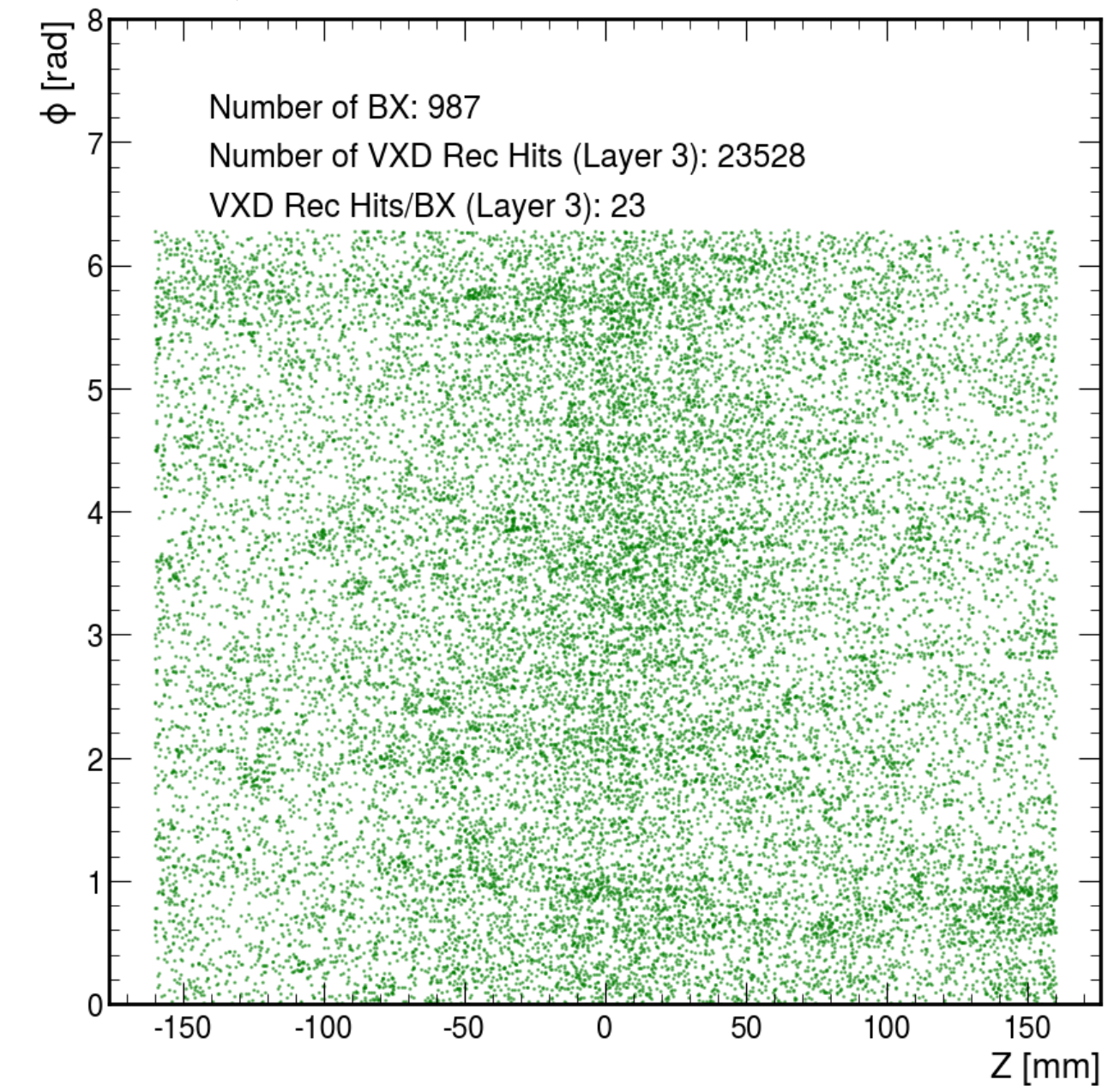
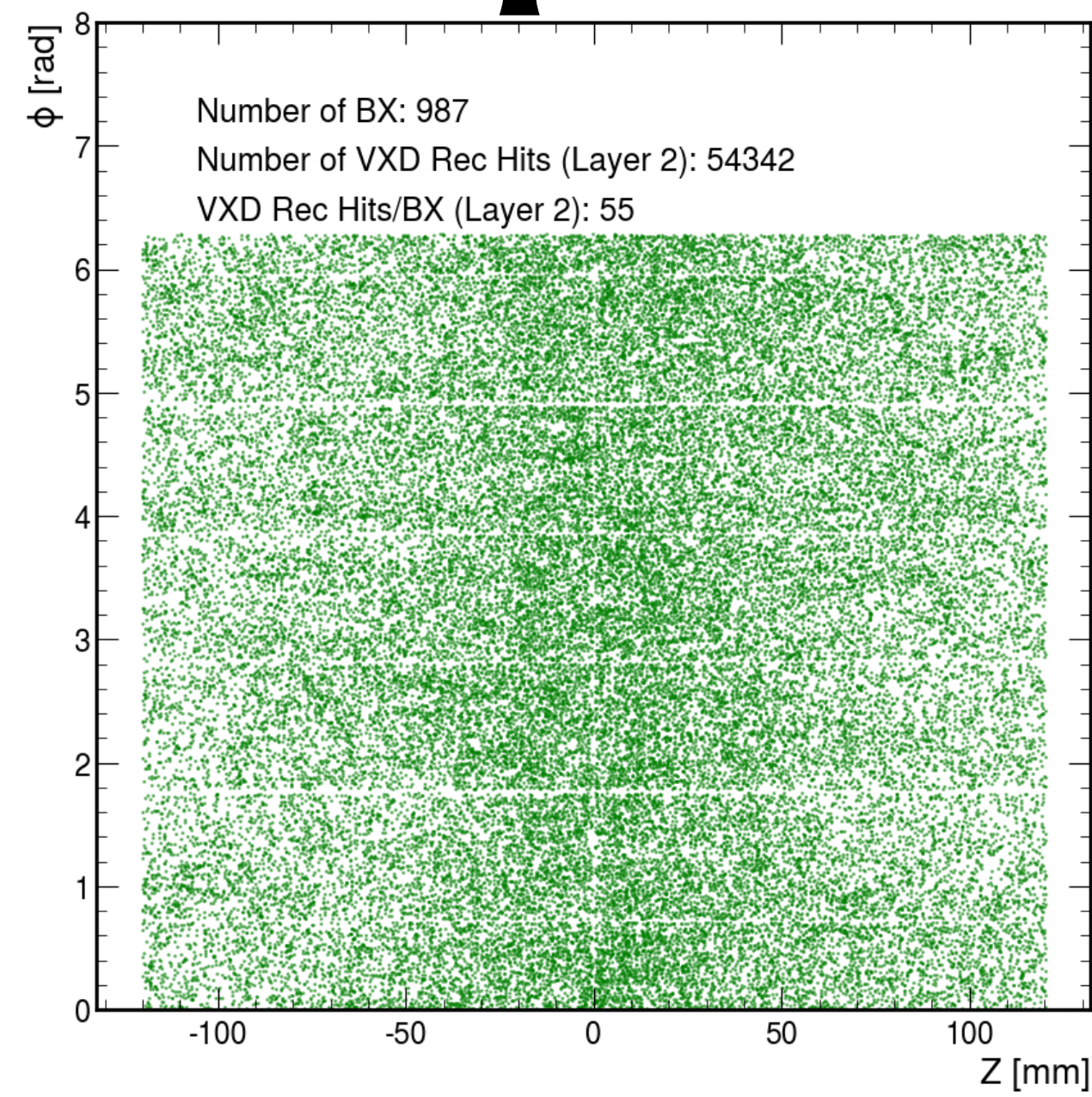
- Confirmed with Haoyu Shi, there is a problem in the simulation
  - There are 100 duplicates per BX event
- For now, sample the first event in every 100 duplicates



# Pure Pair-production (VXD Rec Hits)



# Pure Pair-production (VXD Rec Hits)



# Pure Pair-production (VXD Rec Hits)

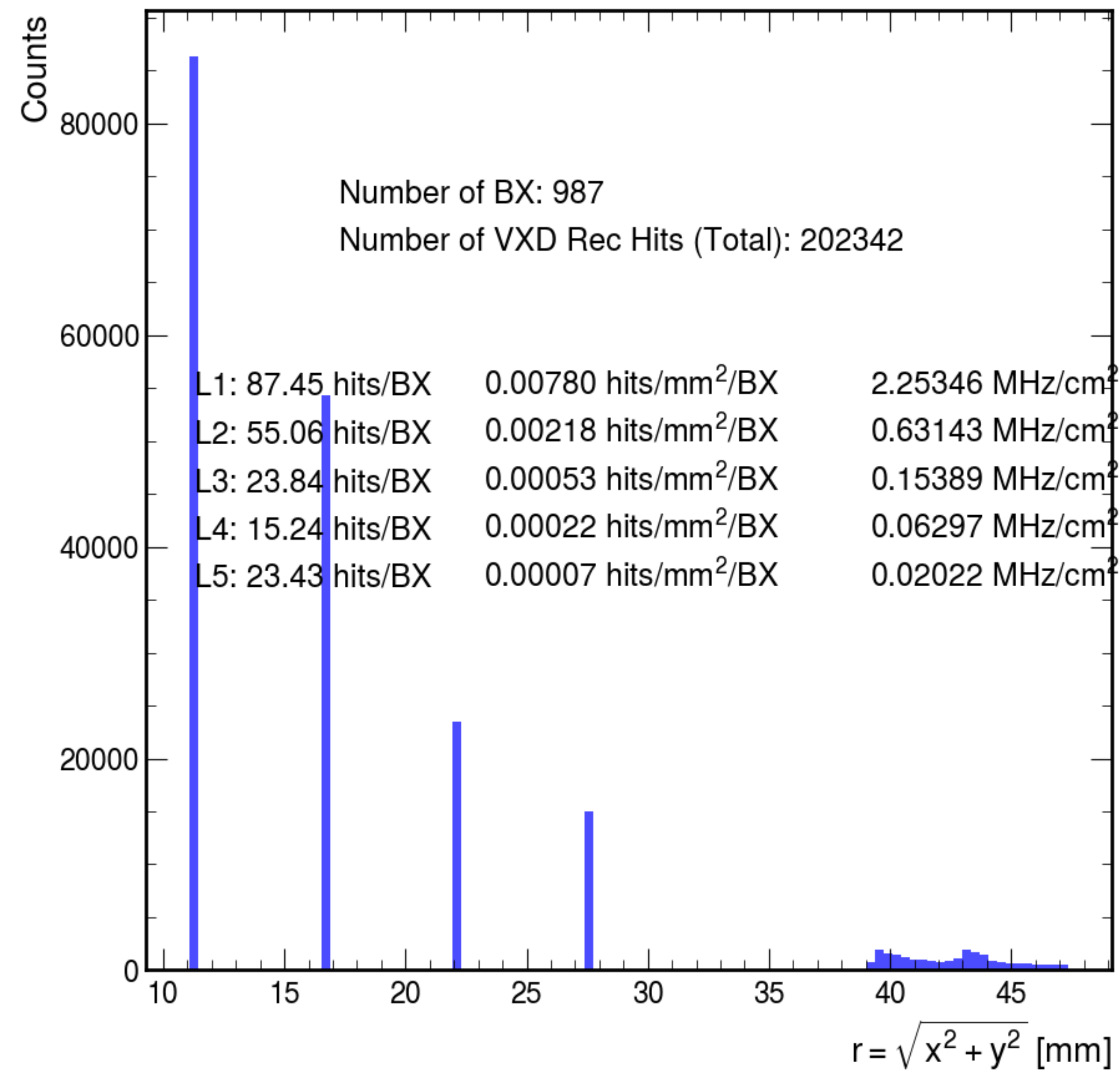


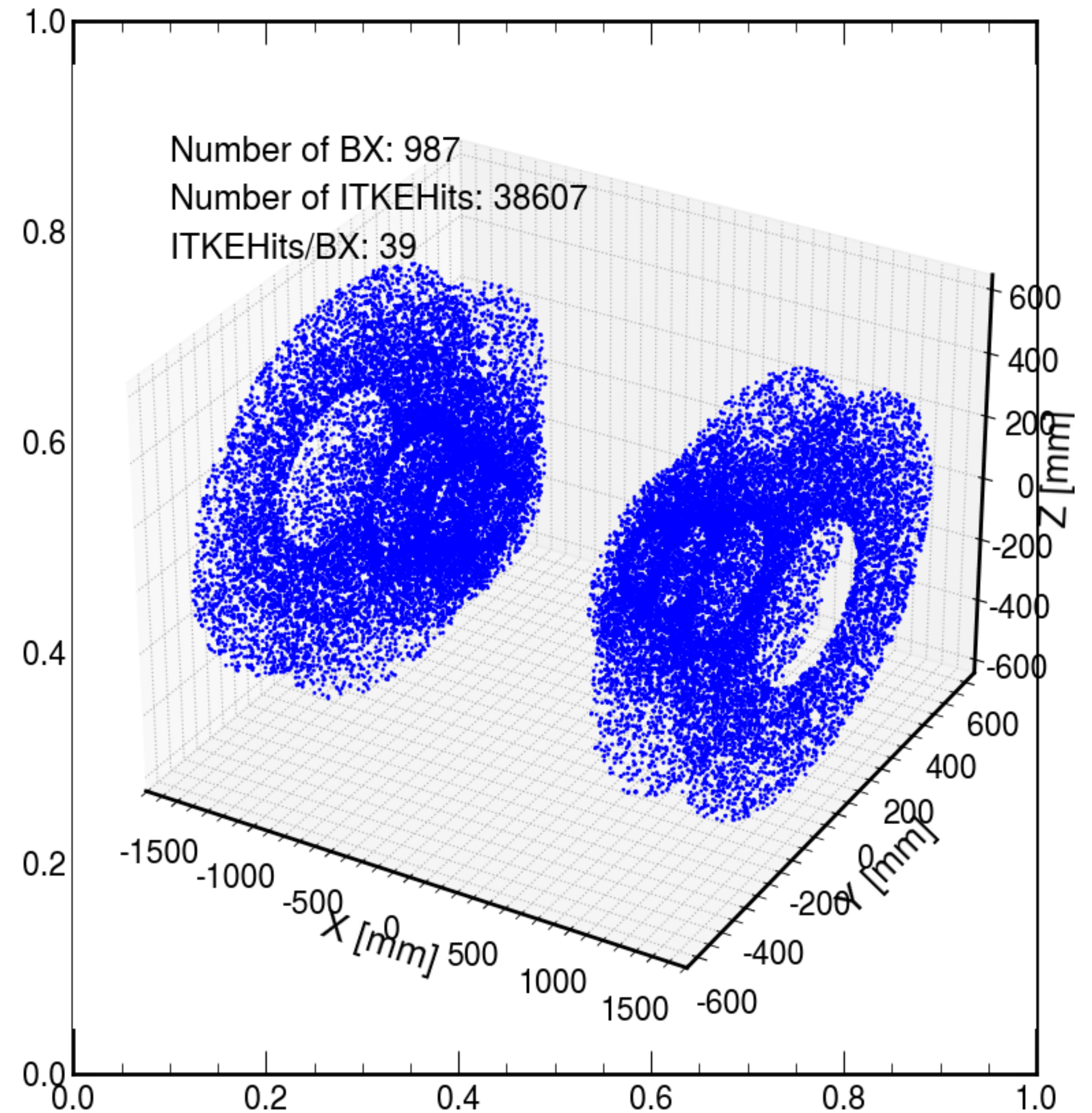
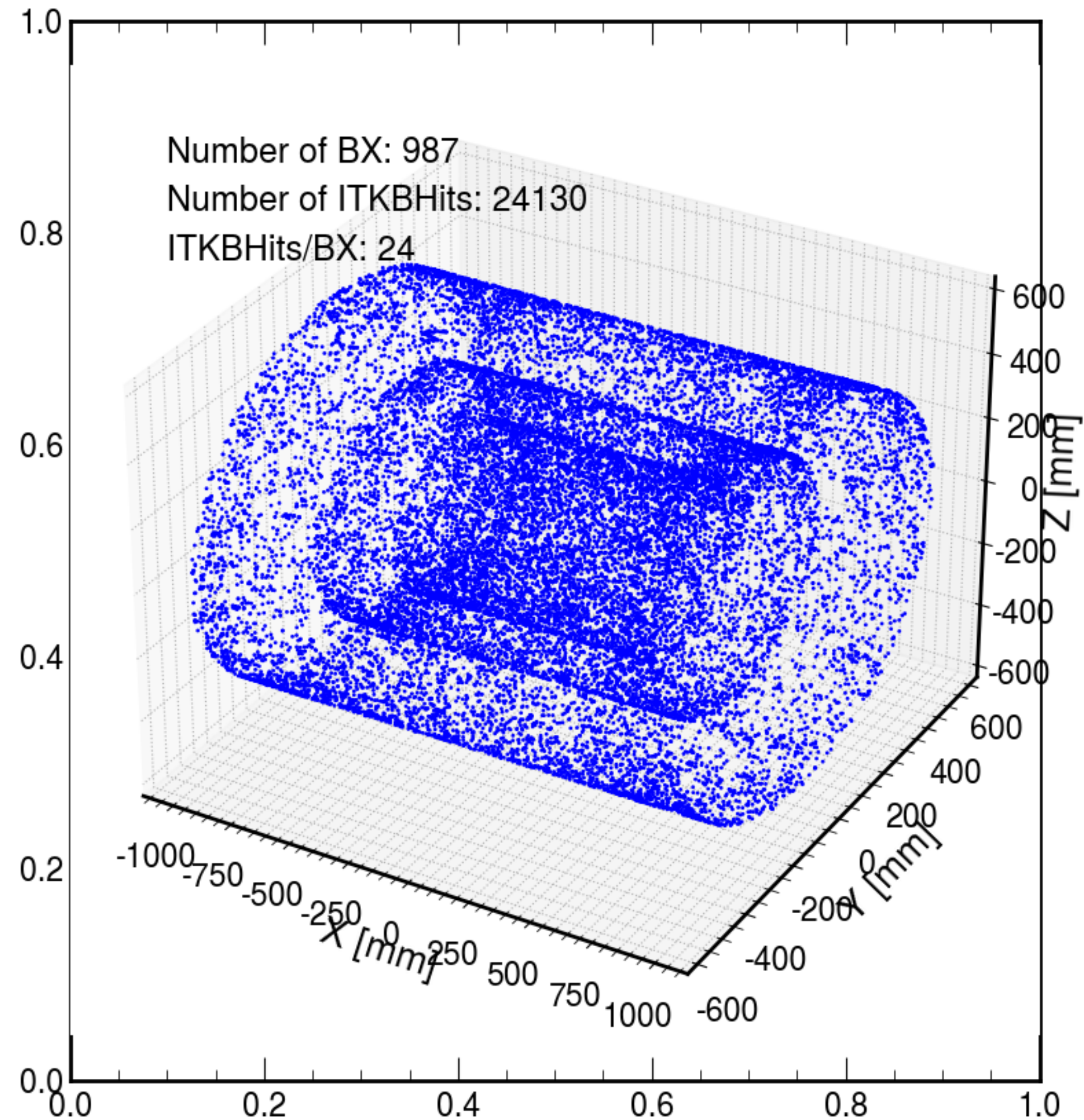
Table 4.5: Geometric configuration parameters.

| Configuration | layer/VXD X | radius .mm | length .mm | arc length .mm |
|---------------|-------------|------------|------------|----------------|
| Baseline      | layer 1     | 11.06      | 161.4      | 69.108         |
|               | layer 2     | 16.56      | 242.2      | 103.662        |
|               | layer 3     | 22.06      | 323.0      | 138.216        |
|               | layer 4     | 27.56      | 403.8      | 172.770        |
|               | VXD 5       | 39.50      | 682.0      | -              |
| Backup        | VXD 1       | 12.46      | 260.0      | -              |
|               | VXD 2       | 27.89      | 494.0      | -              |
|               | VXD 3       | 43.79      | 749.0      | -              |

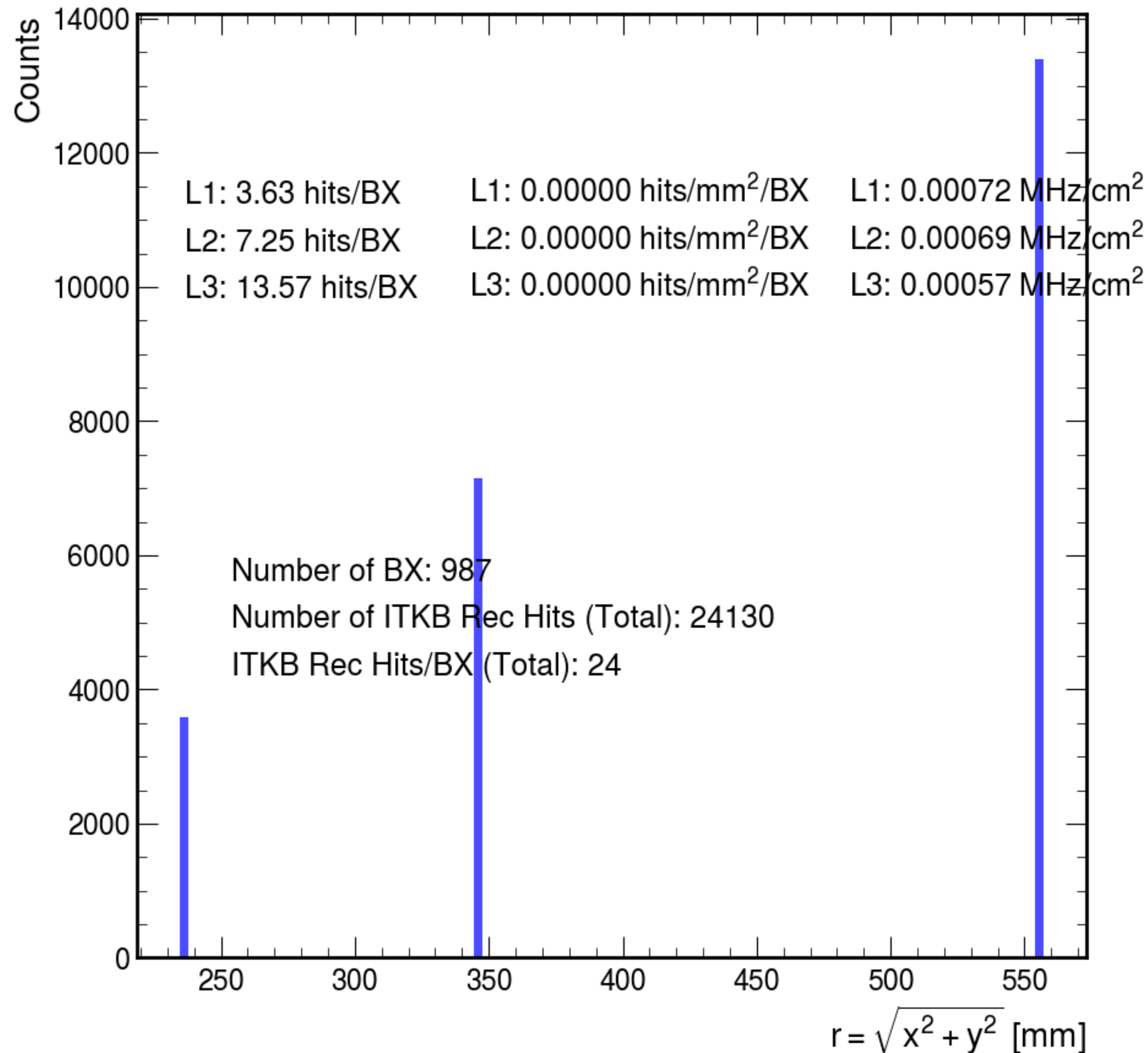
Table 4.7: Summary of background estimation. Current detector scheme cannot completely handle high-lumi Z mode, so the result of high-lumi Z will not be shown here. For the results of high-lumi Z, based on accelerator parameters, a rough estimation can be made by simply multiplying the existing low-lumi Z results by a factor of 3. Synchrotron radiation is included.

| Layer                                                                                                                     | Ave.<br>Hit Rate<br>MHz/cm <sup>2</sup> | Max.<br>Hit Rate<br>MHz/cm <sup>2</sup> | Ave.<br>Hit Rate×C<br>MHz/cm <sup>2</sup> | Max.<br>Hit Rate×C<br>MHz/cm <sup>2</sup> | Ave.<br>Data Rate<br>Mbps/cm <sup>2</sup> | Max.<br>Data Rate<br>Mbps/cm <sup>2</sup> |
|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| Higgs: DataRate = HitRate × 32 bit / pixel × ClusterSize @(Bunch Spacing: 346ns, 53 %Gap, 25× 25 μm <sup>2</sup> / pixel) |                                         |                                         |                                           |                                           |                                           |                                           |
| 1                                                                                                                         | 2.234                                   | 2.509                                   | 8.053                                     | 10.737                                    | 257.710                                   | 343.599                                   |
| 2                                                                                                                         | 0.653                                   | 1.082                                   | 2.318                                     | 3.922                                     | 74.161                                    | 125.511                                   |
| 3                                                                                                                         | 0.175                                   | 0.363                                   | 0.673                                     | 1.382                                     | 21.532                                    | 44.217                                    |
| 4                                                                                                                         | 0.084                                   | 0.163                                   | 0.349                                     | 0.951                                     | 11.163                                    | 30.428                                    |
| 5                                                                                                                         | 0.021                                   | 0.095                                   | 0.117                                     | 0.788                                     | 3.737                                     | 25.212                                    |
| 6                                                                                                                         | 0.016                                   | 0.064                                   | 0.082                                     | 0.434                                     | 2.631                                     | 13.882                                    |

# Pure Pair-production (ITKB Rec Hits)



# Pure Pair-production (ITKB Rec Hits)

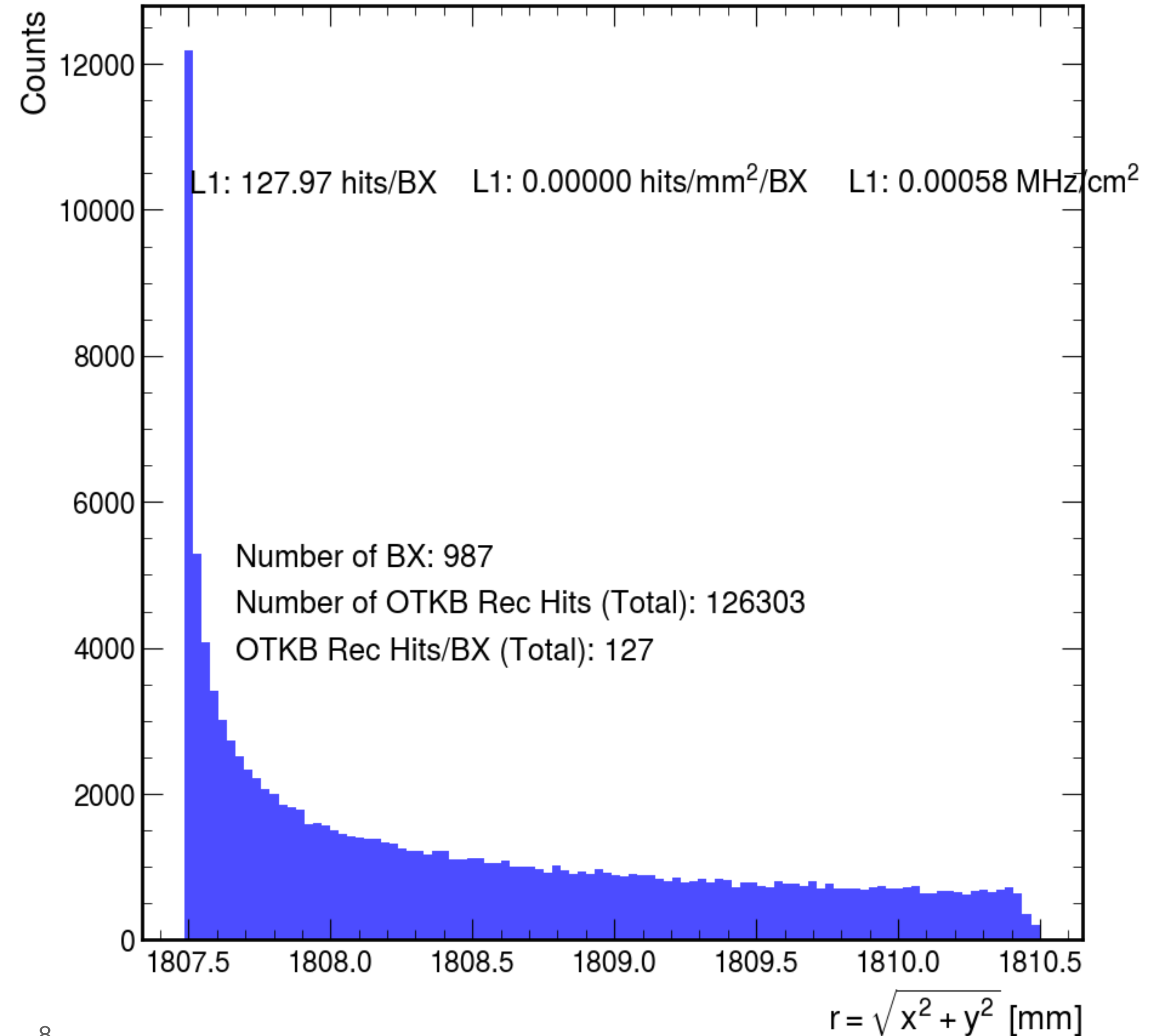
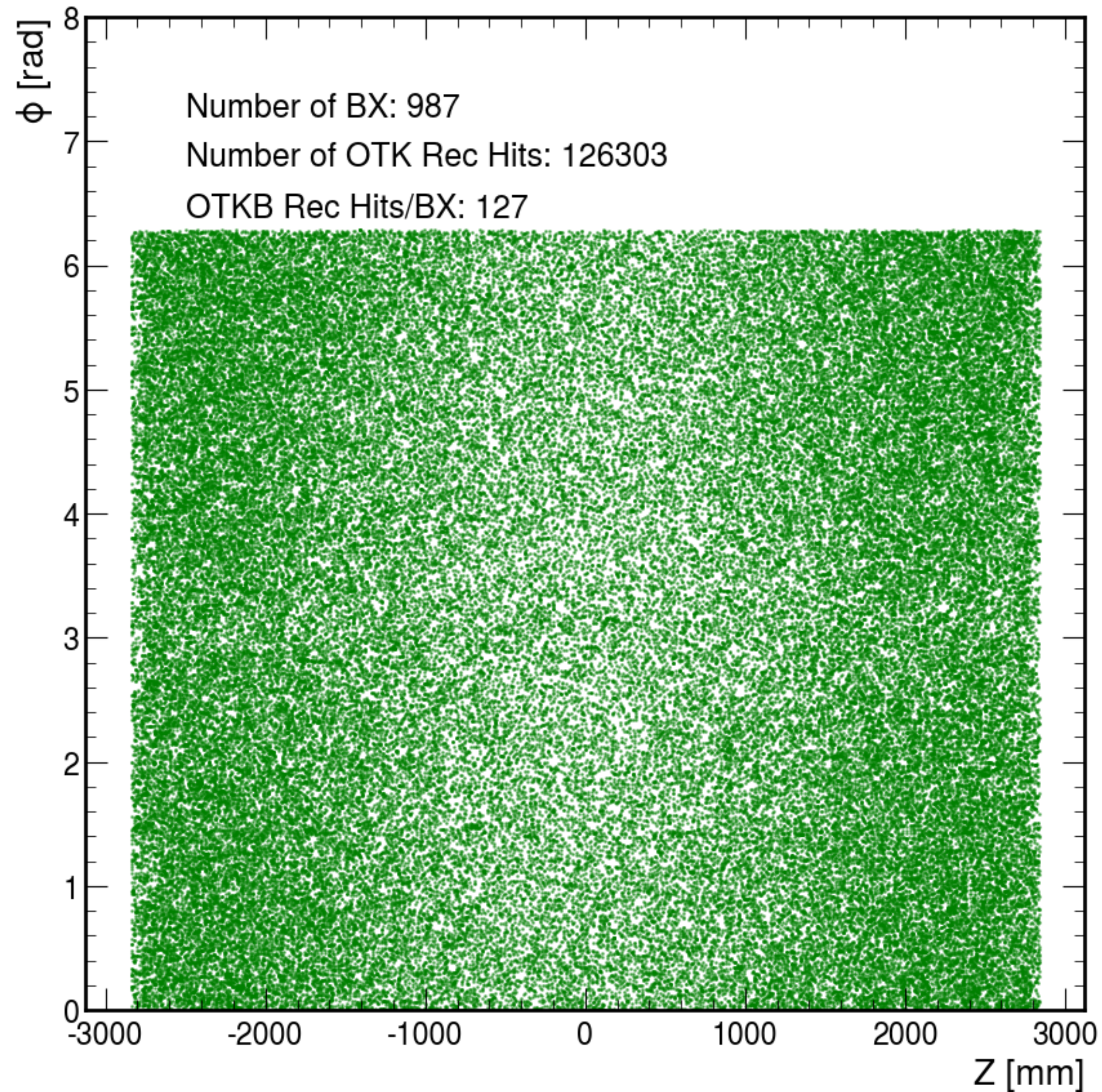


**Table 5.20:** Estimated hit rates of the silicon trackers [ $10^3$  Hz/cm<sup>2</sup>]

|       | Low Lumi Z |      | Higgs   |       | High Lumi Z |       |
|-------|------------|------|---------|-------|-------------|-------|
|       | Average    | Max  | Average | Max   | Average     | Max   |
| ITKB1 | 1.02       | 1.88 | 0.63    | 1.00  | 3.79        | 6.16  |
| ITKB2 | 0.84       | 2.79 | 0.49    | 1.27  | 2.86        | 9.78  |
| ITKB3 | 0.69       | 1.82 | 0.36    | 0.81  | 2.23        | 5.92  |
| OTKB  | 1.21       | 1.89 | 0.68    | 1.05  | 3.75        | 5.87  |
| ITKE1 | 3.98       | 12.3 | 2.77    | 13.06 | 14.30       | 56.14 |
| ITKE2 | 3.60       | 18.1 | 1.99    | 9.26  | 11.67       | 58.60 |
| ITKE3 | 2.97       | 19.7 | 1.34    | 8.02  | 9.31        | 72.39 |
| ITKE4 | 3.19       | 12.0 | 1.54    | 4.98  | 9.99        | 34.37 |
| OTKE  | 1.56       | 6.64 | 0.93    | 4.06  | 4.87        | 21.06 |

The estimated average and maximum hit rates for different layers of the tracking detector are summarized in Table 5.20. As an example, for the High Lumi Z, the differential hit maps for individual tracker layers are shown in Figs. 5.109 and 5.110.

# Pure Pair-production (OTKB Rec Hits)



| Detector          |                 | Radius $R$ [mm] |                  | $\pm z$ [mm] | Material budget [ $X_0$ ] | Spatial resolution [ $\mu\text{m}$ ] |
|-------------------|-----------------|-----------------|------------------|--------------|---------------------------|--------------------------------------|
| <b>VXD</b>        | Layer 1         | 11.06           |                  | 80.7         | 0.06%                     | 5                                    |
|                   | Layer 2         | 16.56           |                  | 121.1        | 0.06%                     | 5                                    |
|                   | Layer 3         | 22.06           |                  | 161.5        | 0.06%                     | 5                                    |
|                   | Layer 4         | 27.56           |                  | 201.9        | 0.06%                     | 5                                    |
|                   | VXD 5           | 43.79           |                  | 250.0        | 0.63%                     | 5                                    |
| <b>ITK Barrel</b> | Layer 1 (ITKB1) | 235.0           |                  | 493.3        | 0.65%                     | 8                                    |
|                   | Layer 2 (ITKB2) | 345.0           |                  | 704.8        | 0.65%                     | 8                                    |
|                   | Layer 3 (ITKB3) | 555.6           |                  | 986.6        | 0.65%                     | 8                                    |
| <b>OTK Barrel</b> | Layer 4 (OTKB)  | 1,800           |                  | 2,840        | 1.50%                     | 10                                   |
| <b>TPC</b>        | Inner wall      | 600             |                  | 2900         | 0.16%                     | —                                    |
|                   | Gas             | 625-1775        |                  | 2761         | $\sim 1\%$                | 110-144 (220 hits)                   |
|                   | Outer wall      | 1800            |                  | 2900         | 0.16%                     | —                                    |
|                   |                 | $R_{\text{in}}$ | $R_{\text{out}}$ |              |                           |                                      |
|                   | Disk 1 (ITKE1)  | 82.5            | 244.7            | 505.0        | 0.7%                      | 8                                    |
|                   | Disk 2 (ITKE2)  | 110.5           | 353.7            | 718.5        | 0.7%                      | 8                                    |
|                   | Disk 3 (ITKE3)  | 160.5           | 564              | 1,000        | 0.7%                      | 8                                    |
|                   | Disk 4 (ITKE4)  | 220.3           | 564.0            | 1,489        | 0.7%                      | 8                                    |
| <b>OTK Endcap</b> | Disk 5 (OTKE)   | 406.0           | 1,816            | 2,910        | 1.50%                     | 10                                   |