

BM performances @ CNAO2023

XV FOOT General Meeting
Yunsheng Dong
11/12/2023

Gas flow

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Message ID: 12 Entry time: Sun Oct 29 22:09:20 2023
Author: FC
Type: Info
Category: Run Info
Subject: 6123

Run 6123
Beam on; C beam: 200 MeV/u, target 5 mm C (config entry 10)
Beam rate adjustment
During the run the beam position has been moved to have it at the center of the TOF
For IT and vertex default thresholds. IT sensors 116-3 and 117-3 on. For vertex sensor 3 on.
Beam monitor HV variation; from event 60 000 HV = 1825 V (for BM)
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Message ID: 13 Entry time: Sun Oct 29 22:29:07 2023
Author: FC
Type: Info
Category: Run Info
Subject: 6124

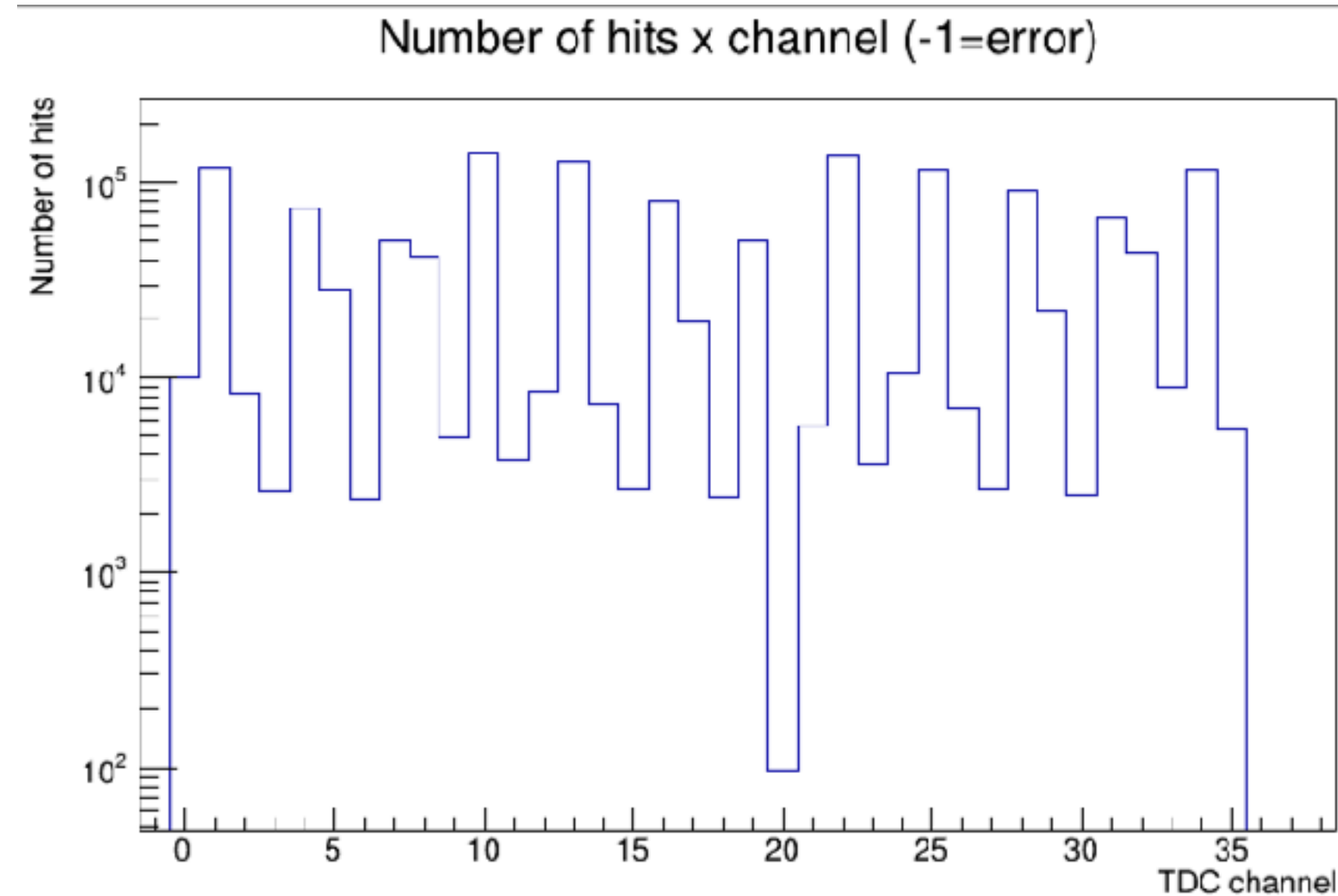
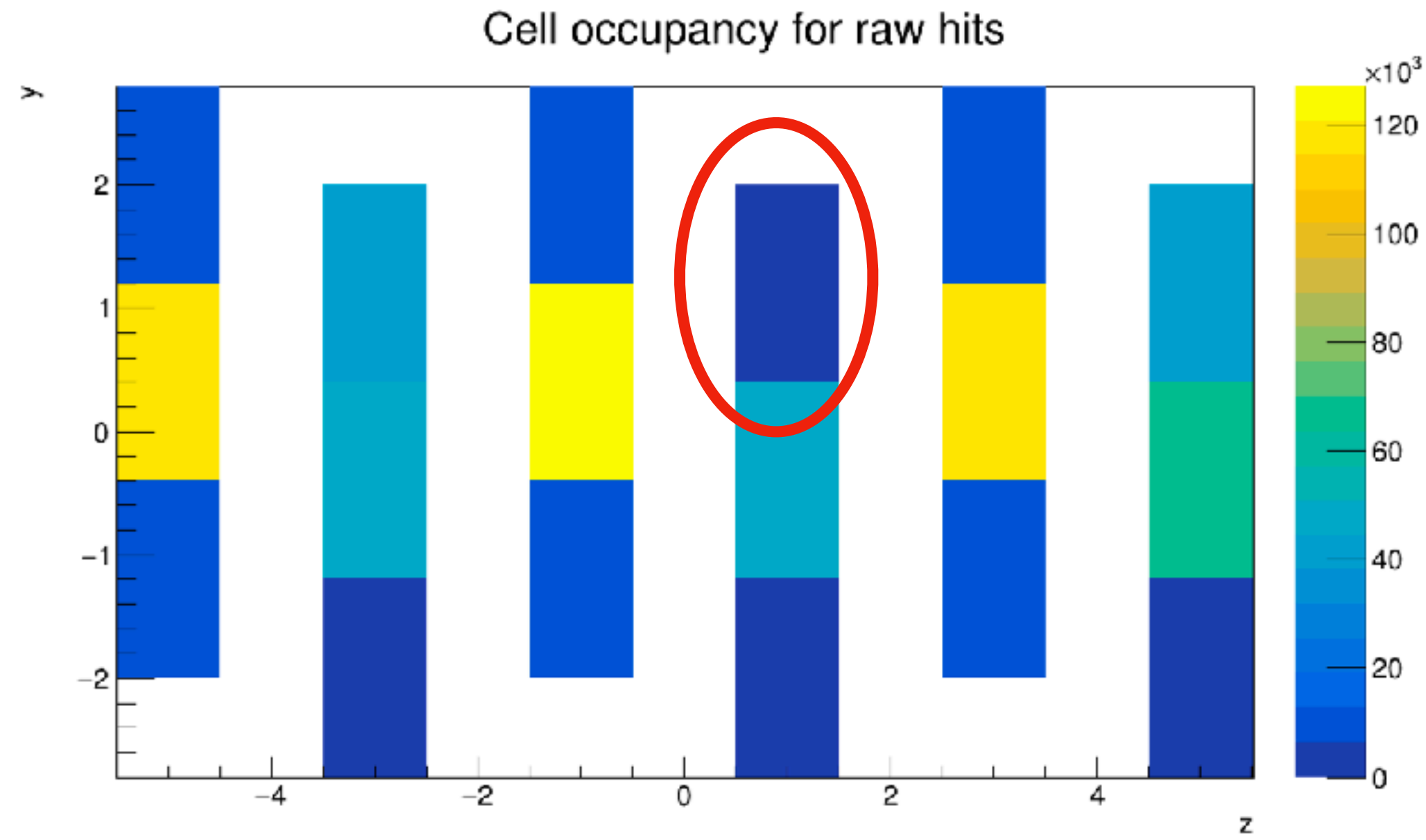
Run 6124
Beam on; C beam: 200 MeV/u, target 5 mm C (config entry 10)
Add the row to disable the zero suppression for central bars of the TOF (config file: cnao2023_C20
For IT and vertex default thresholds. IT sensors 116-3 and 117-2 on. For vertex sensor 3 on.
IT sensors off: 112_2, 112_3, 114_2, 115_3, 116_1
Beam monitor HV: 1805 V
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Message ID: 18 Entry time: Sun Oct 29 23:46:14 2023
Author: FC
Type: Info
Category: Run Info
Subject: 6136

Run 6136
Beam on; C beam: 200 MeV/u, target 5 mm C (config entry 10)
For IT and vertex default thresholds. IT sensors 116-3 and 117-2 on. For vertex sensor 3 on.
IT sensors of: 112_2, 112_3, 114_2, 115_3, 116_1
Beam monitor HV: 1700 V
Beam rate: 400 Hz
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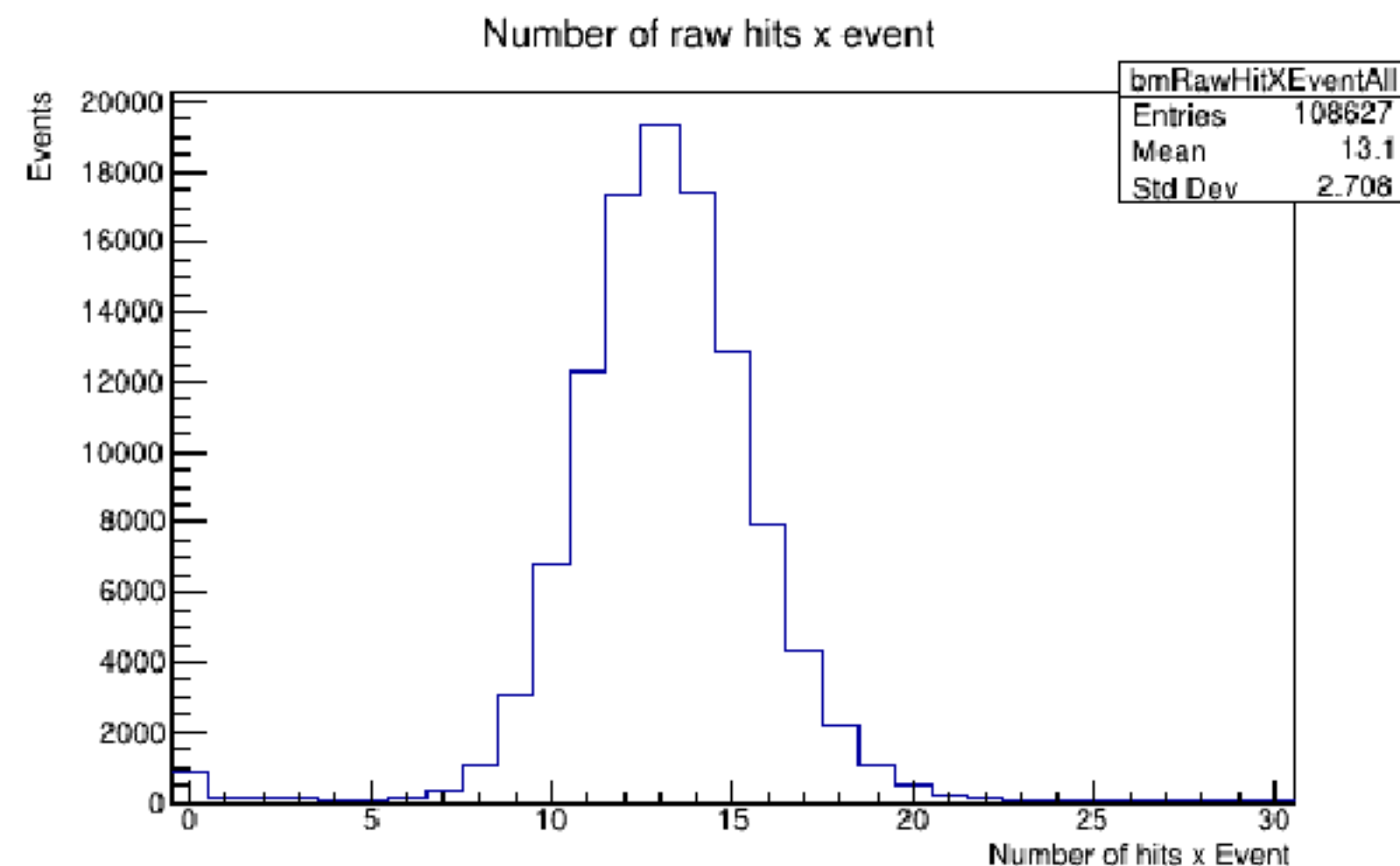
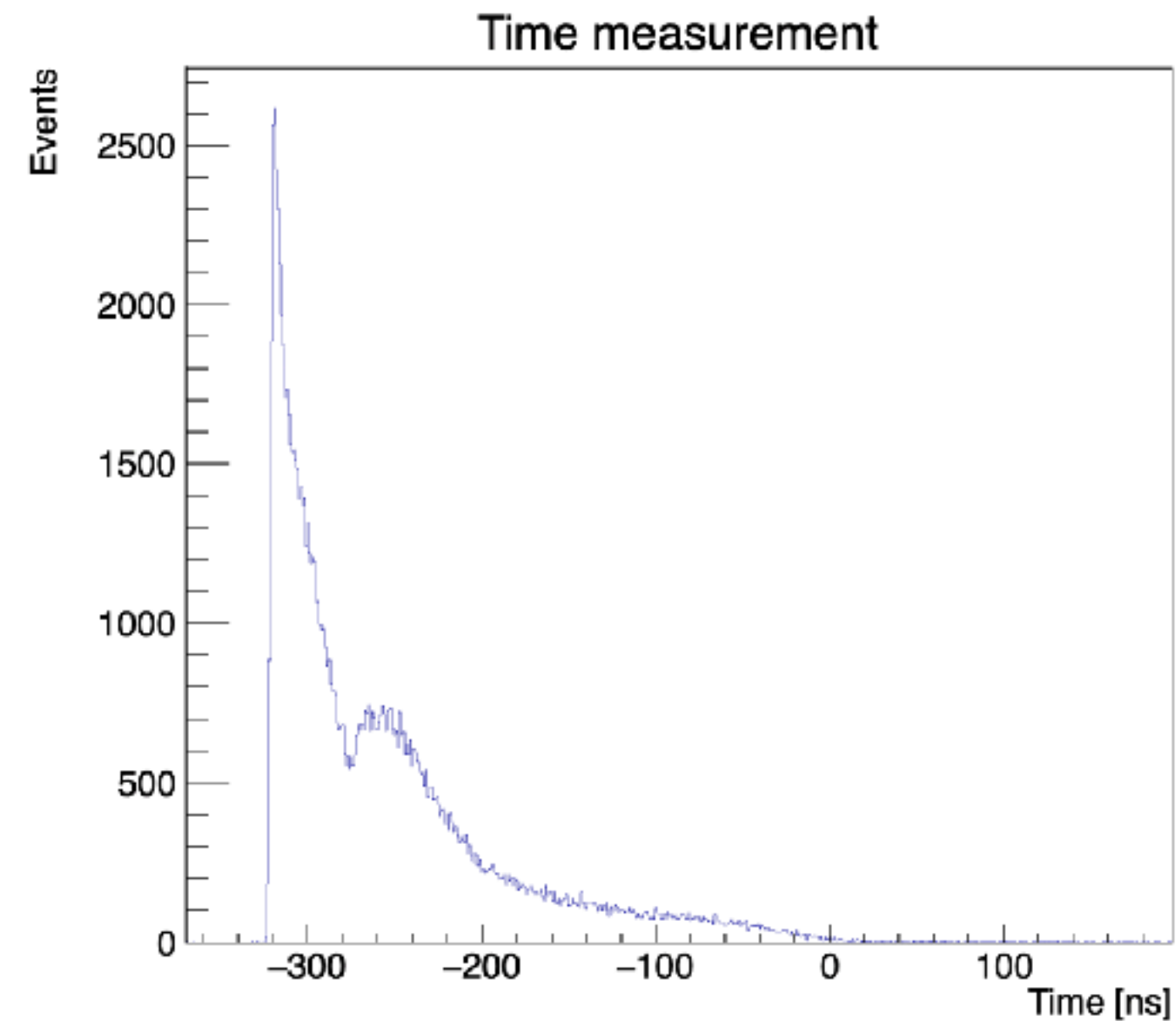
- We had got few issues to set a proper working point for the BM, probably due to gas leakage
- The gas leakage can be compensated increasing the HV and the initial gas flux
- The optimal HV for 12C @ 200 MeV/u was 1685-1700
- About 2 hours to have a stable condition during the first night
- **In some run the BM HV is not stable**
- No relevant issues in the other nights since we started to flux the BM with a high flux rate half an hour before the beam time and we reduced the flux during the data taking

Dead channel



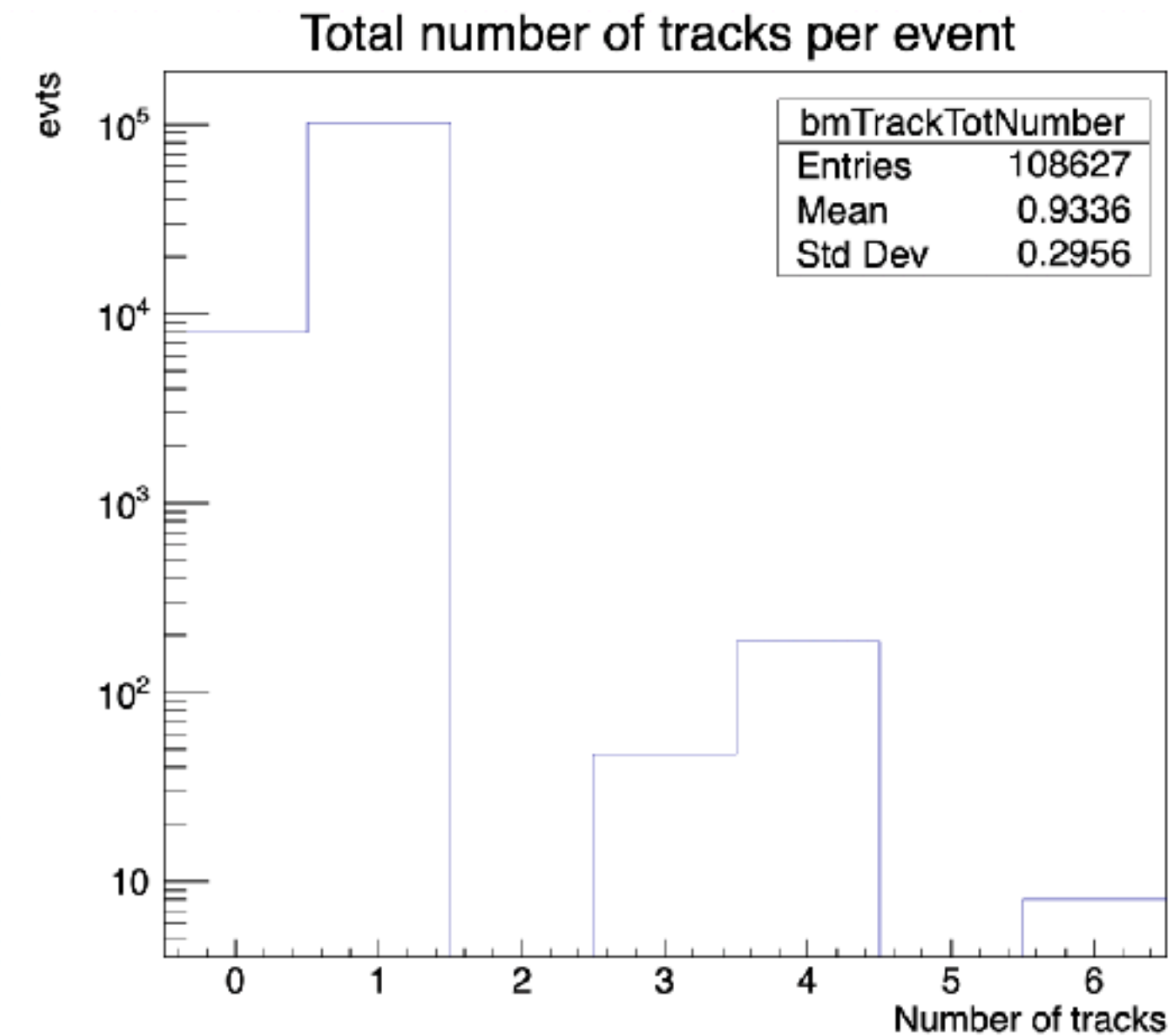
- One of the BM cell didn't work properly. The signals were too low and not properly shaped.
- Need to check the channel in the Lab (the detector is at CNAO at the moment)
- Due to the redundancy, this effect can be mitigated, but it's not negligible

Raw measurements

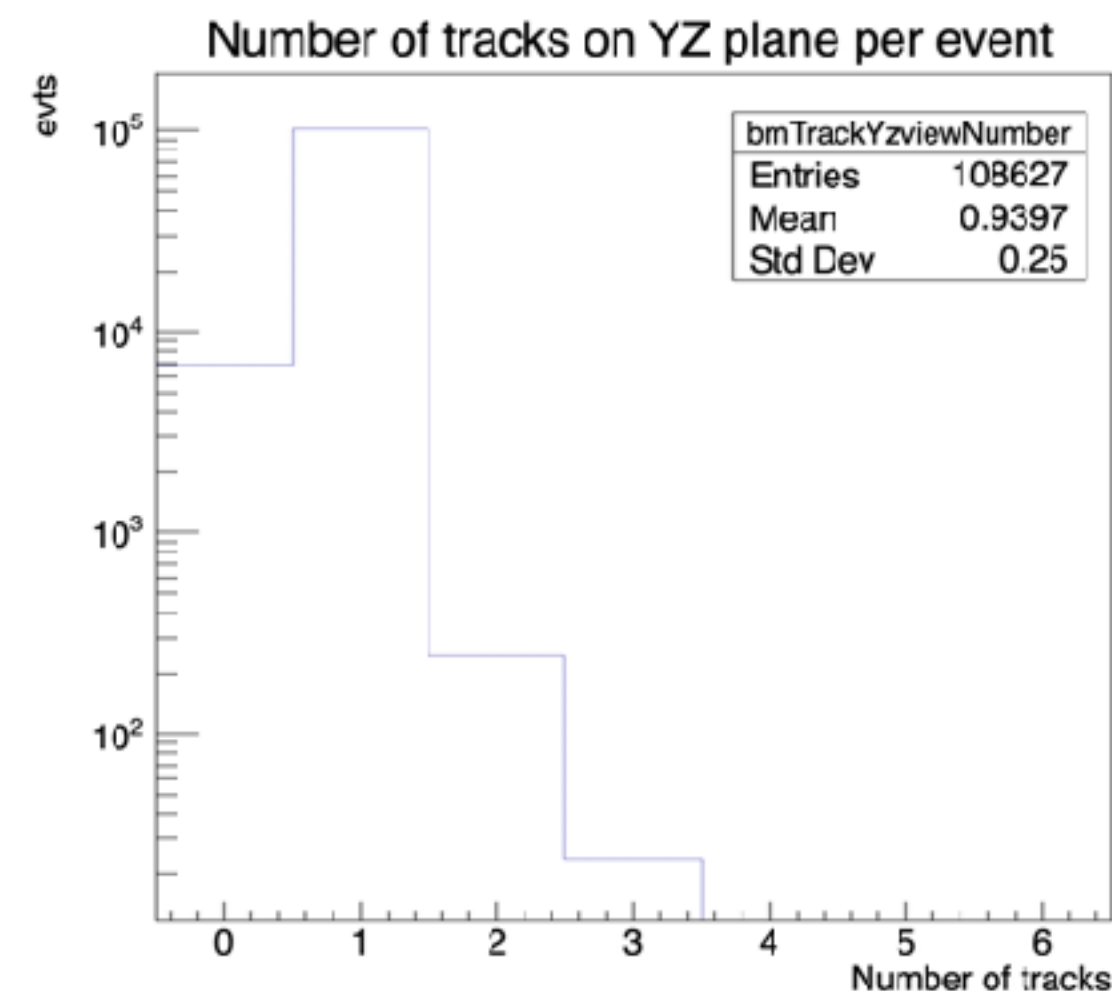
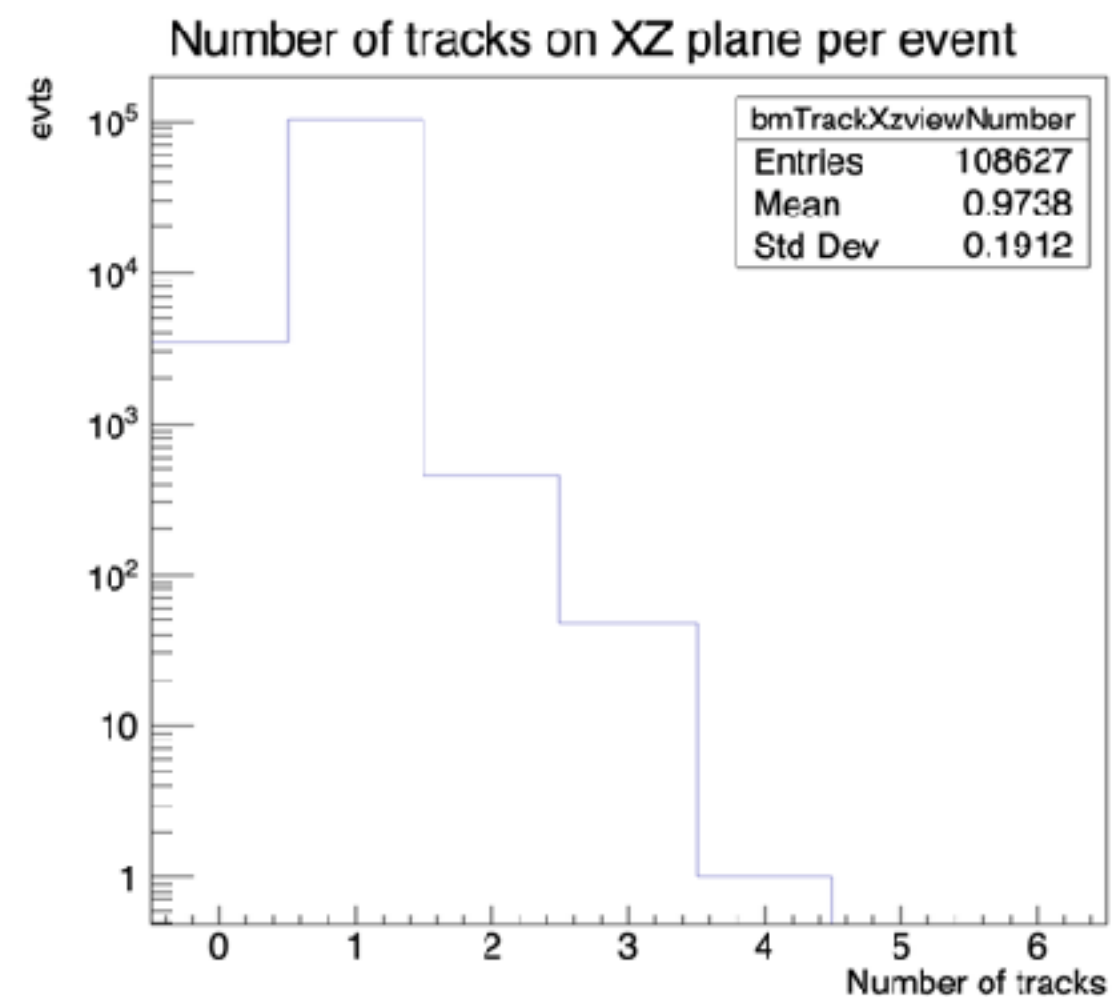


- Alignment run: 6102
- Time distribution as expected, no strange behaviour or abnormal jitter
- We tried to set the HV in order to have about 13 hits/event (we expect ~12 hits of the projectile + ~1 delta ray)

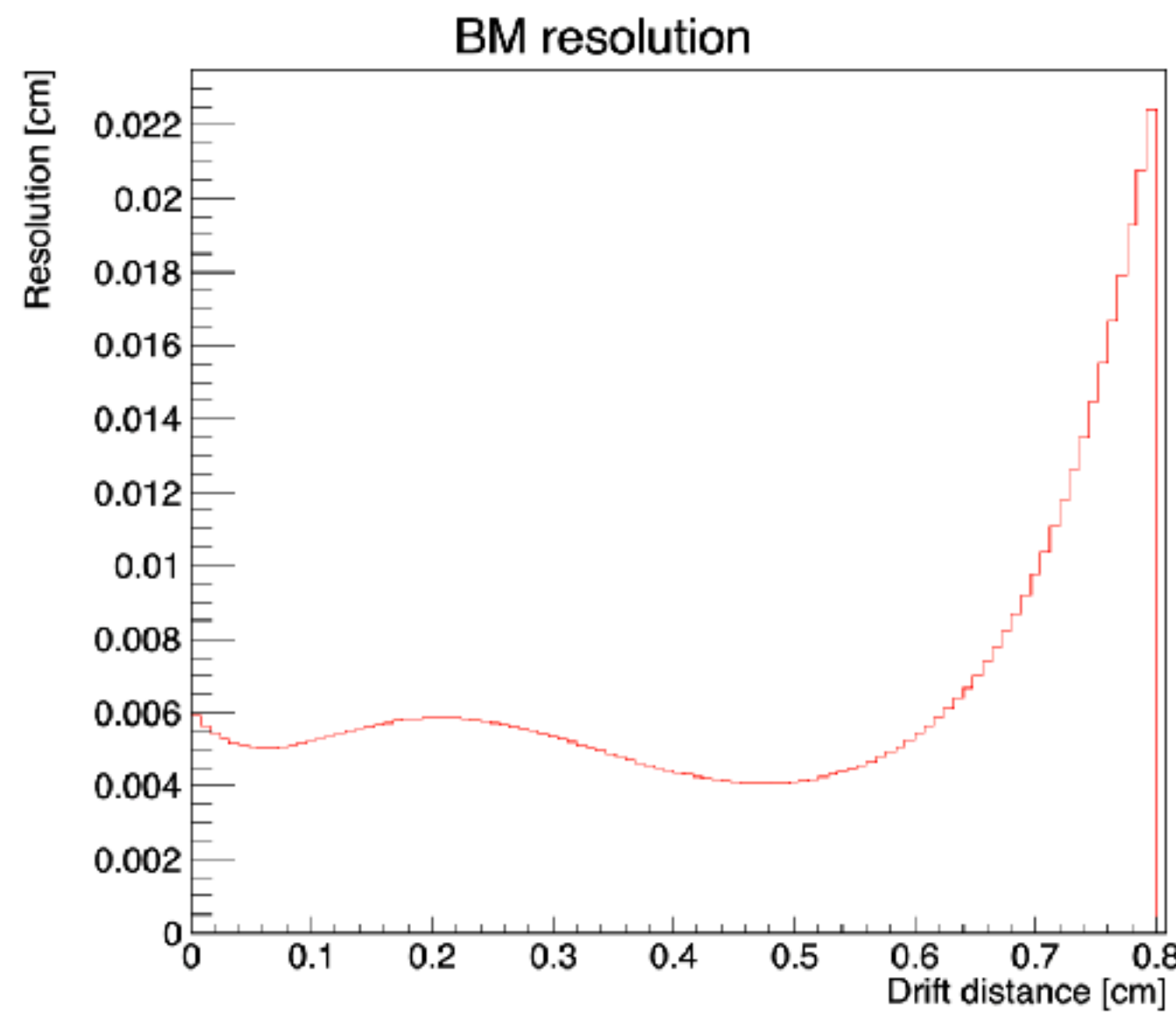
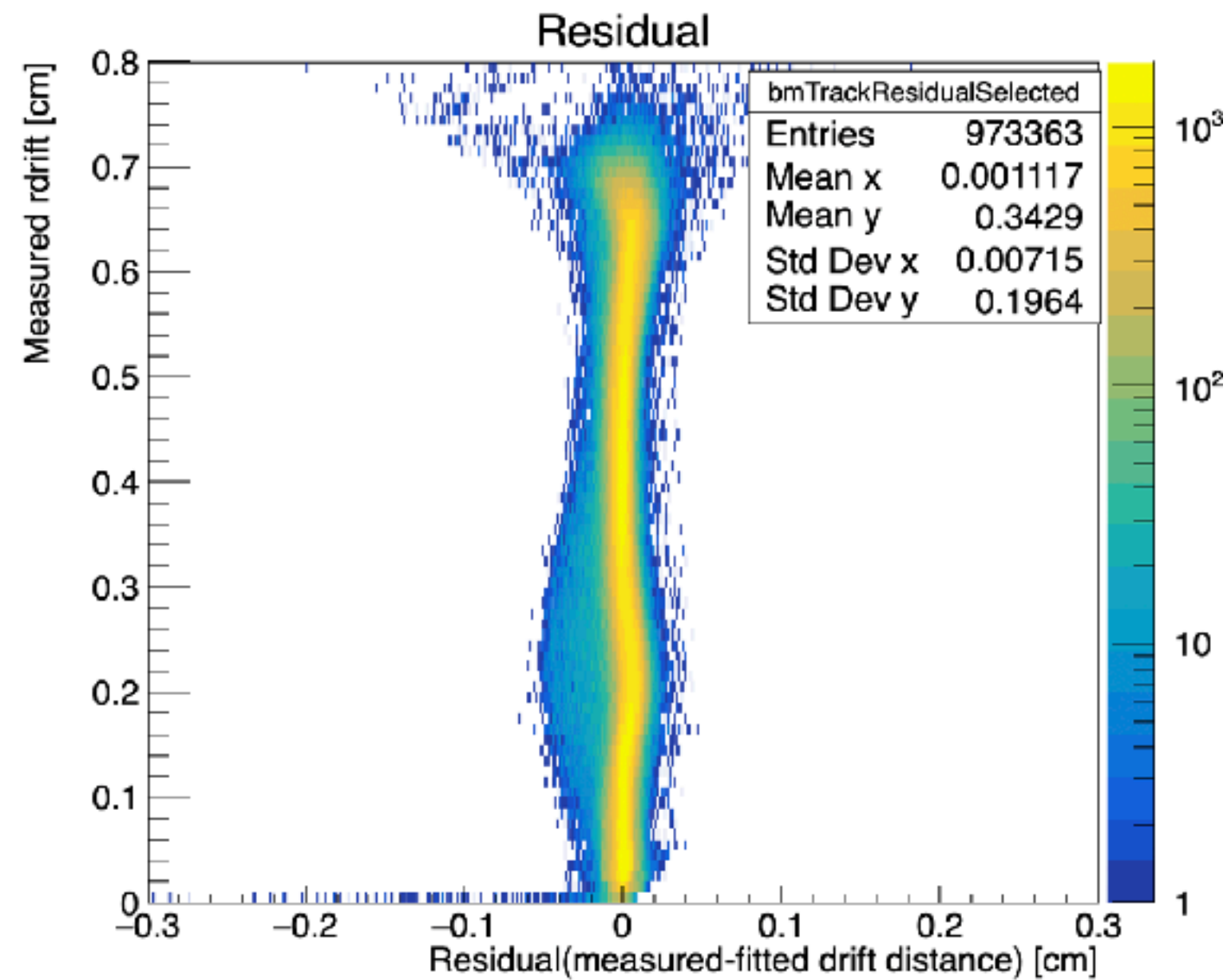
Track reconstruction efficiency in 6102



- BM track efficiency ~ 93-94%
- In about 2% of events the BM detected less than 3 hits per view
- The dead channel (on the YZ view) has an impact on the reconstruction
- The track efficiency on XZ view is of ~97%, while on the YZ view is of ~94%
- The two views are independent each other. In principle they can have different performances



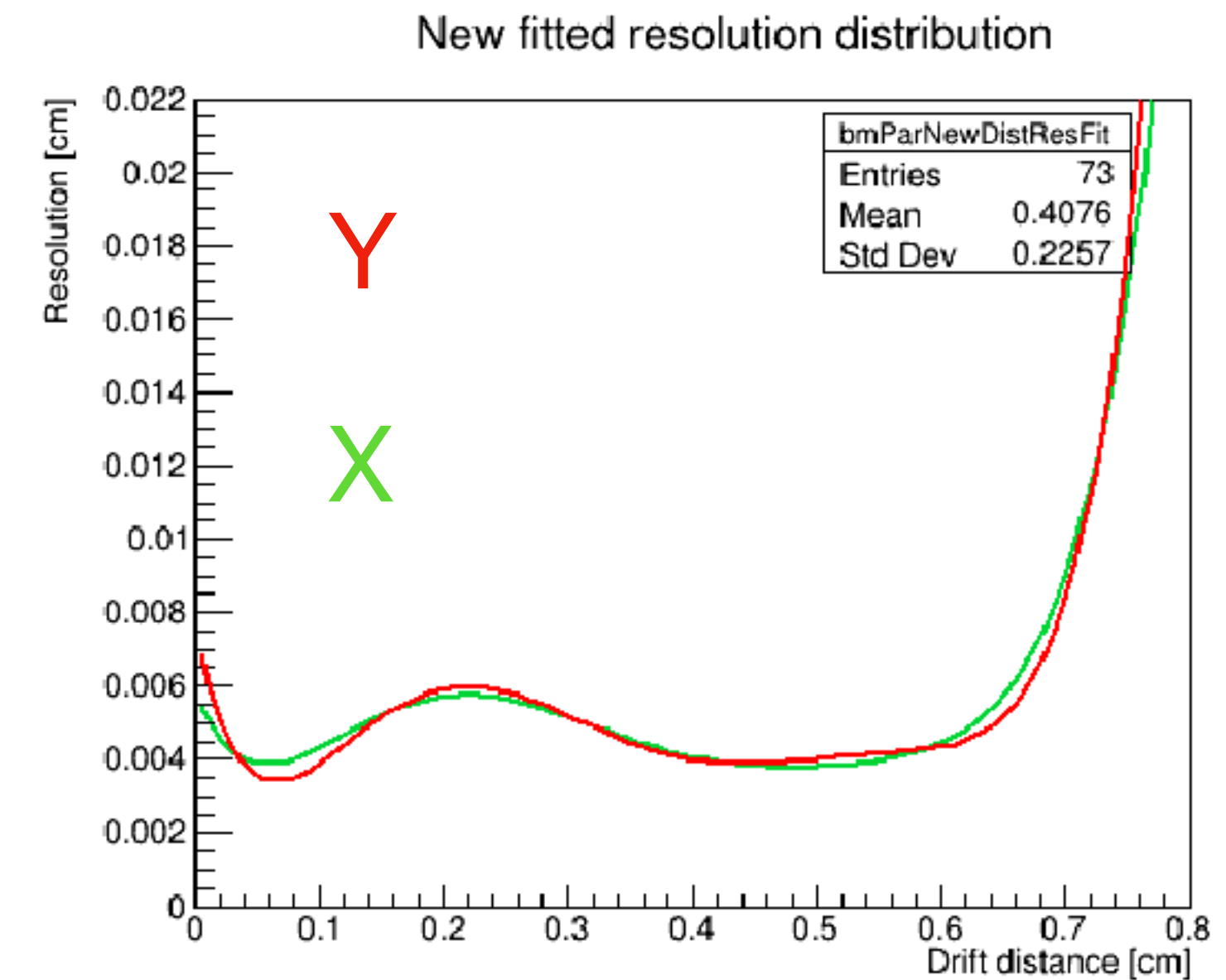
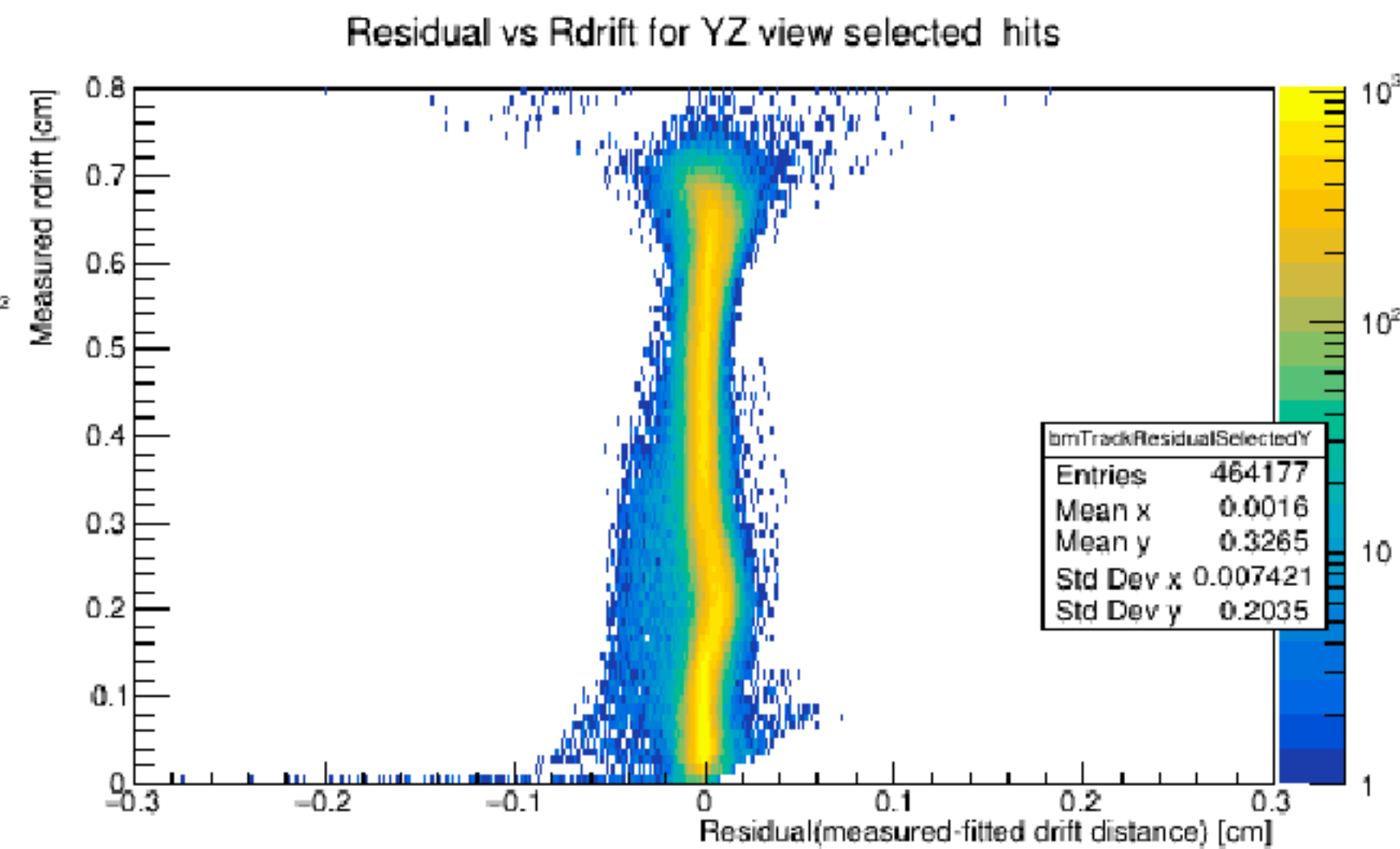
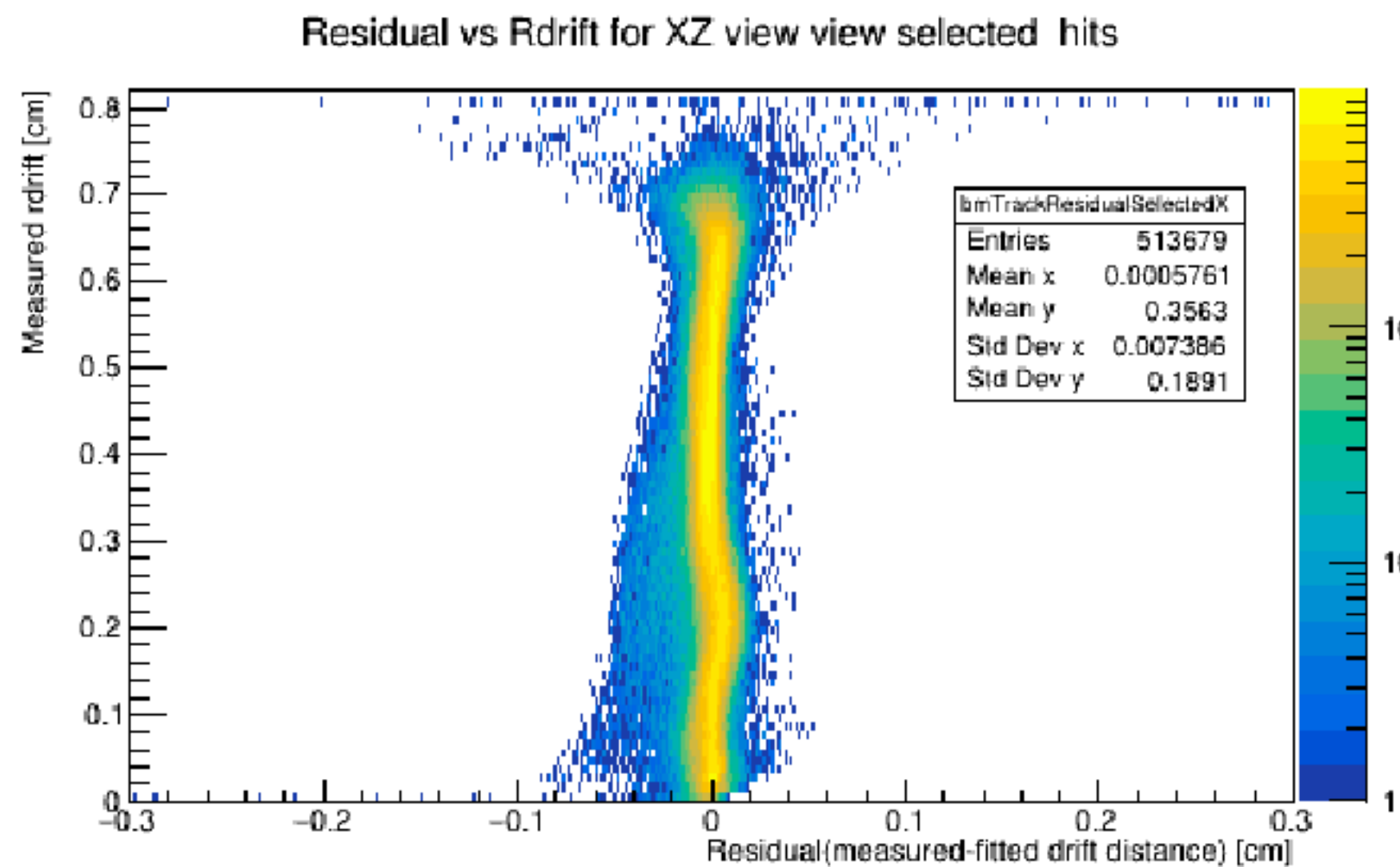
Overall spatial resolution



- The space-time relation has been calculated matching the BM time measurement with the VTX drift distance projection
- The spatial resolution is evaluated from the residual distribution with the usual method.
- Apparently, the BM spatial resolution is much better than the usual values, probably due to the new reconstruction parameter optimization.
- Space-time relations, spatial resolution and tracking parameters are all strictly connected: the change one of these parameter has an impact on all the others

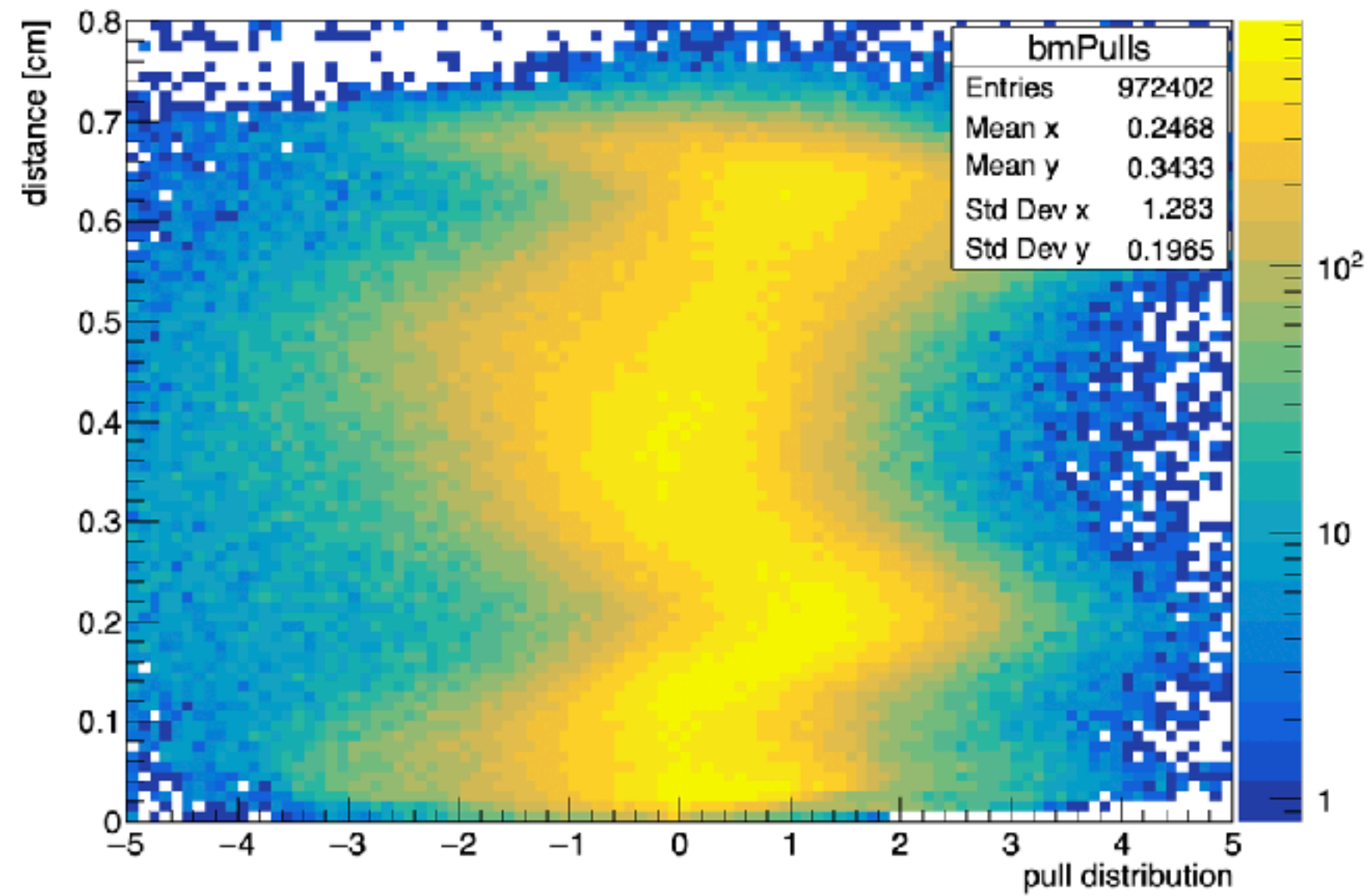
Spatial resolution X vs Y view

- Despite the different beam geometry and the dead channel on the Y view. Apparently there aren't any relevant differences in spatial resolution between X and Y views



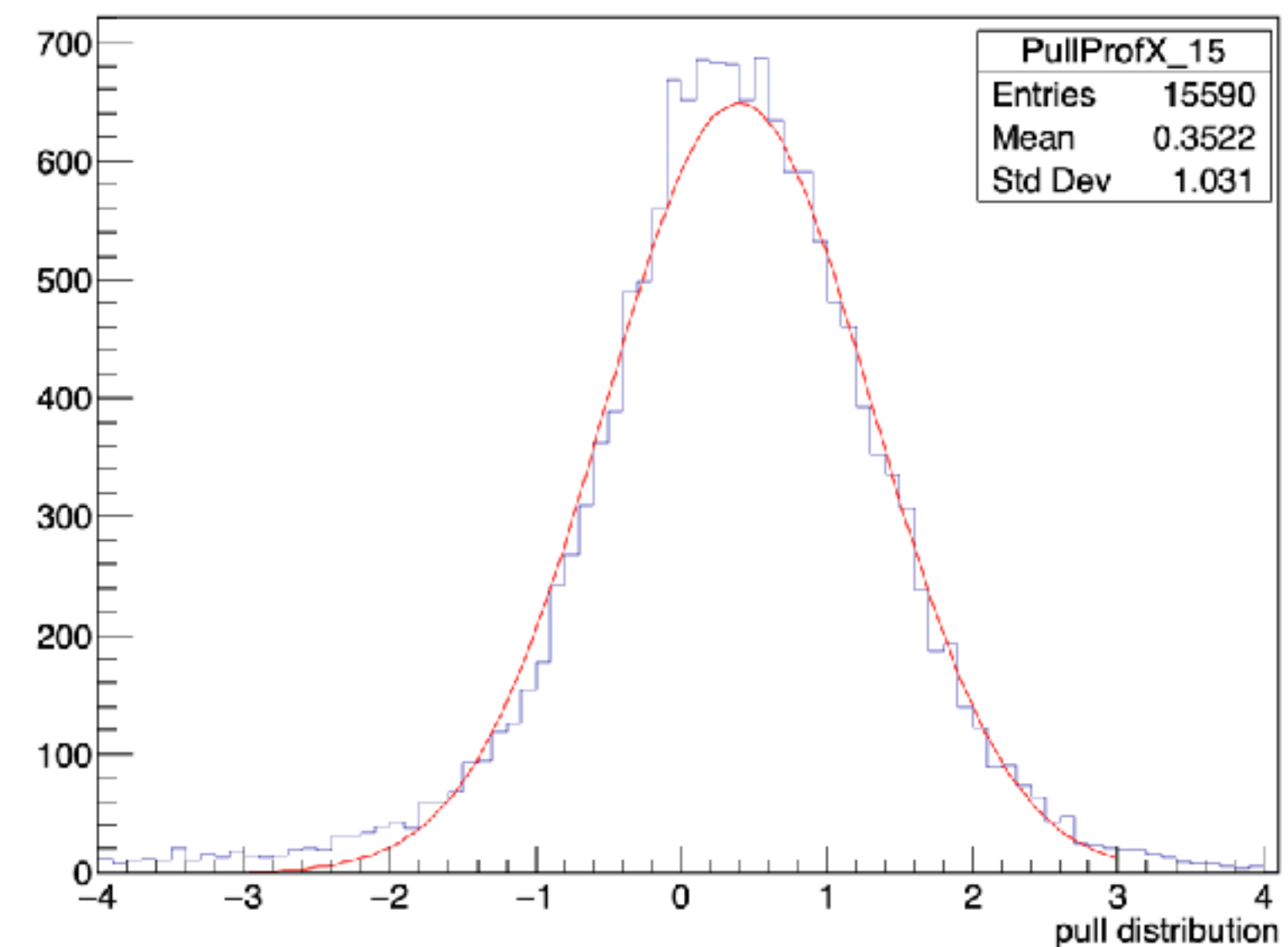
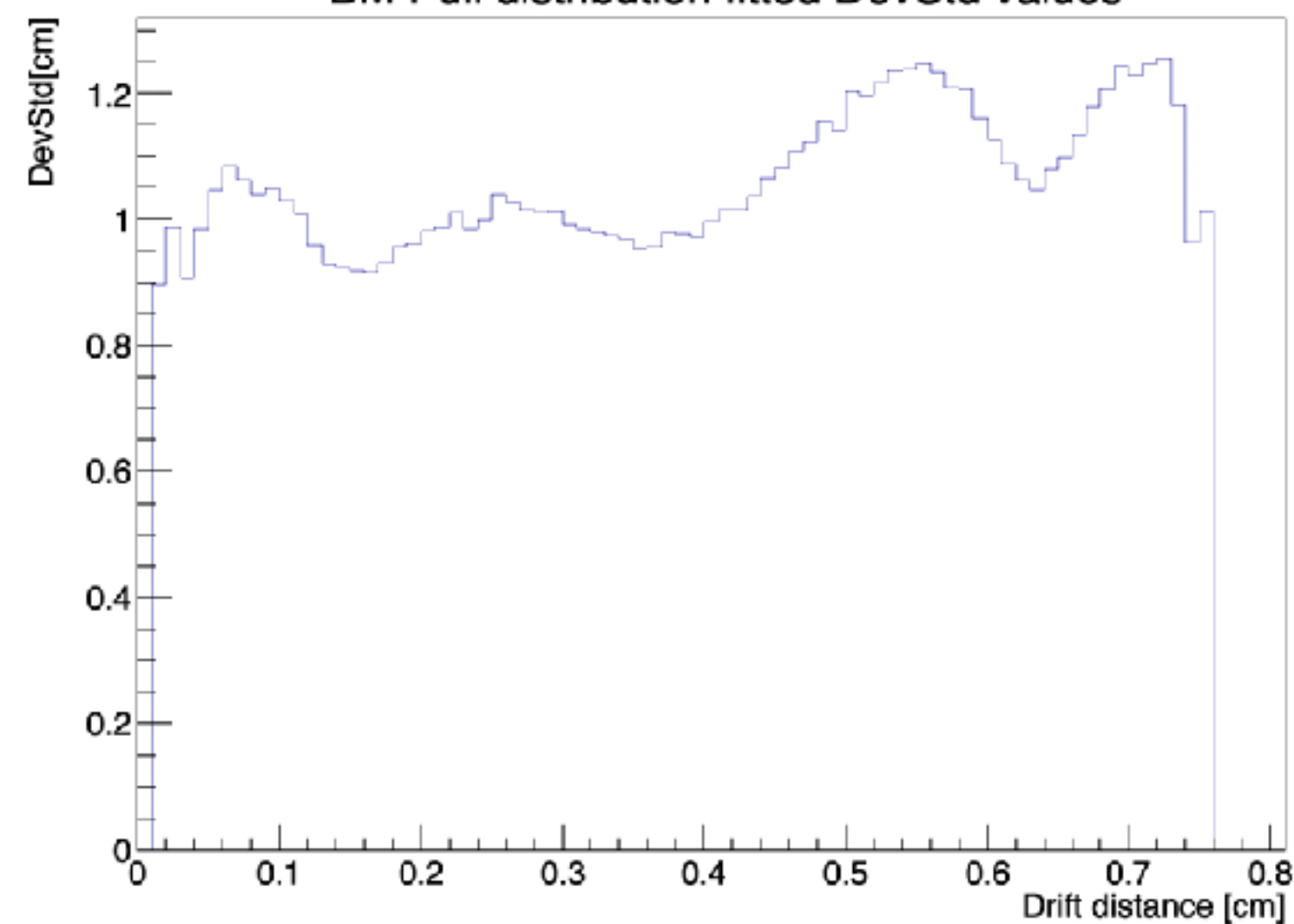
Pull distribution

Pull distribution



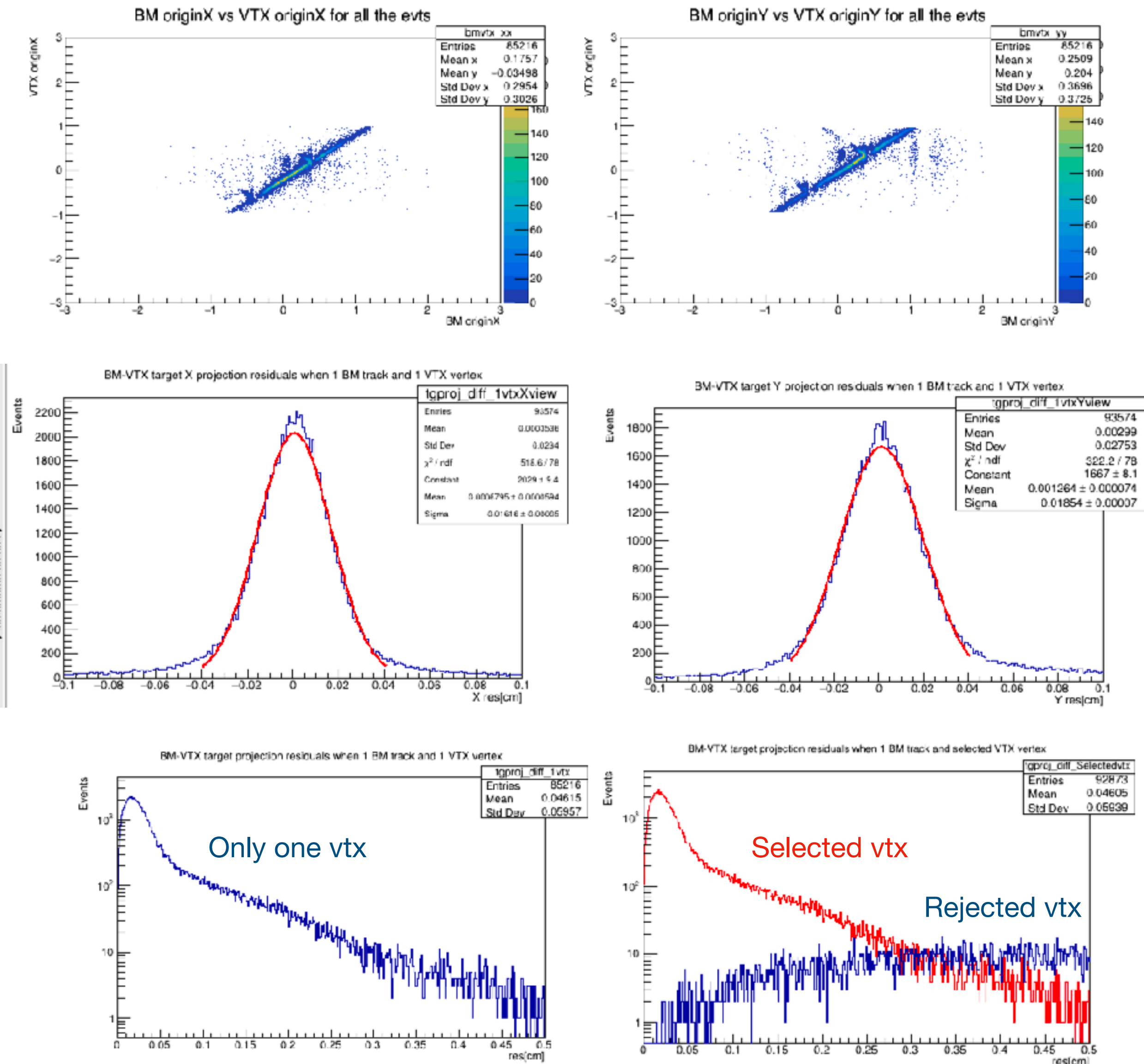
- The pull distribution has a devstd close to 1 for almost all the drift distances
- Still room for improvement, but relevant changes are not expected

BM Pull distribution fitted DevStd values



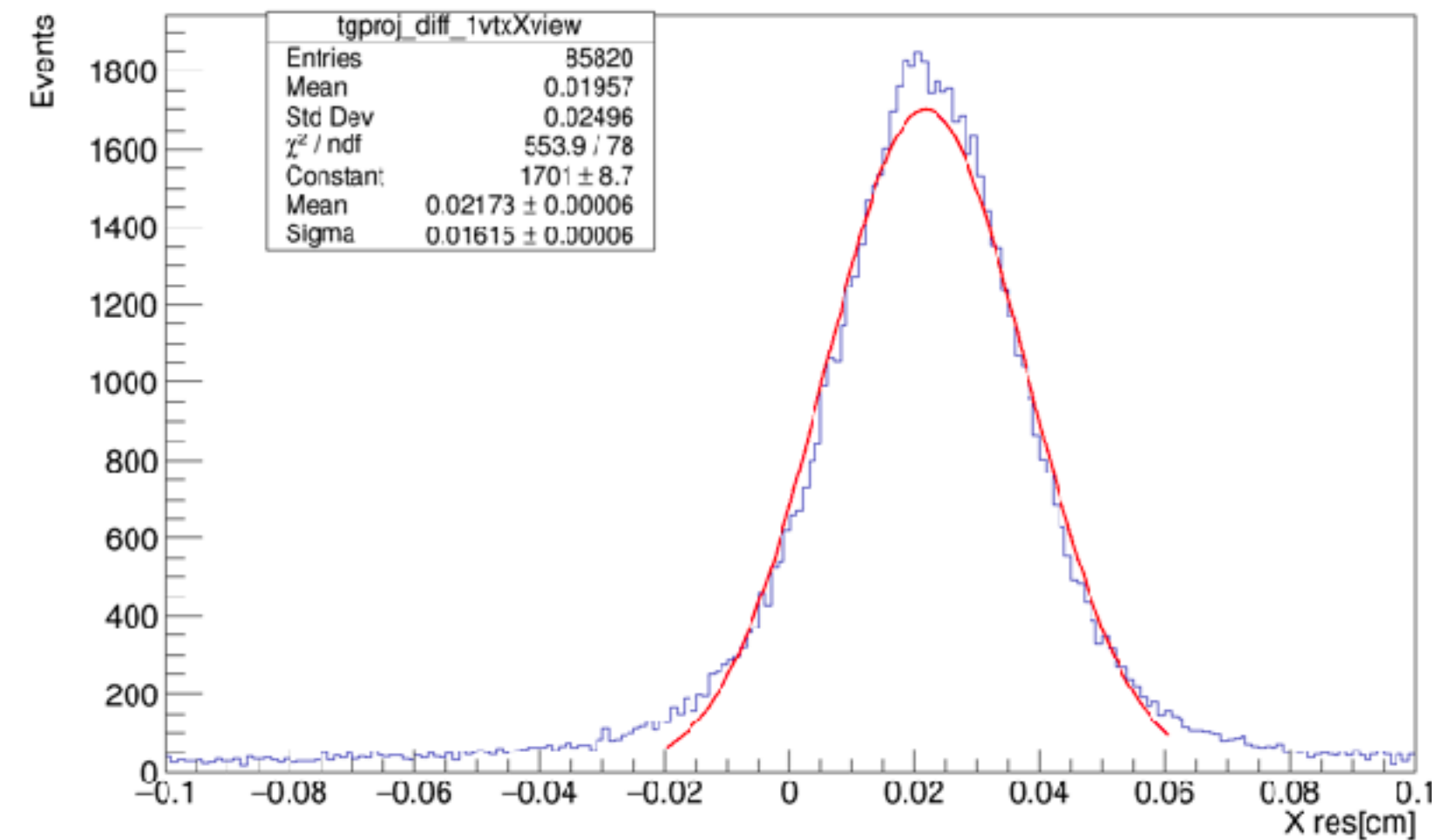
BM - VTX @ 6102 (no target, no magnetic field)

- Run 6102: BM-VTX correlation maintained till the end, but this is not valid for all the runs
- Residuals between BM and VTX with a sigma of $\sim 160-190 \mu\text{m}$ and centered in zero (mean $\sim 0.0007-0.0012 \text{ cm}$)
- With the updated space time relations and track reconstruction parameters, the capability of the BM to resolve the VTX pile up is increased
- Need to study “high” beam rate runs, maybe also with new methods

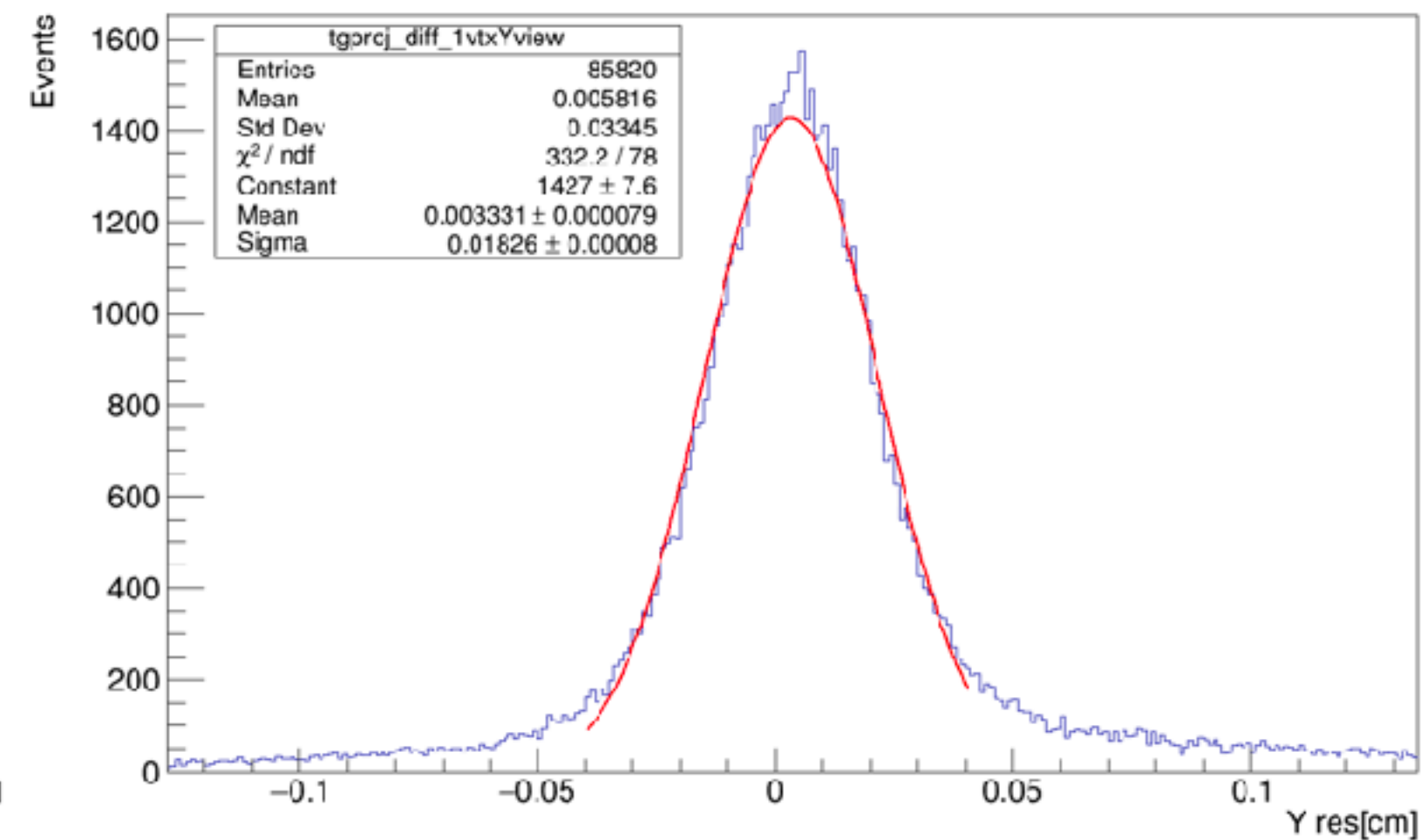


BM - VTX @ 6093 (no target, with mag. field)

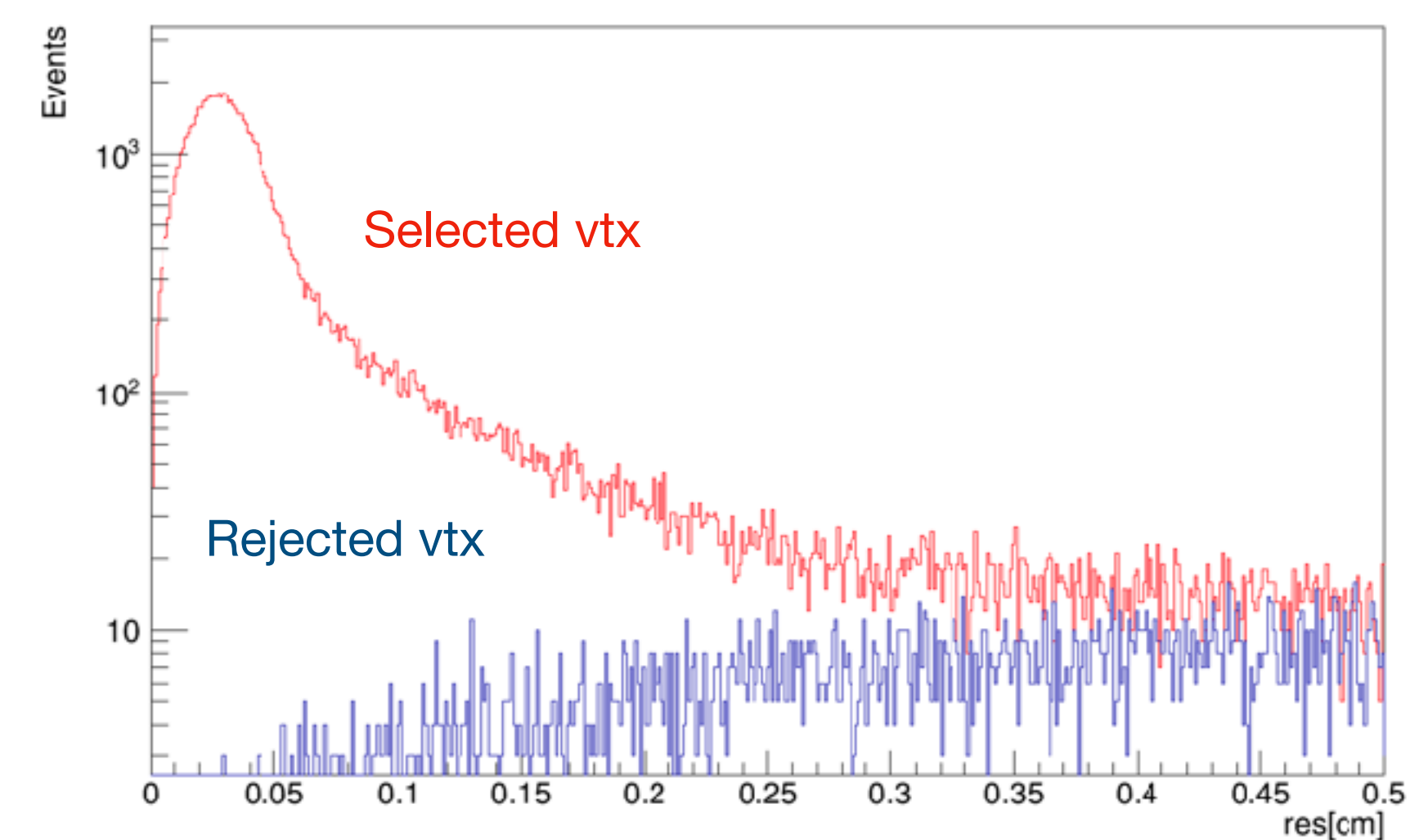
BM-VTX target X projection residuals when 1 BM track and 1 VTX vertex



BM-VTX target Y projection residuals when 1 BM track and 1 VTX vertex



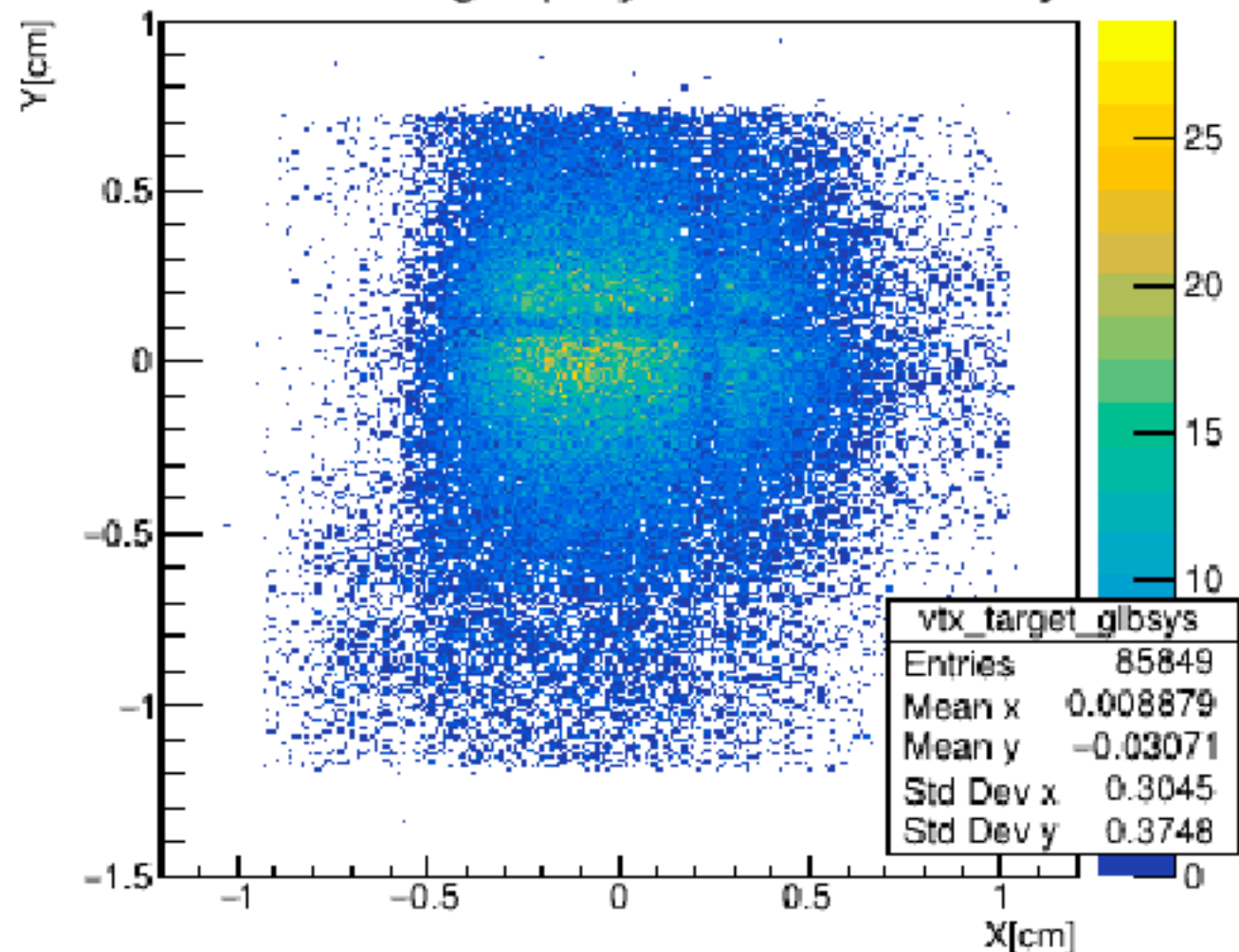
BM-VTX target projection residuals when 1 BM track and selected VTX vertex



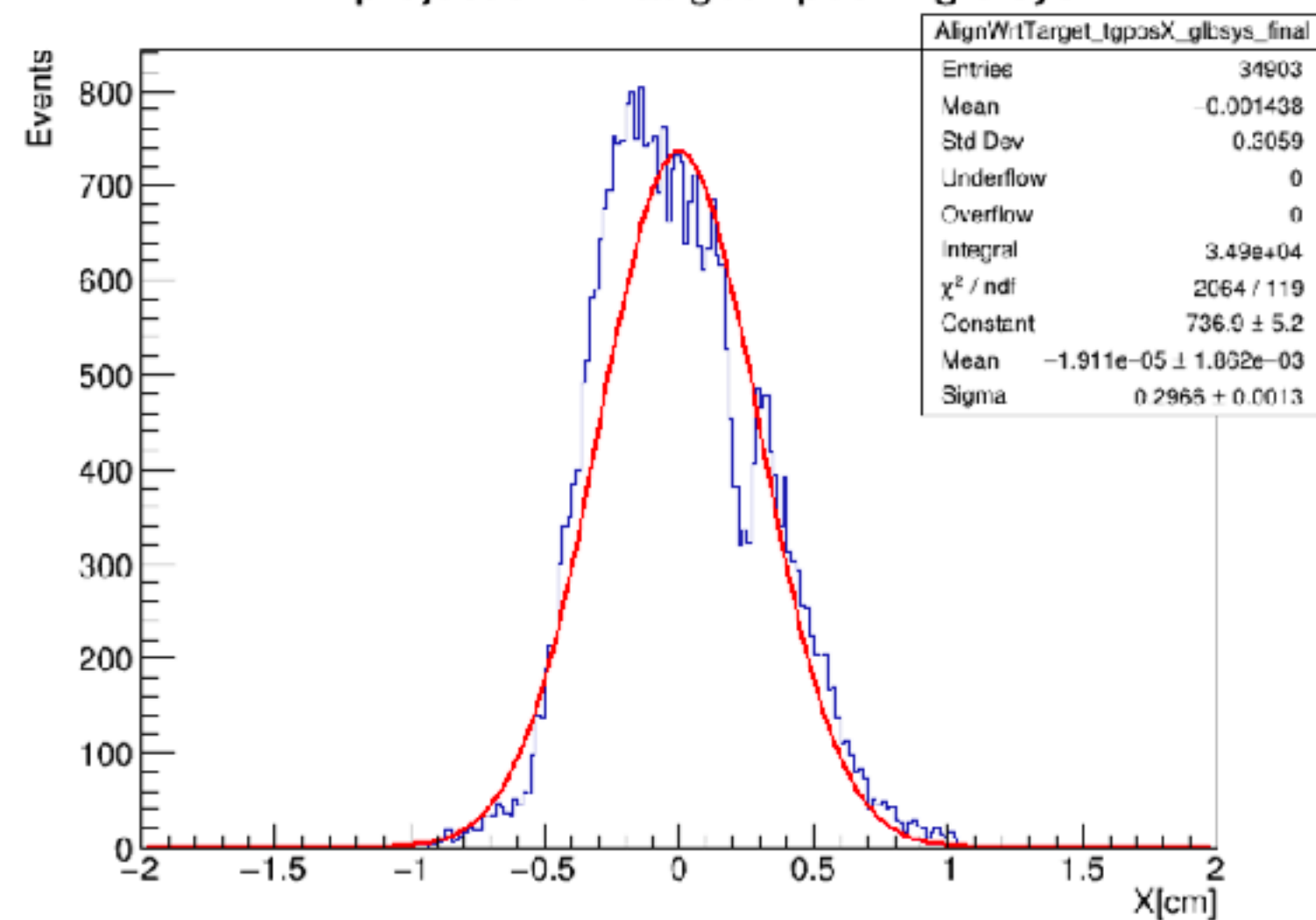
- Run 6124: BM-VTX correlation maintained till the end
- Mean value of the residuals between BM and VTX are shifted, mainly on the X view. No shift in MC
- The magnetic field has an impact on the BM and/or VTX tracks, but there is the necessity to study the match of the global tracks with the BM track
- However, no relevant impact on the vtx pile up, at least at CNAO2023 beam rate
- Necessity to include the magnetic field in the BM track reconstruction? (Change the chi2 minimisation with a genfit based algorithm... as in the past)

Beam Profile(s)

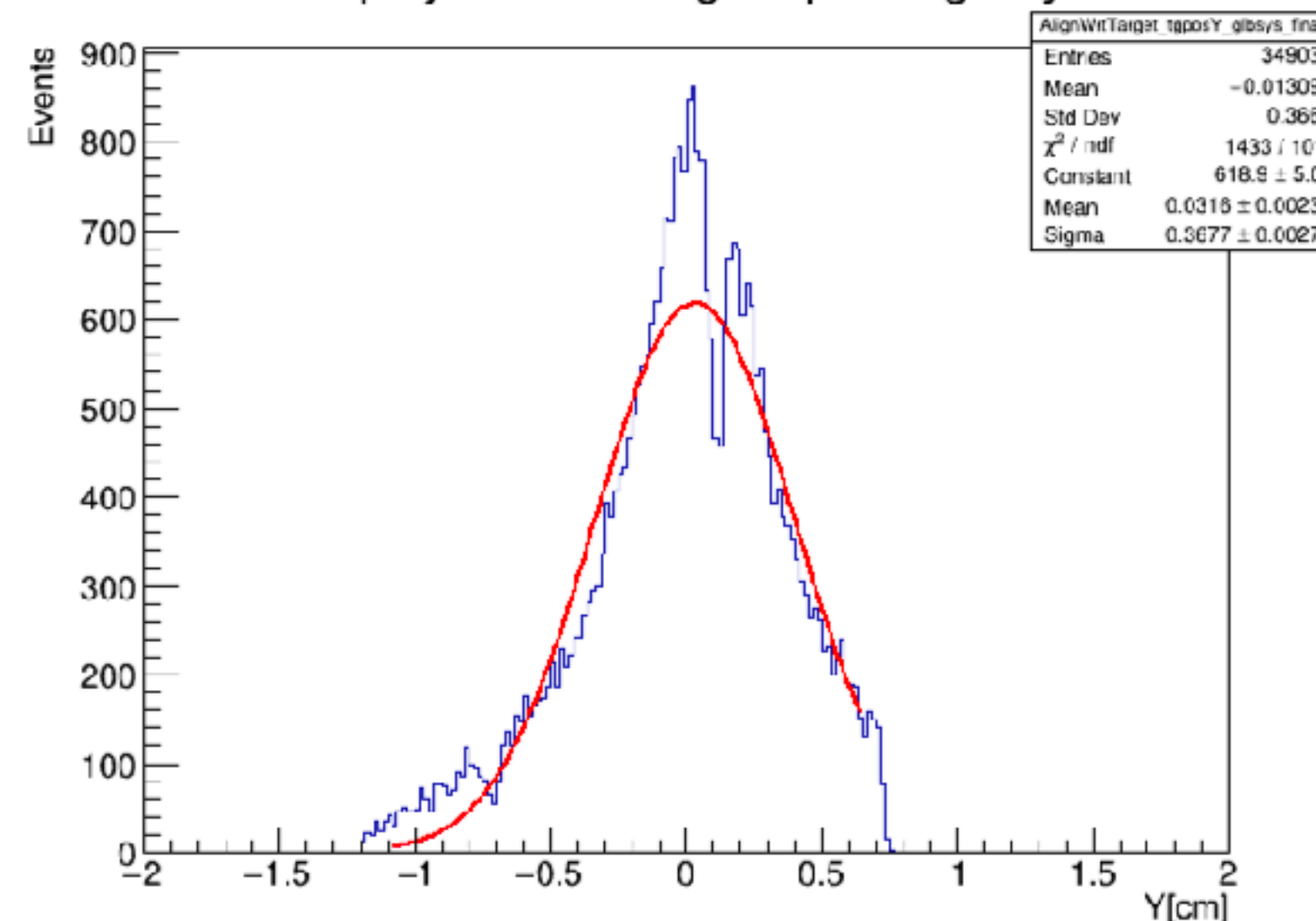
vtx tracks on target projections in GLB sys



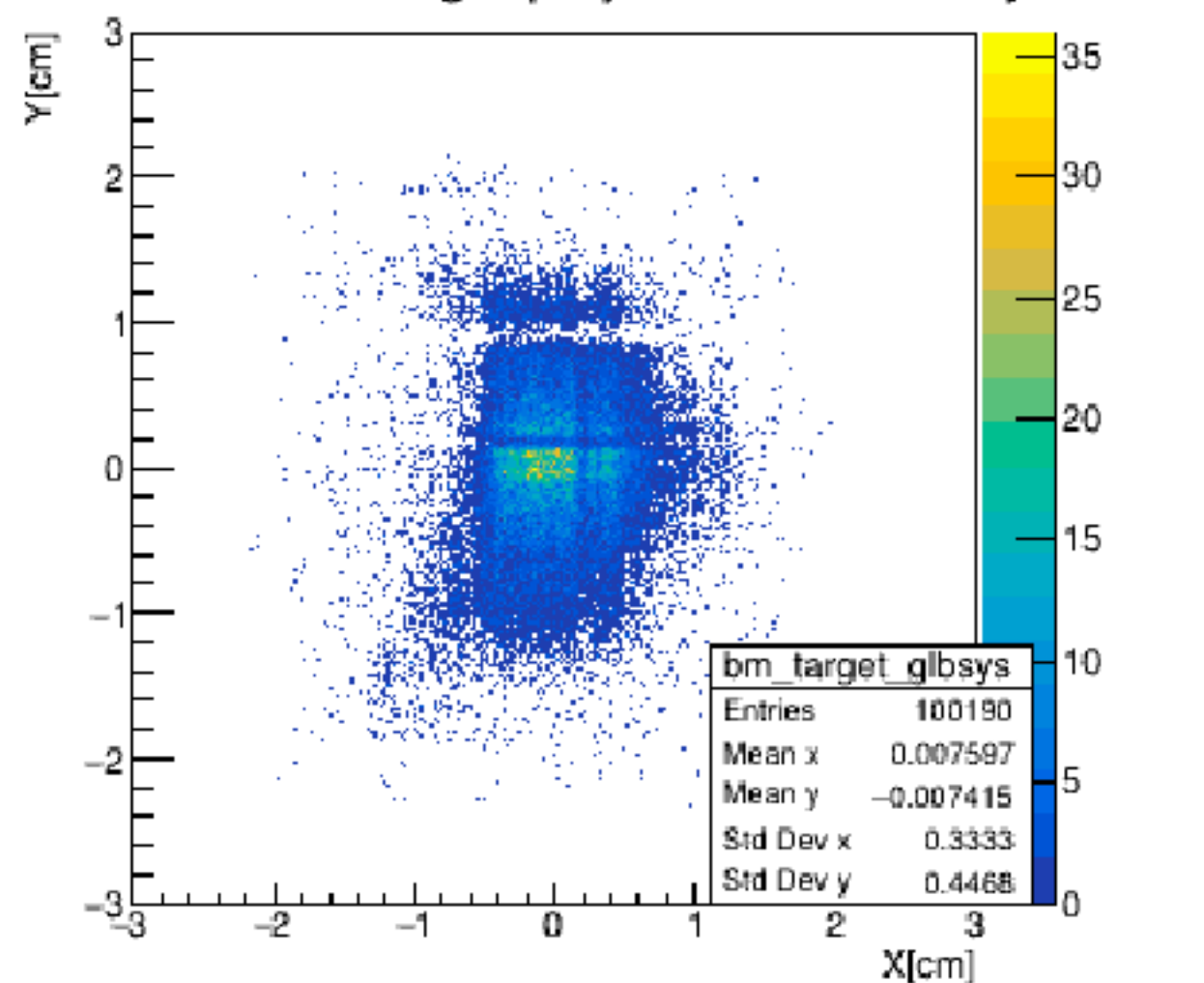
VT projection on target Xpos in glb sys



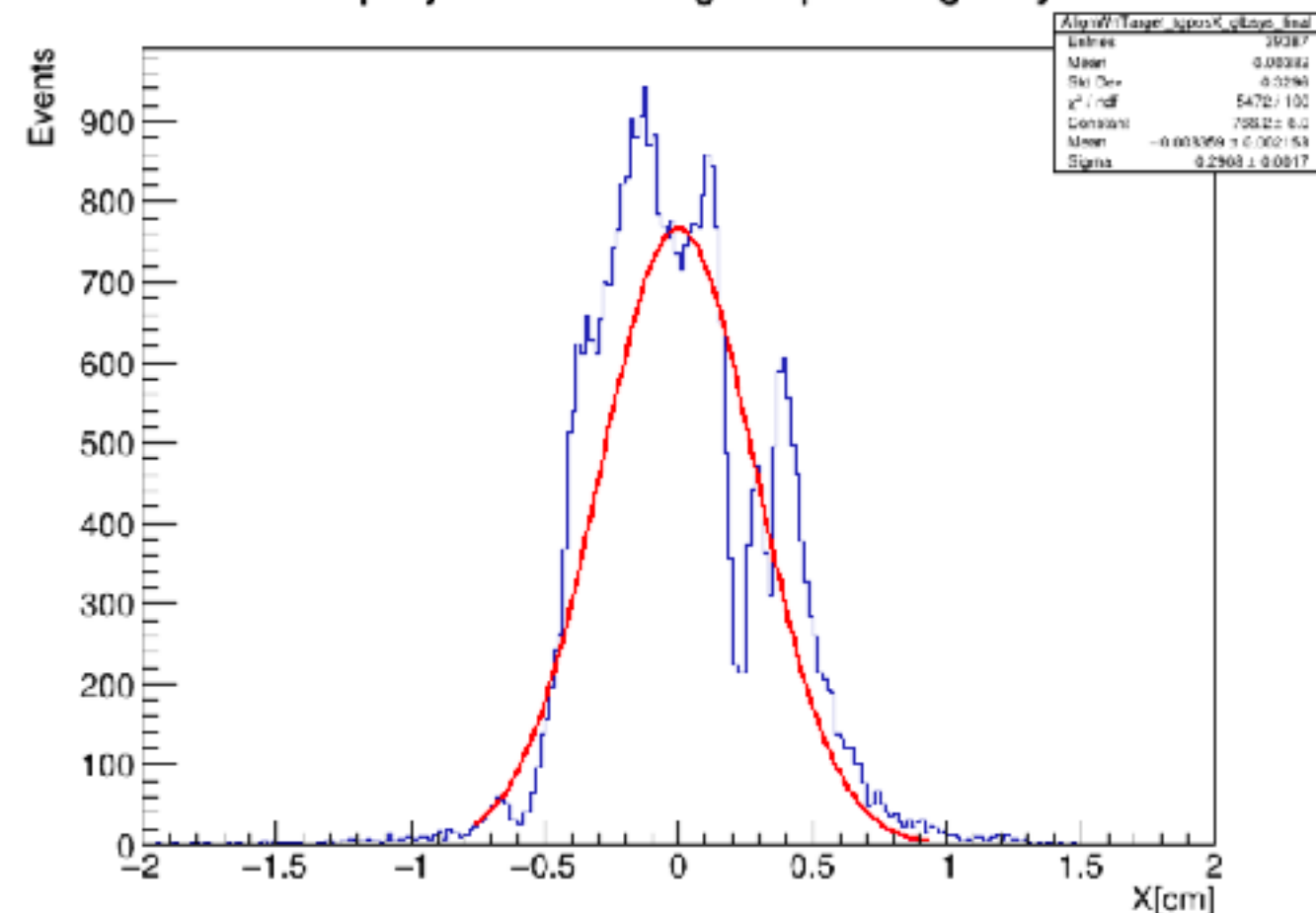
VT projection on target Ypos in glb sys



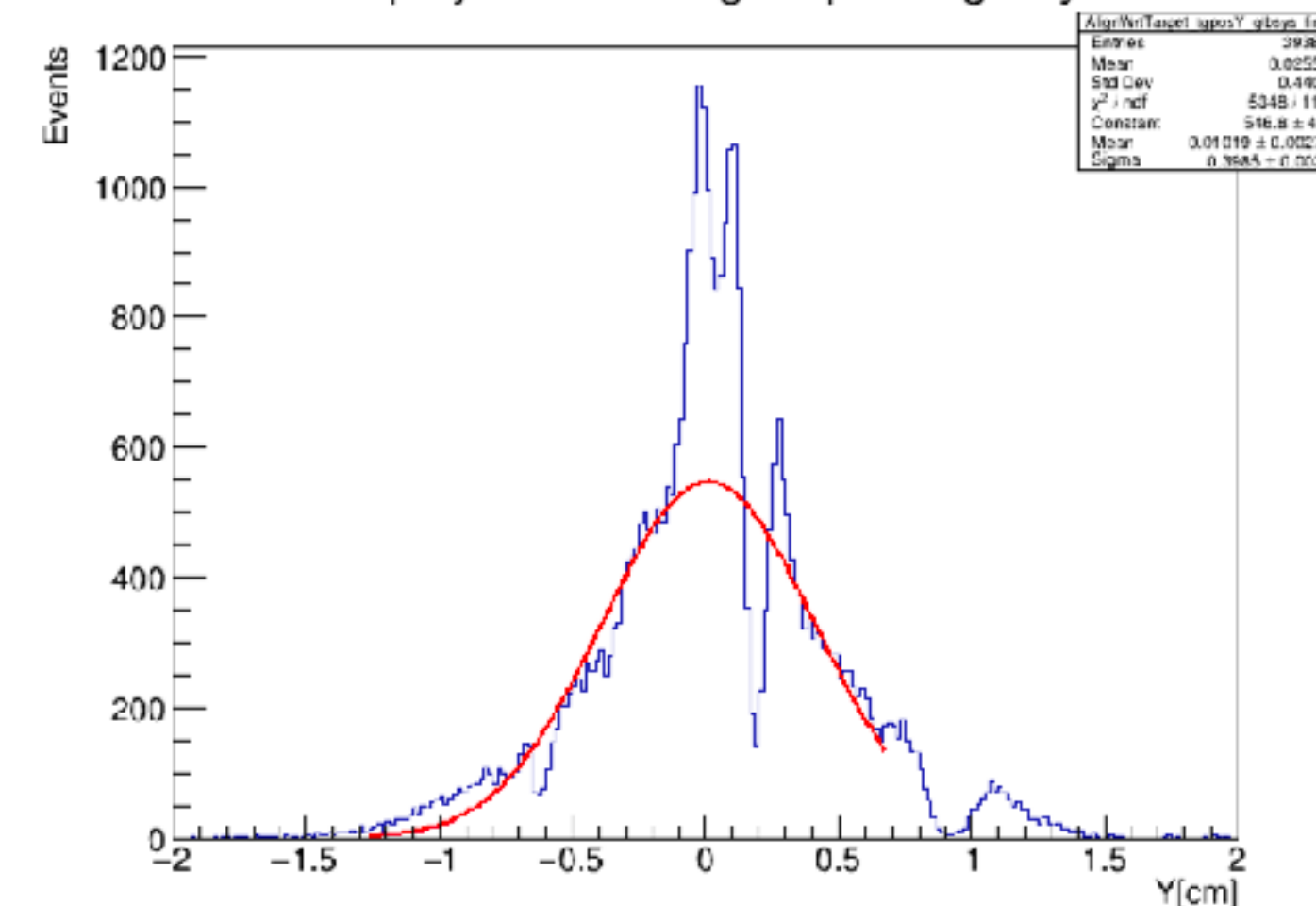
BM tracks on target projections in GLB sys



BM projection on target Xpos in glb sys



BM projection on target Ypos in glb sys

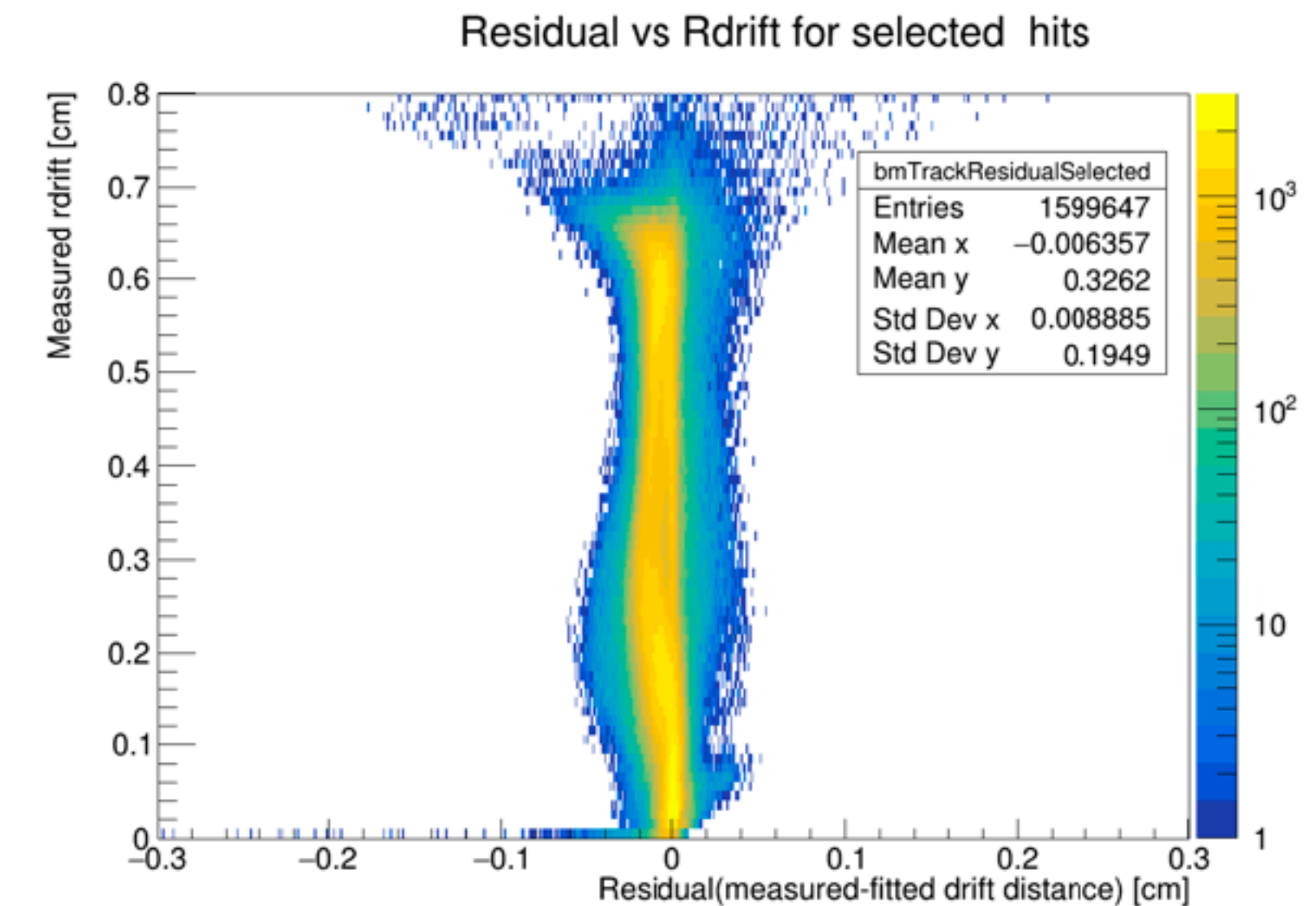
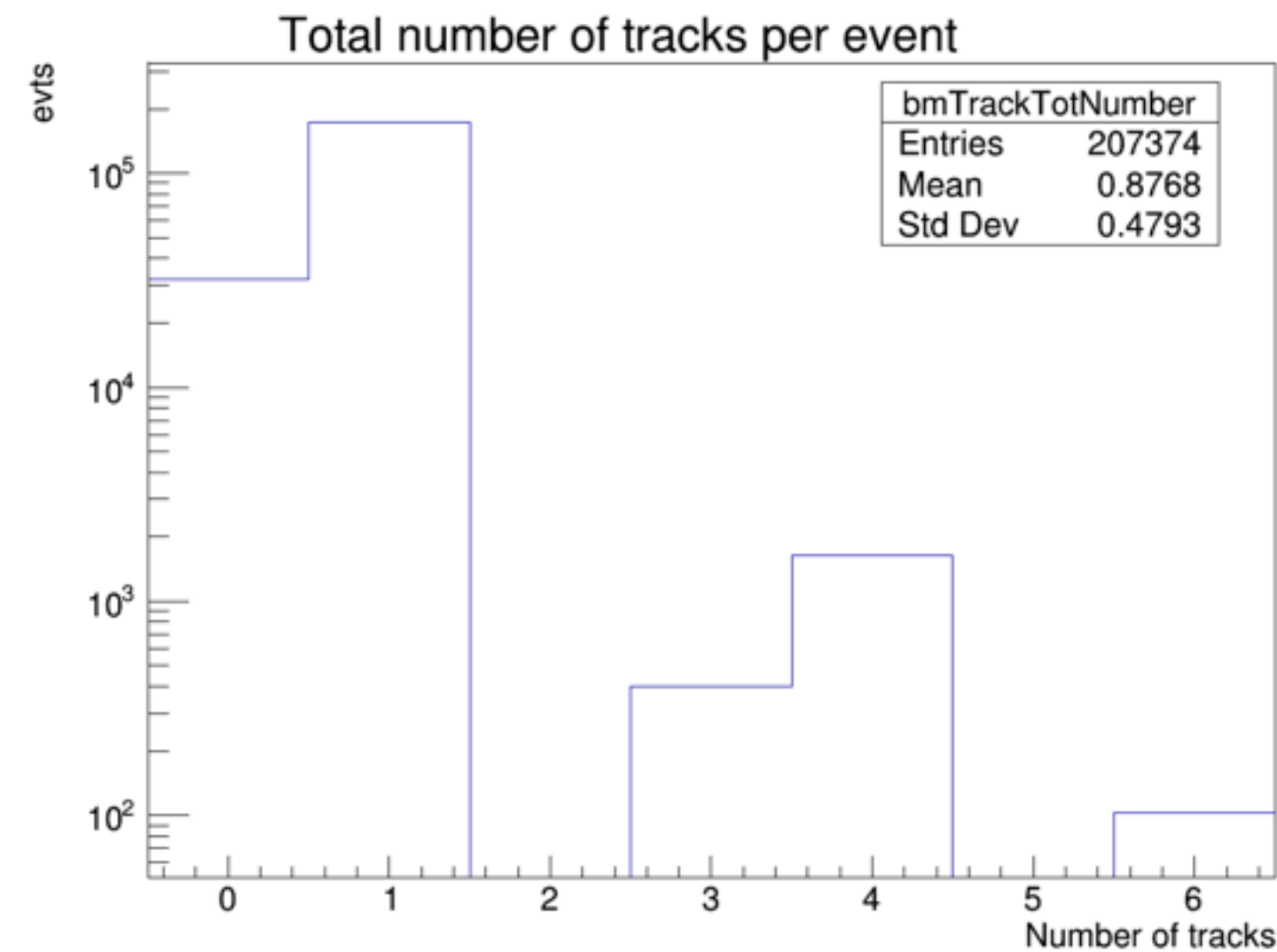
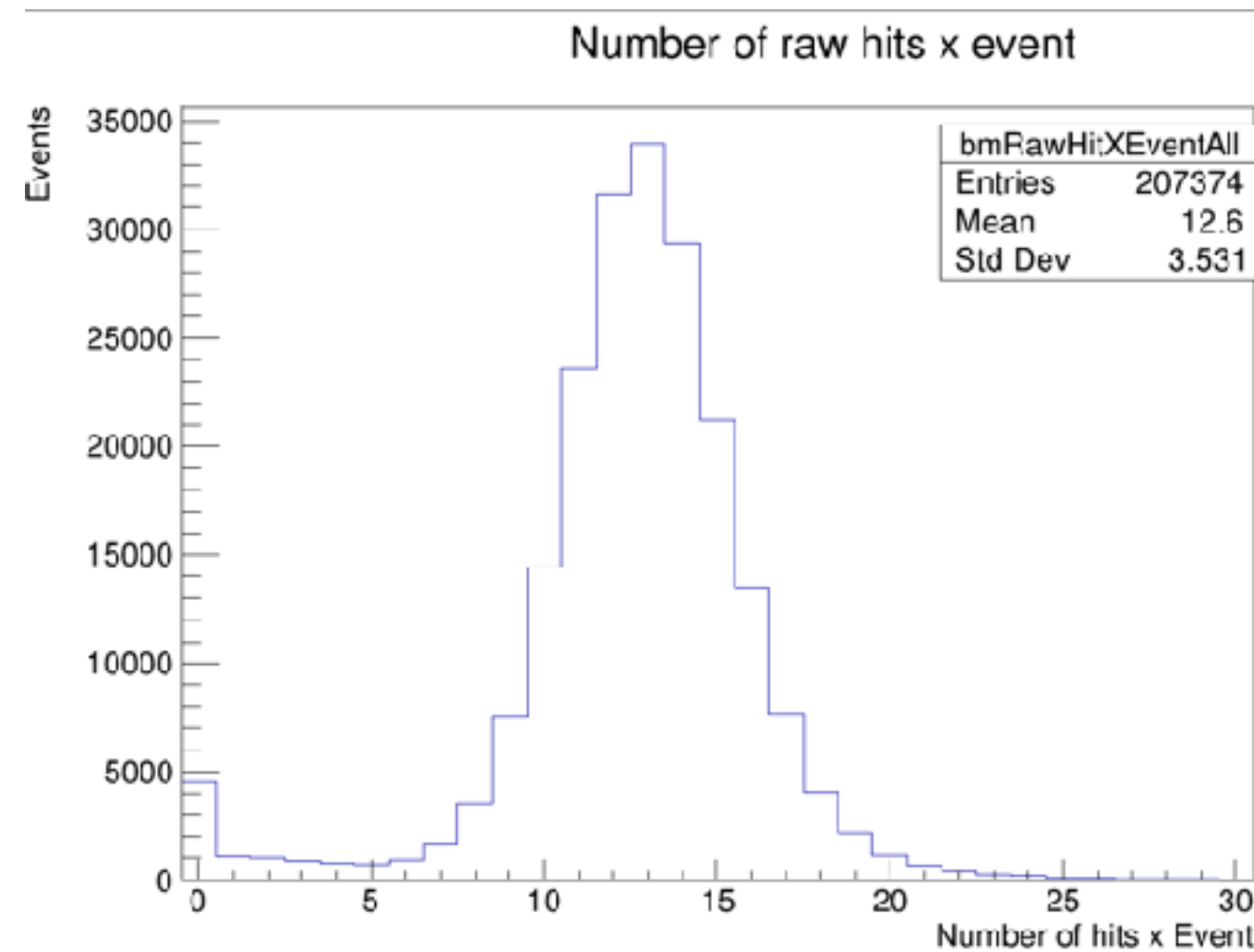


Conclusions

- @ CNAO2023 the BM had got a gas leakage issue at the beginning of the data taking. We found a solution for the next days, but in the initial runs the detector wasn't in a stable condition
- There was a dead channel. It has to be checked
- The track reconstruction efficiency is of about 93-94% and the spatial resolution was of the order of 60 μm , up to about 0.6 cm of drift distance
- The BM seems to be capable to resolve the VTX pile up. Possibility to study the high beam rate runs and to study other methods
- There is an effect of the magnetic field on the VTX-BM residuals. There is the necessity to study the global track-BM track matching, but maybe it could be useful to use Genfit also in the BM track reco

To do list for CNAO2023

- Study of the fragmentation runs in CNAO2023 ongoing (e.g.: 6144 pure fragmentation run)



To do list

- Re-process of all the past campaigns ongoing, optimising the tracking parameters
- e.g.: CNAO2022, 5466: track efficiency $\sim 97-98\%$, Space time relation and spatial resolution not fully optimized

