Tracking with Hashing

Current state

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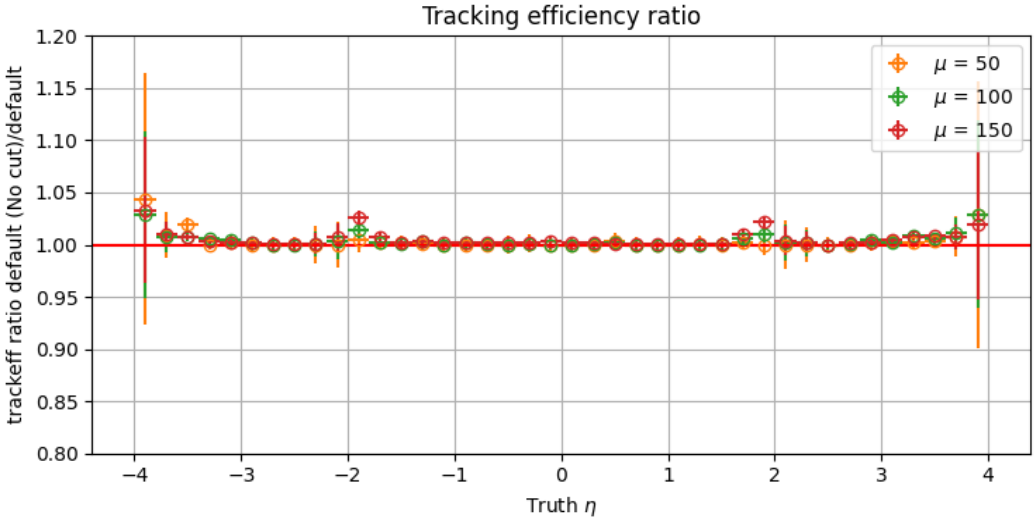
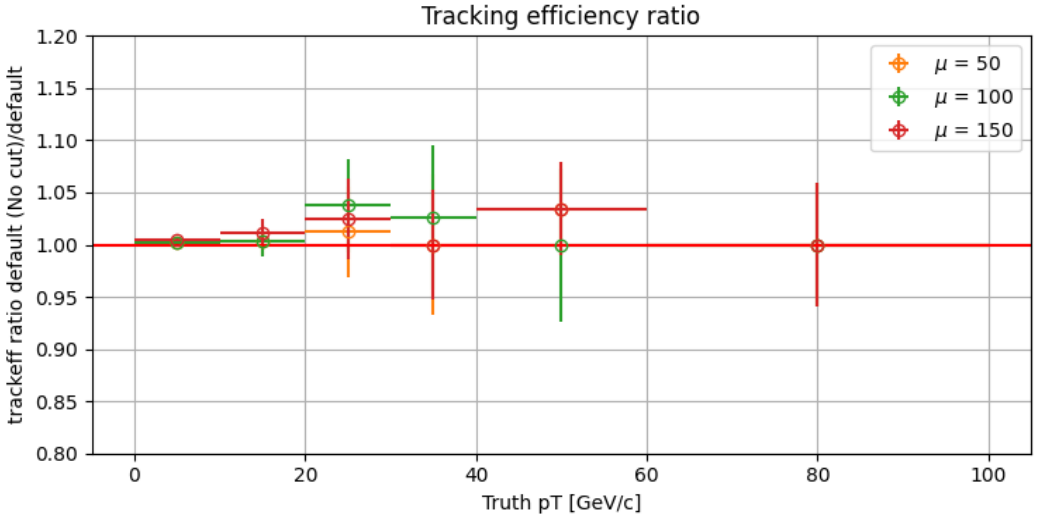
MaxSeedsPerSpM cut

- **Purpose:**
  - Reduce the number of seeds to expand to speedup the track finding
- **Idea:**
  - Only keep at most MaxSeedsPerSpM+1 seeds sharing the same middle space point
- **Implementation:**
  - Uses a score to compare the seeds
  - The score is related to how close the impact parameter is to 0
- **Benefit:**
  - speedup and less memory used
- **Consequence:**
  - Loss of efficiency

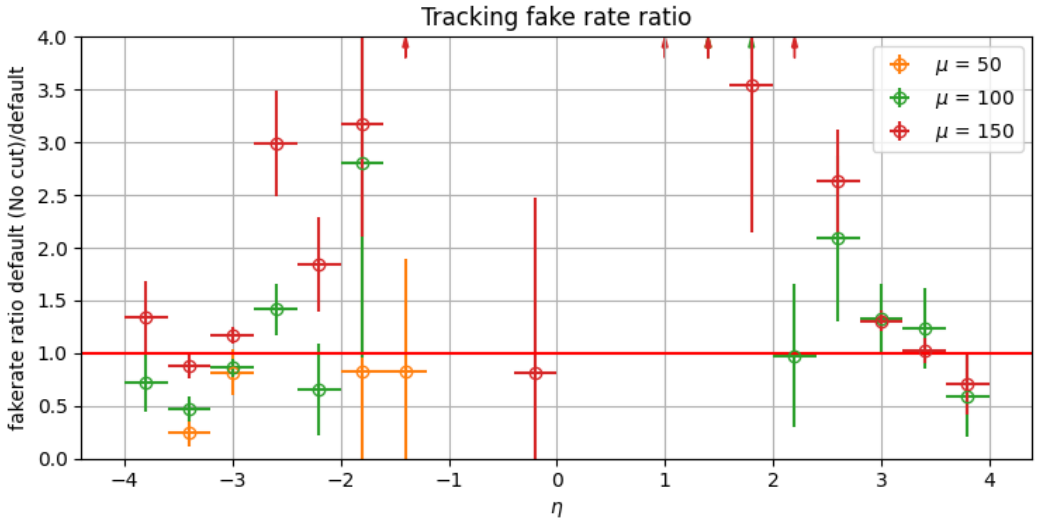
Ratio Default no cut vs Default: efficiency

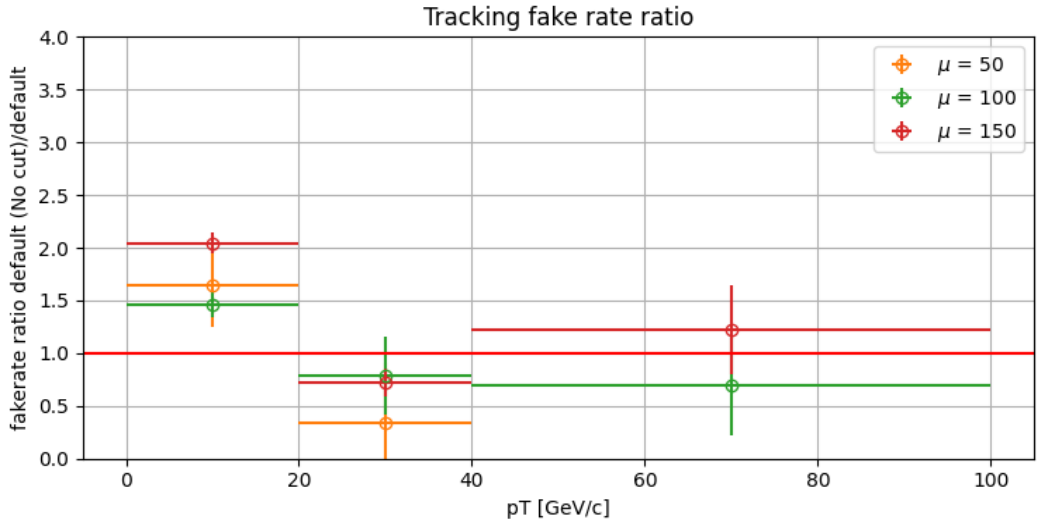




Cutted tracks are in forward region and around |η| = 2

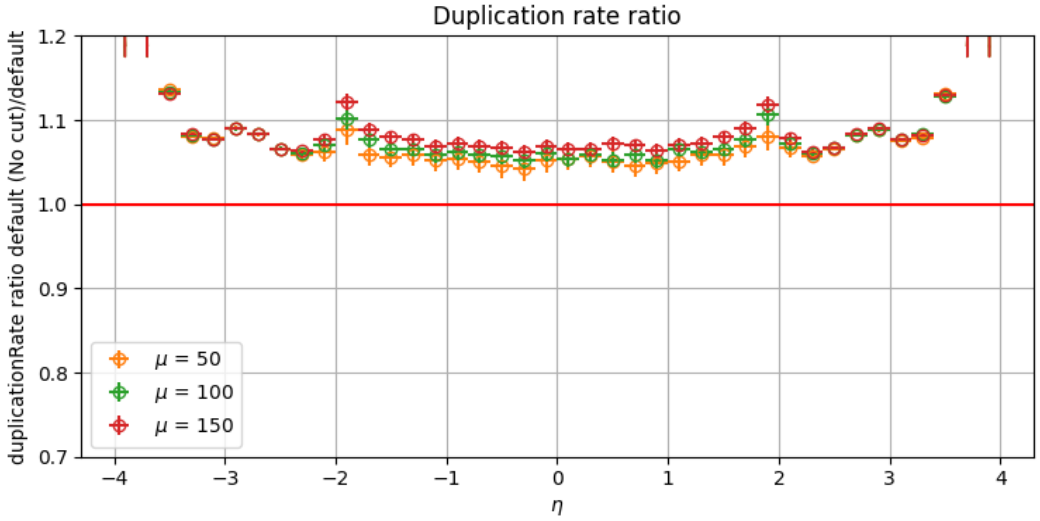
Ratio Default no cut vs Default: fake rate

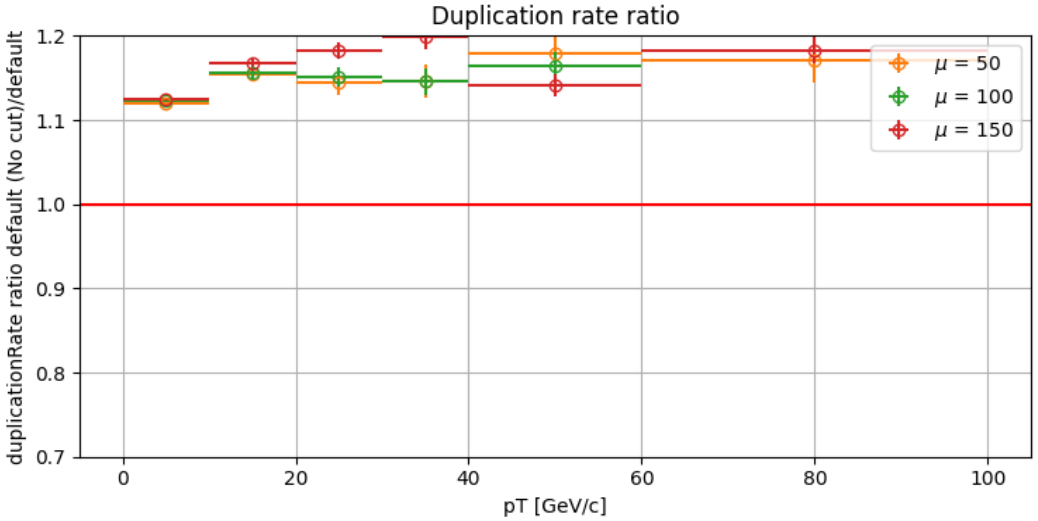




Higher fake rate in central region and low pT

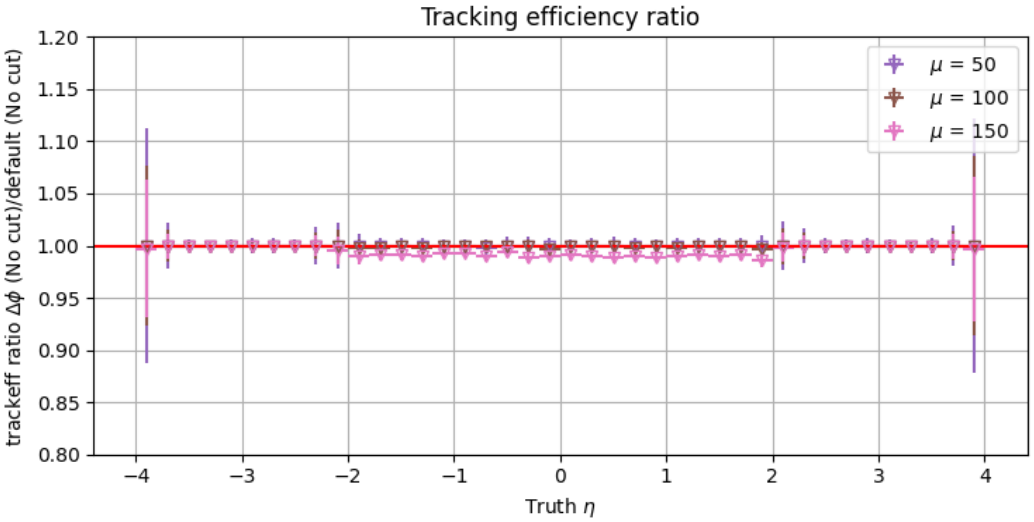
Ratio Default no cut vs Default: duplicates

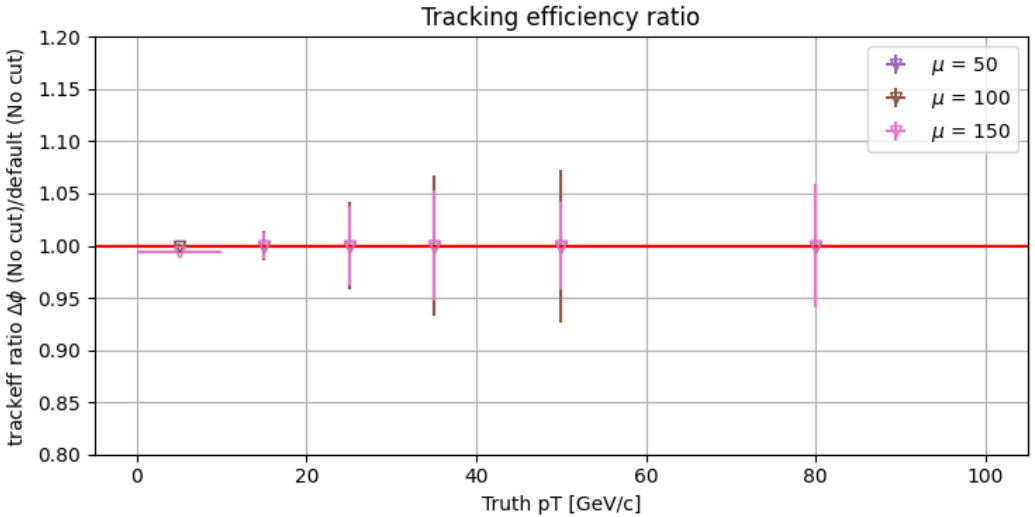




Higher duplication rate and shape similar to efficiency

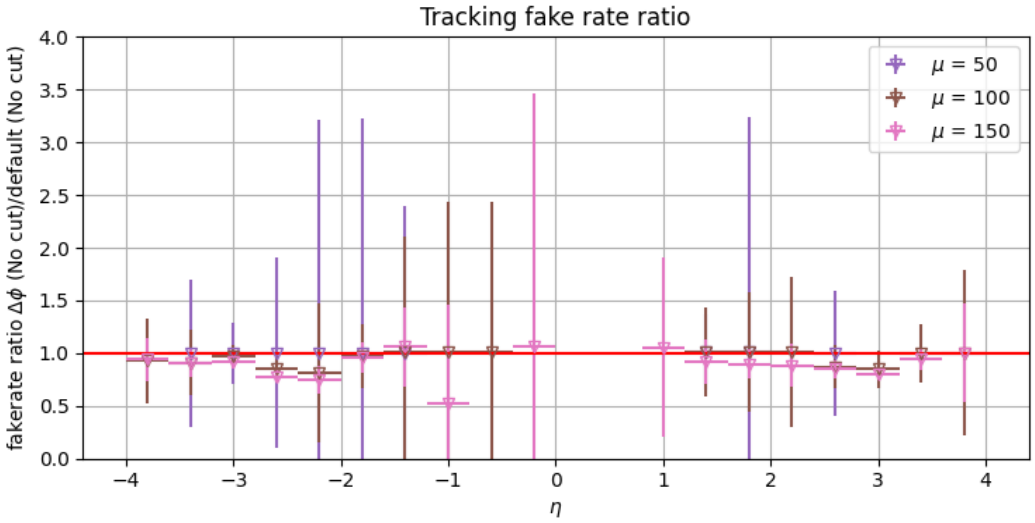
Ratio Hashing no cut vs Default no cut: efficiency

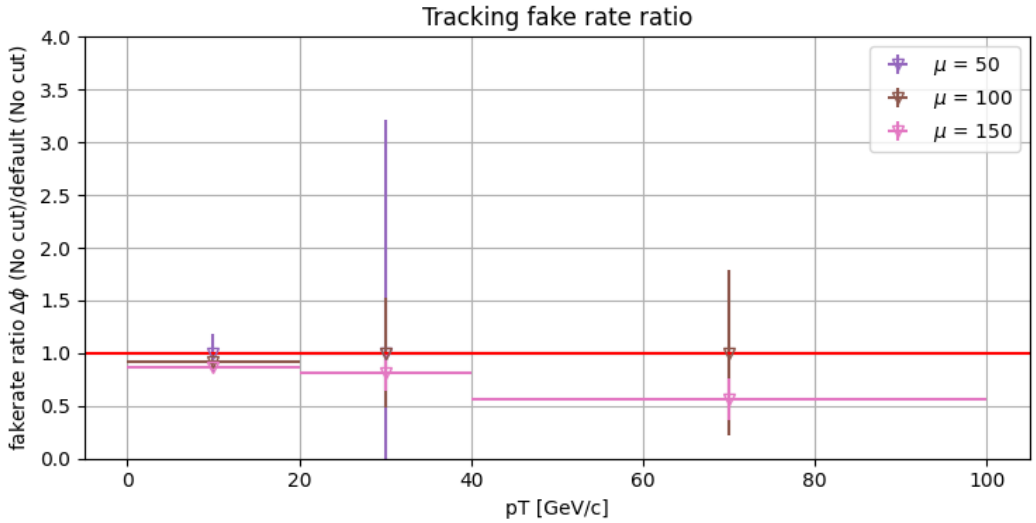




Same efficiency with and without hashing except in central region (low pT)

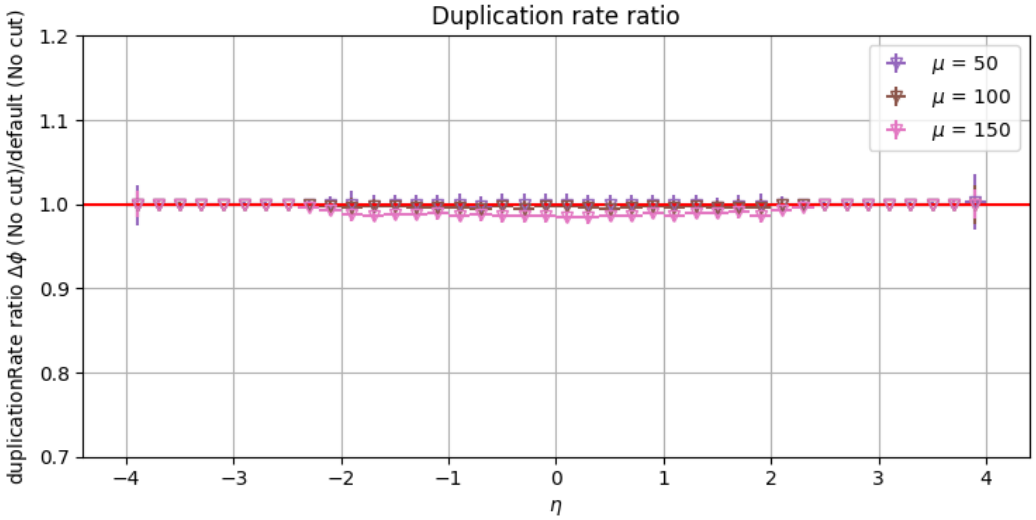
Ratio Hashing no cut vs Default no cut: fake rate

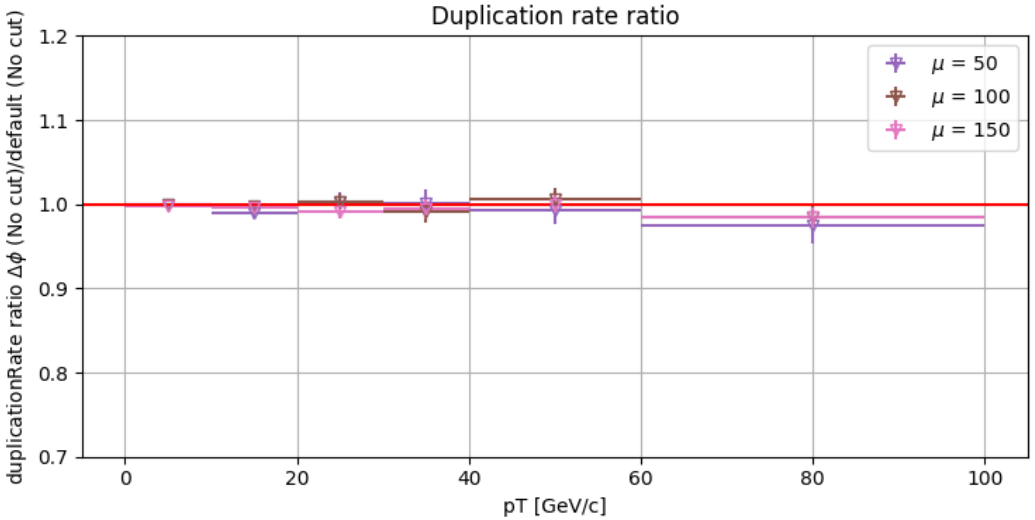




Similar fake rates

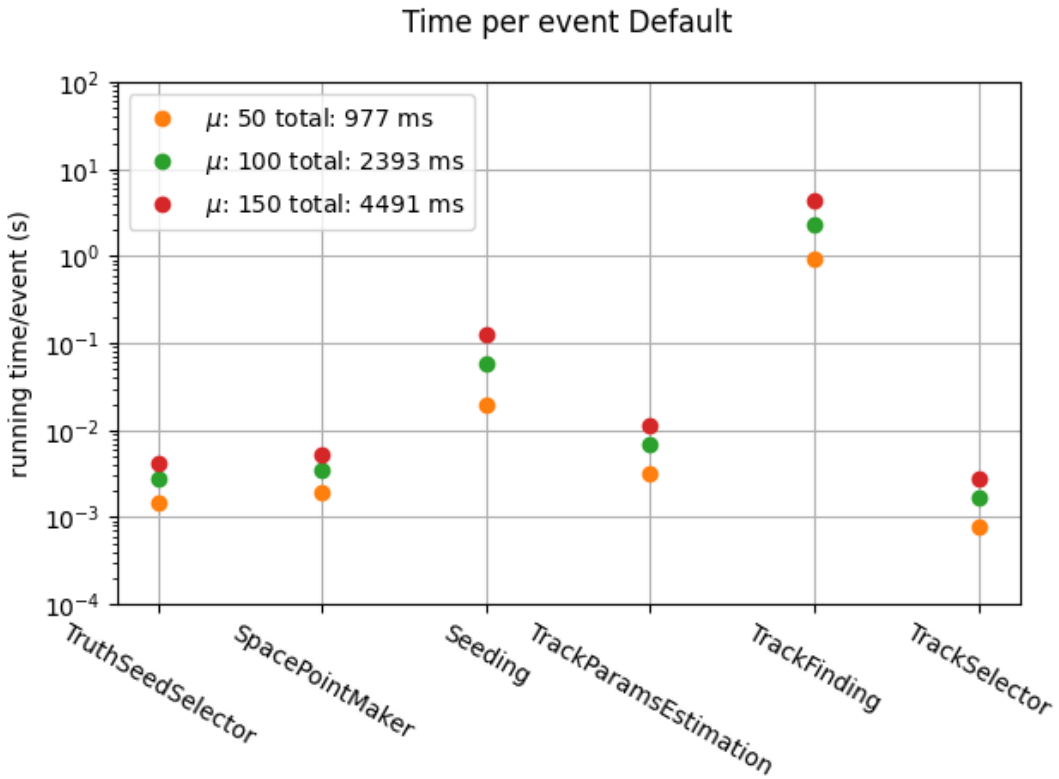
Ratio Hashing no cut vs Default no cut: duplicates

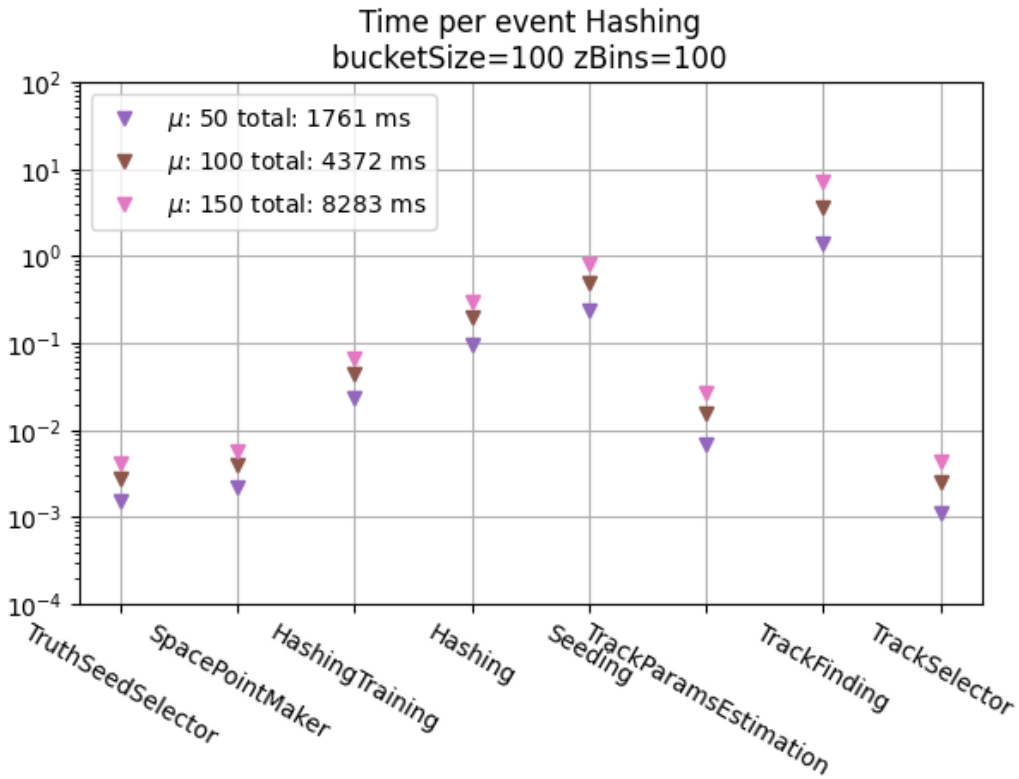




Same duplication rate except in central region

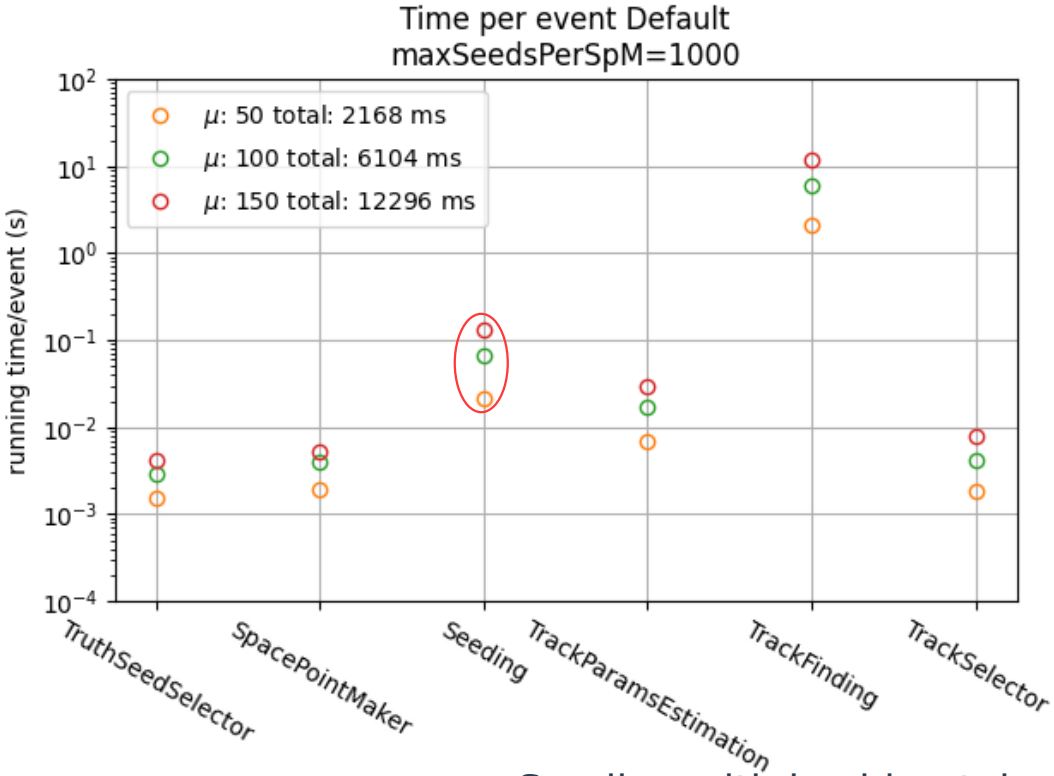
Running time cut

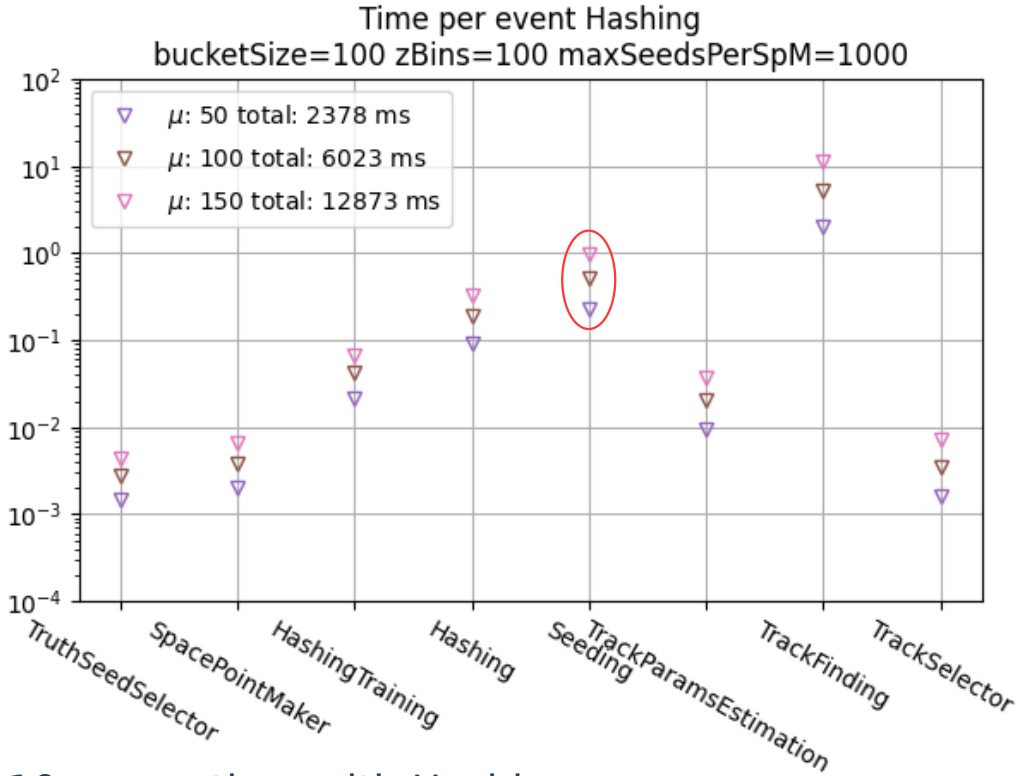




Seeding and TrackFinding take more time with Hashing

Running time no cut





Seeding with hashing takes 10x more time with Hashing
~ 900 ms for μ = 150

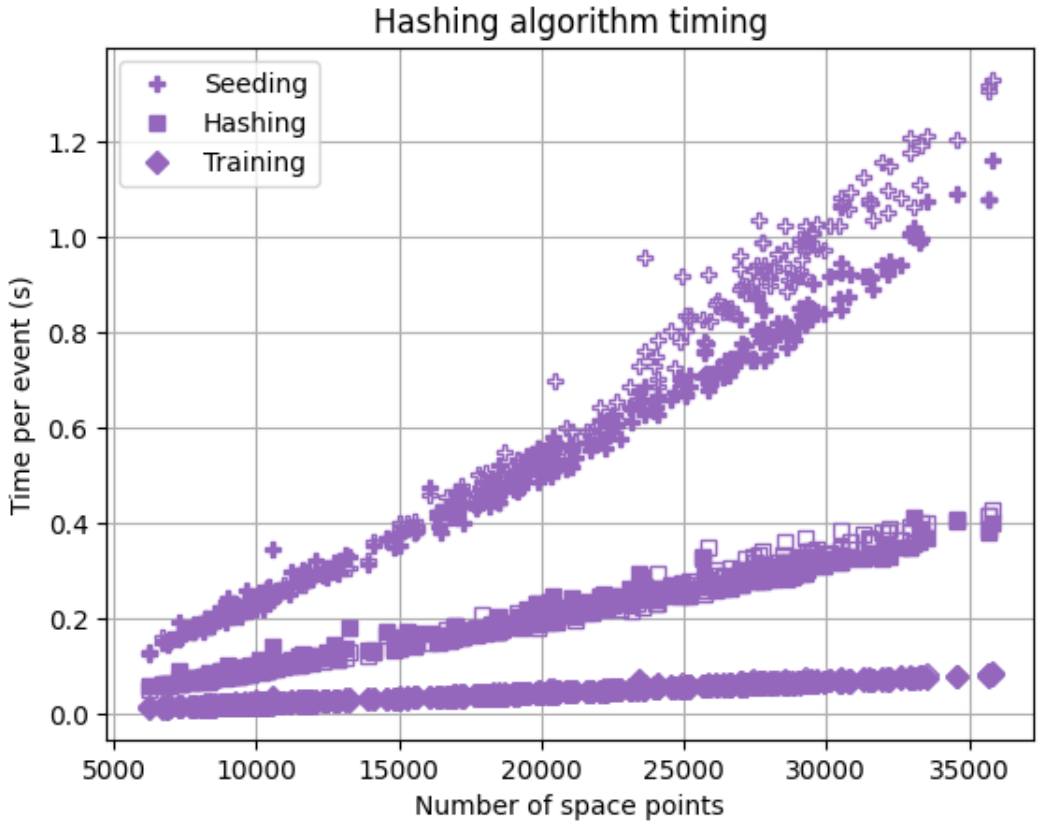
Timing of Hashing parts

100 z bins ; bucket size 100
Unfilled markers are without cut

From the plot:

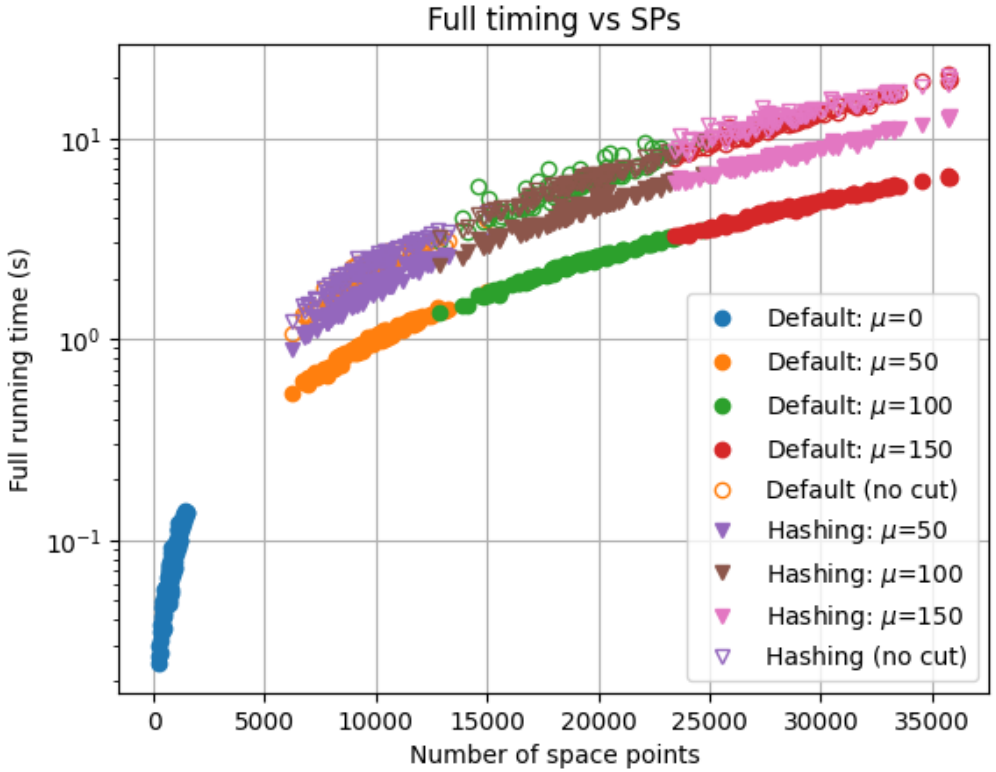
- Seeding > Hashing > Training
- Hashing ~ 4x Training
- Seeding no cut > Seeding cut
- Hashing no cut ~ Hashing cut
- Training no cut ~ Training cut

The last 3 points were expected



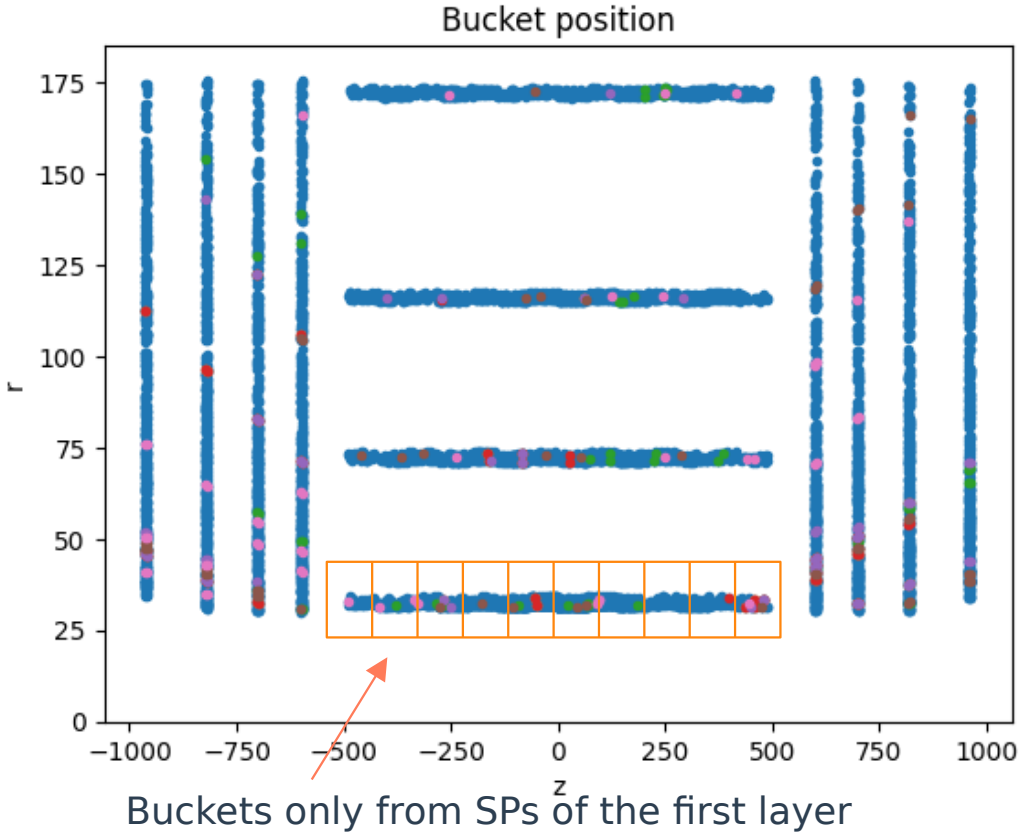
Timing vs number of space points

100 z bins ; bucket size 100



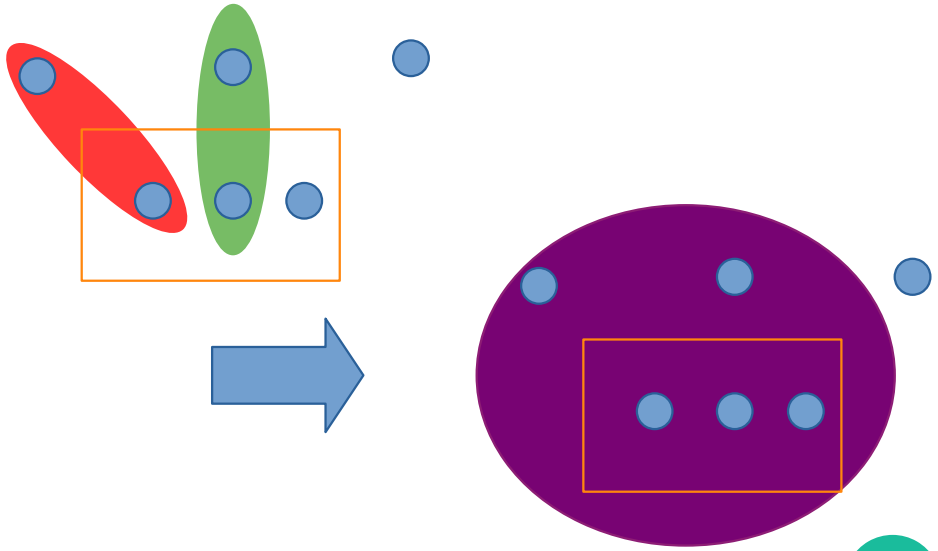
Running times without cut are similars for all μ

Super bucket (reminder)



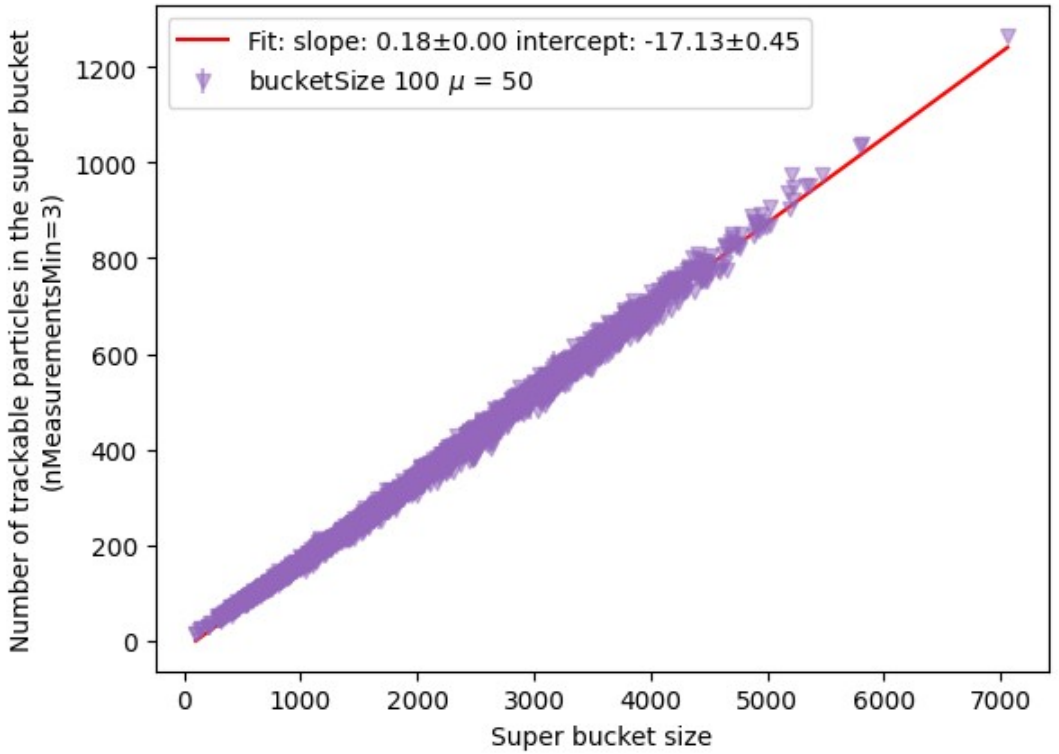
Buckets only from SPs of the first layer

Super bucket:
Merging of the buckets created from the space points inside the bin



Number of trackable particles in a bucket

100 z bins ; bucket size 100



The number of trackable particles is linear with the bucket size

Removing cut Conclusion

- **Without cut Hashing performances are similar to Default without cut**
  - No gain using hashing without the cut
- **Improving seeding running time is not enough**
  - Need to reduce the number of seeds for track finding

What’s next?

- Try a phi binning instead of a z binning in order to reduce overlaps between buckets
- ODD with ACTS version 24