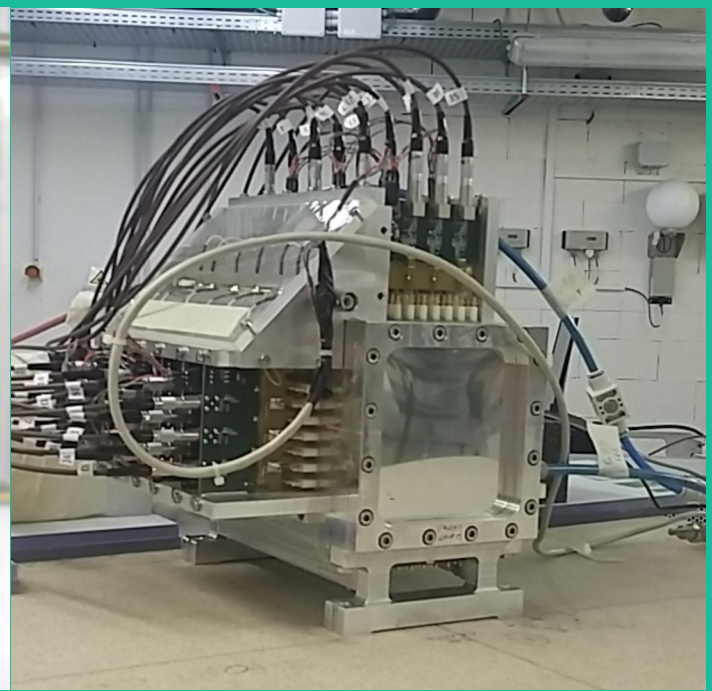
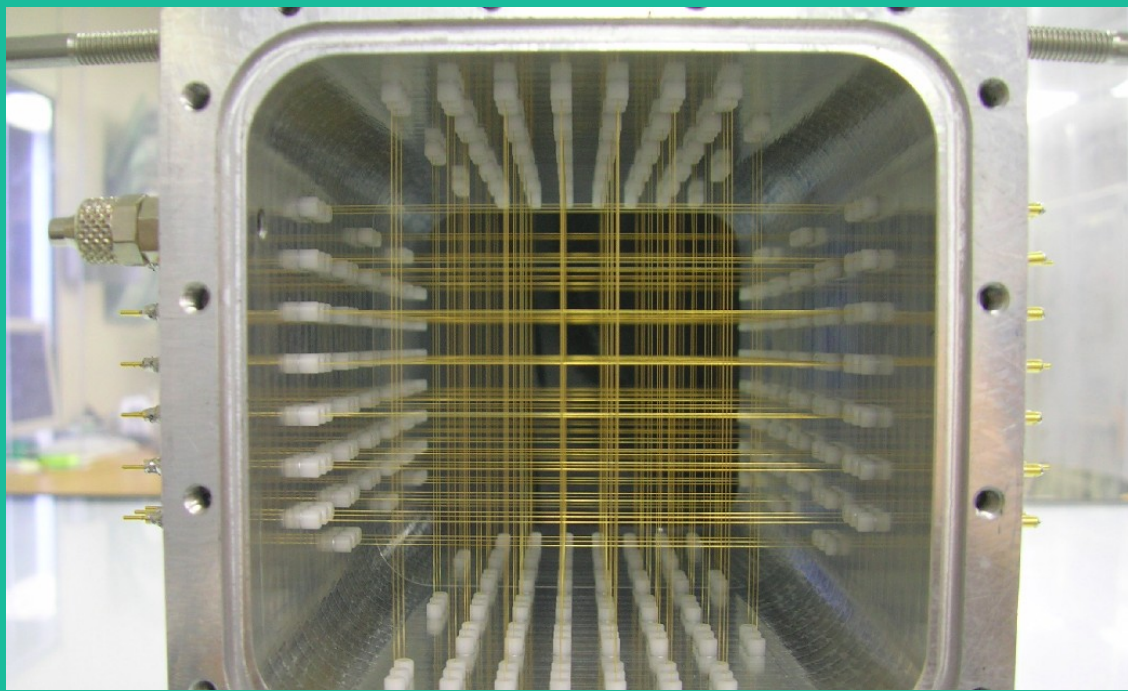


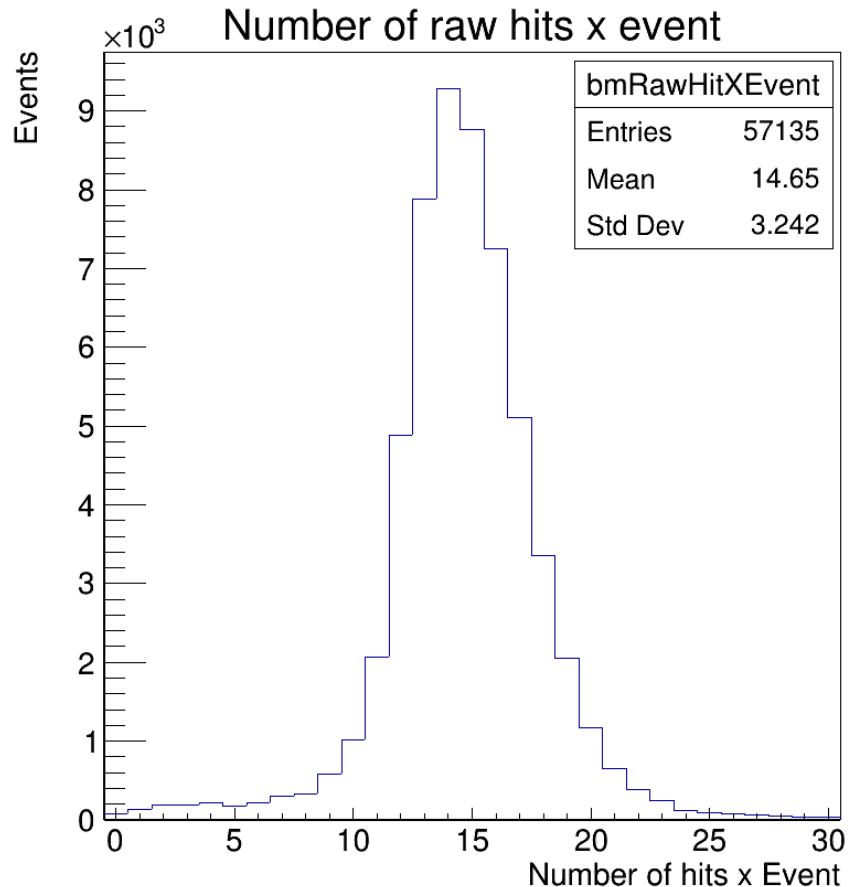


BM double tracks studies

Yunsheng Dong

12/01/2022

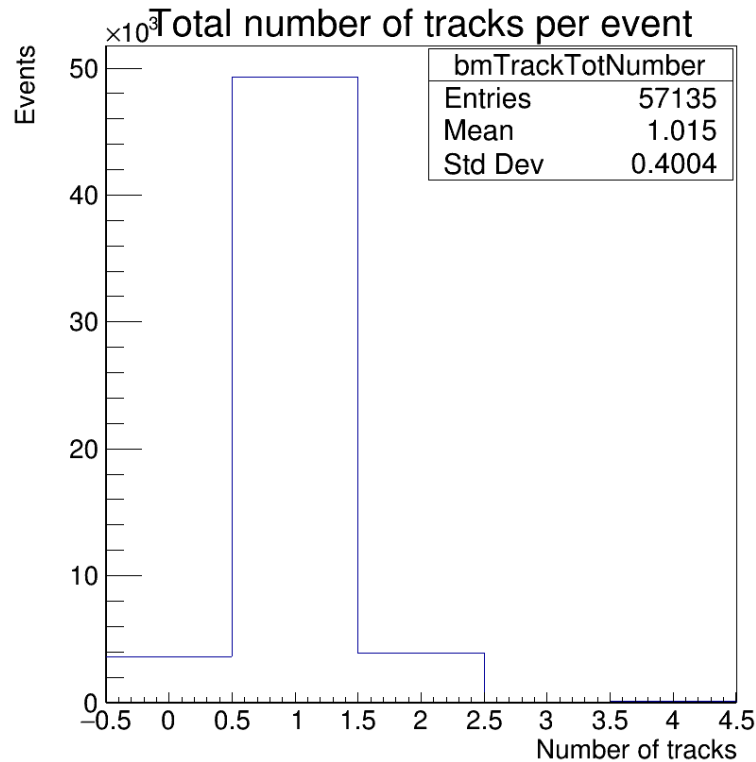
Number of hits



This study has been conducted on Run 4313 (400 MeV, no target)

- The mean BM hits is of 13-15
- The distribution of the number of hits can be different depending on the specific run
- On each events there are hits due to delta rays, noise, cross talks etc.
- A track in the BM has a maximum of 12 hits (6 on each view if all the hits are detected)
- The minimum number of hits to reconstruct a track in the BM is 6 (3 hits on each view)

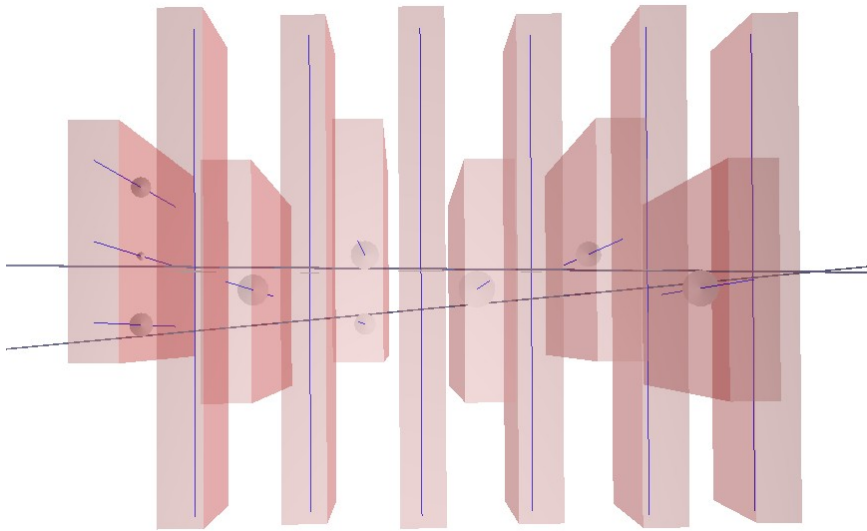
Number tracks



0 trk: 3.6 k ~ 6% (3% MC)
1 trk: 49.3 k ~ 86% (92% MC)
2 trk: 3.9 k ~ 7% (5% MC)
3+trk: 0.2 k ~ 0.4% (0.3% MC)

- The track reconstruction is performed on each view independently, then the tracks on the two views are combined
- 0 track: -50% because the number of hits is insufficient (<3 hit per view)
-50% because the hits are not aligned
- **2 tracks: there is one track reco on one view and two tracks reco on the other view**
- 4 tracks: there are two tracks on each view combined into four tracks (2 real tracks and 2 ghosts)

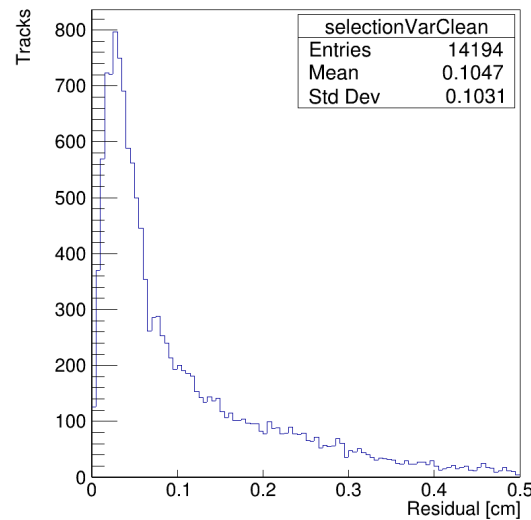
Two tracks events



- The BM can reconstruct two tracks in the following cases:
 - There are two real particles inside the BM parallel on one view (0.3% from MC)
 - There is only one real track from one particle, while the second track is given by a random combination of noise, delta rays and cross talk hits (>99% from MC)
- Form MC, the expected rate of pre target fragmentation is of the order of 0.3%. This corresponds to the number of events in which the BM reconstructed 4 tracks ($\sim 0.25\%$)
- **Need to study a selection criteria to find the correct track in the events in which the bm reconstructed two tracks**

BM-VTX residual

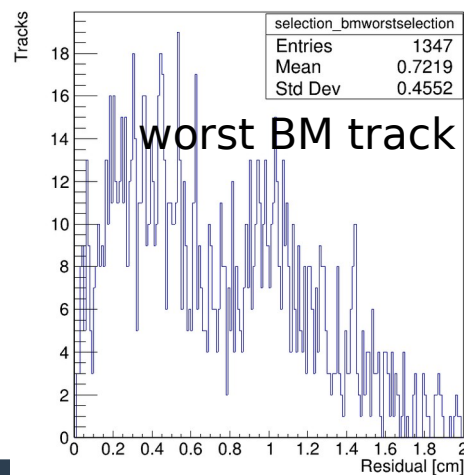
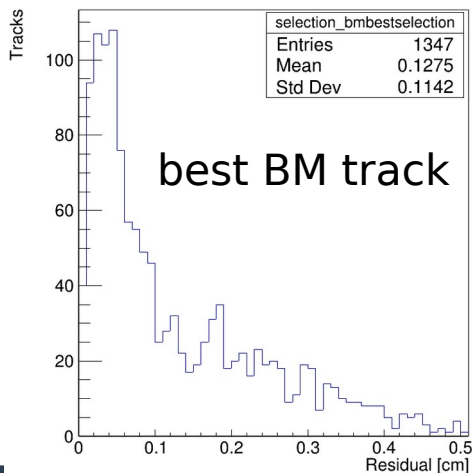
1 BM track 1 VTX vertex:



The residual between BM tracks and VTX vertices can be exploited to evaluate the selection criteria

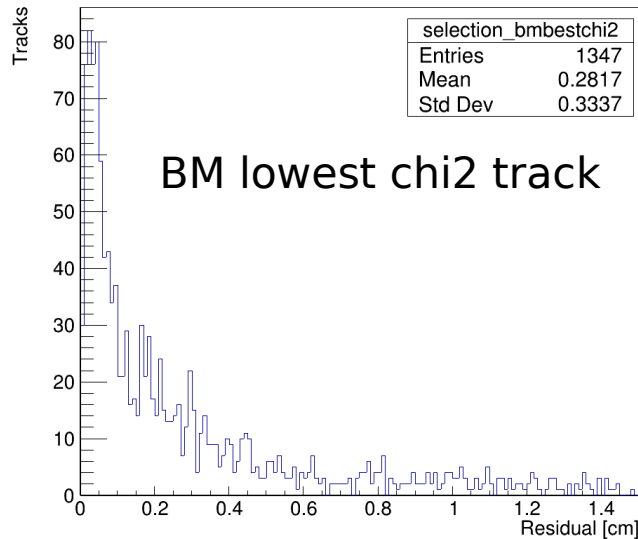
- The residual distribution for the events with 1 VTX vertex and 1 BM reconstructed track has a peak at $\sim 300 \mu\text{m}$ and a tail up to $\sim 0.5 \text{ cm}$
- Selecting the events in which there is only 1 VTX vertex and 2 BM tracks, the correct BM track can be identified as the track with the minimum residual (best BM track)

2 BM tracks 1 VTX vertex:



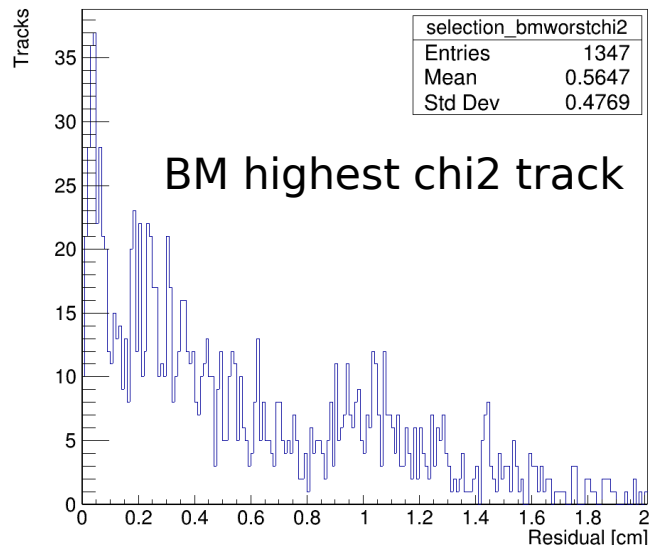
- **Then one can study different track parameters to identify the correct BM track without the use of the VTX detector**

First criteria: Chi square

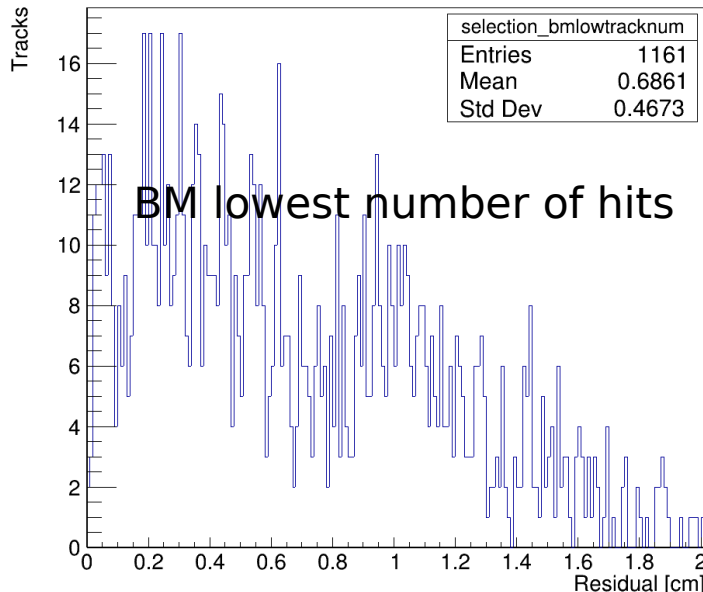
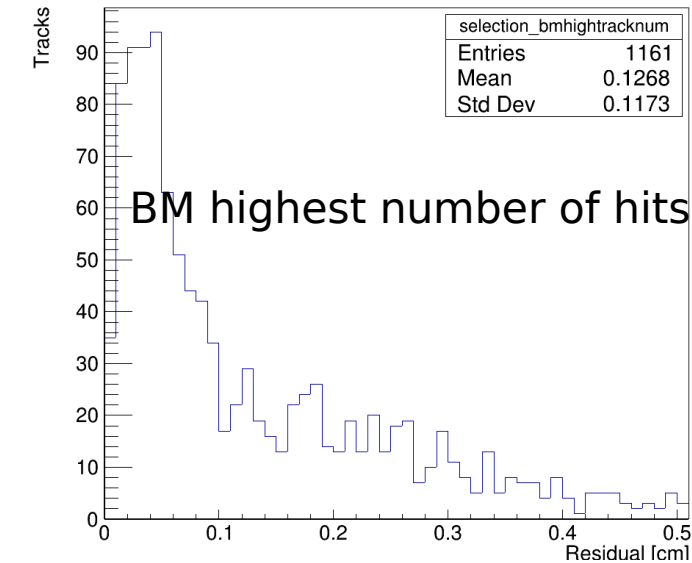


One can select the BM track with the lowest chi square

- The BM-VTX residual distribution for the tracks with the lowest chi square show a peak at ~ 300 with a long tail
- A similar distribution is shown also for the residual calculated using the BM track with the highest chi2
- Checking with the correct BM track identified previously, with this method about 70% (65% in MC) of the BM tracks are correctly identified



Second criteria: Number of hits



One can select the BM track with the highest number of hits

- The BM-VTX residual distribution for the tracks with the highest number of hits shows a peak at ~ 300 with a tail
- The residual distribution for the tracks with a lower number of hits is completely different
- Checking with the correct BM track identified previously, with this method about 90% (95% in MC) of the BM tracks are correctly identified

Conclusion

- The events in which the BM reconstruct two tracks have been studied with the 400 MeV alignment run events in which the VTX reconstructed 1 vertex
- The BM double tracks have been identified as the events in which only one track is given by a real particle, while the other one is derived from a random combination of noise, delta rays and cross talk hits.
- Different criteria have been studied and the best strategy seems to select the track with the highest number of hits.
- The main results on the GSI2021 data are similar to the results with MC studies
- At the moment in newgeom this selection with the number of hits is already performed in the TABM codes (added in newgeom just before Christmas). There are no more events with two BM tracks, this is valid also for the old data takings (e.g.: GSI2019)