Heavy Photon Search Level 3 Trigger Some Thoughts

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Outline

Level 3 Requirements

- The Silicon Vertex Tracker (SVT) data rates after the Level 1 trigger selection are expected to be
  - **Test Run :** $\approx$ 140 Mb/s
  - **Full Run :** $\approx$ 240 Mb/s
- In order to write the data to the tapes, the rates need to be reduced $<$ 100 Mb/s. However, a reduction by a factor of 8 ($\approx$ 18 Mb/s for the Test Run) is desired.
- The Level 3 software trigger requirements further include:
  - To perform FULL event reconstruction in a time frame of $\approx 30\mu s$
  - Maintain high tracking efficiency
  - Suppress events which aren't of much physics interest.
  - It seems likely some sort of EVIO to LCIO conversion will need occur within Level 3

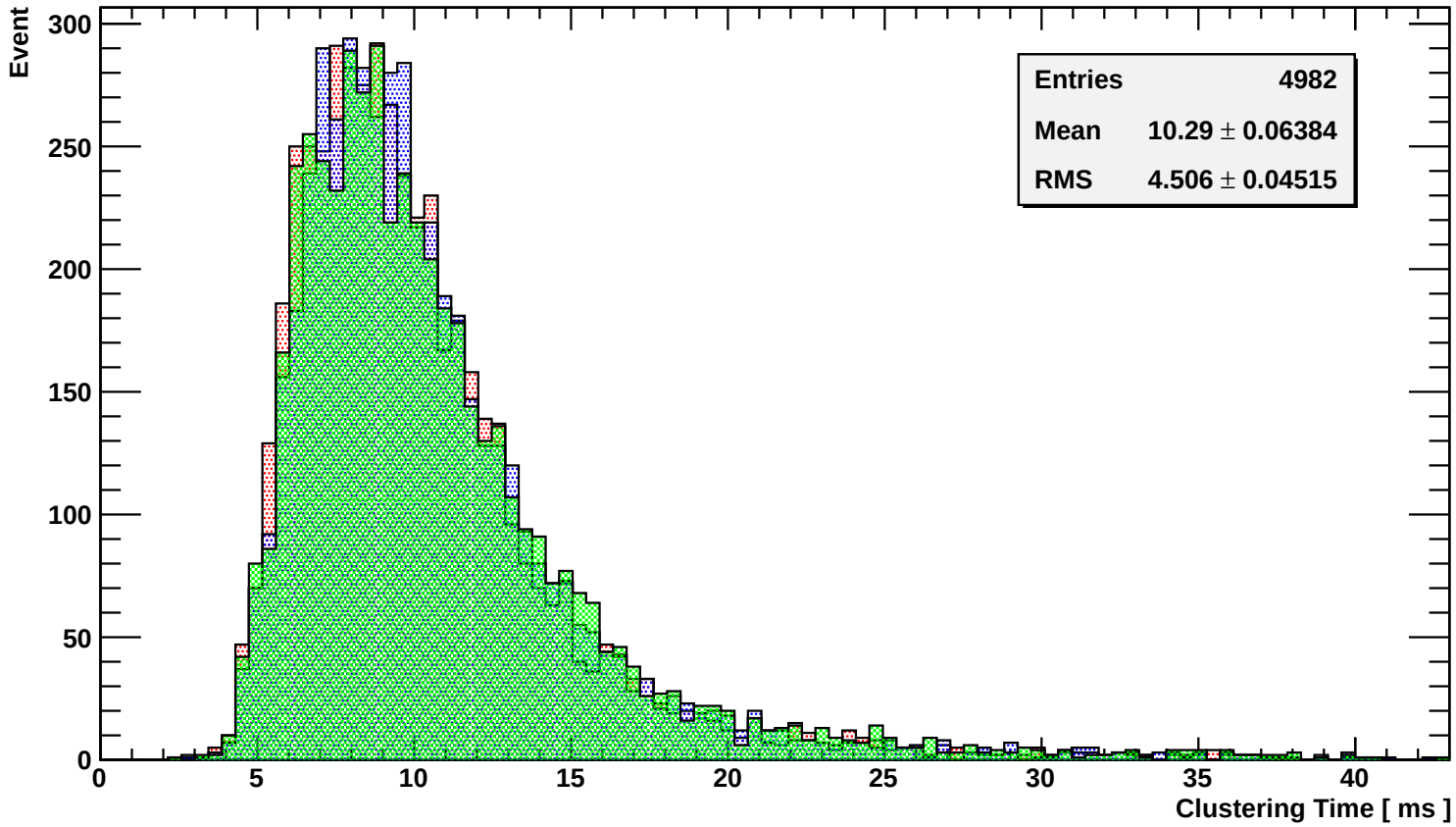
So how do you approach the problem?

- Currently, SVT layers 3, 5 and 7 are used to create seed tracks (In-to-Out tracking). The speed and tracking efficiency of this tracking strategy needs to be compared to other approaches e.g. creating seeds with layers 5, 7 and 9 (Out-to-In tracking).
- Tracking algorithm has been optimized to achieve the highest tracking efficiency possible. Not for speed!
- Look into eliminating tracks which fall outside of the acceptance of ECal.
- The current tracking algorithm is calculating the multiple scattering contribution for every individual hit. Using a pre-calculated average value may increase the algorithms speed.
- ...

Benchmarking the tracking algorithm

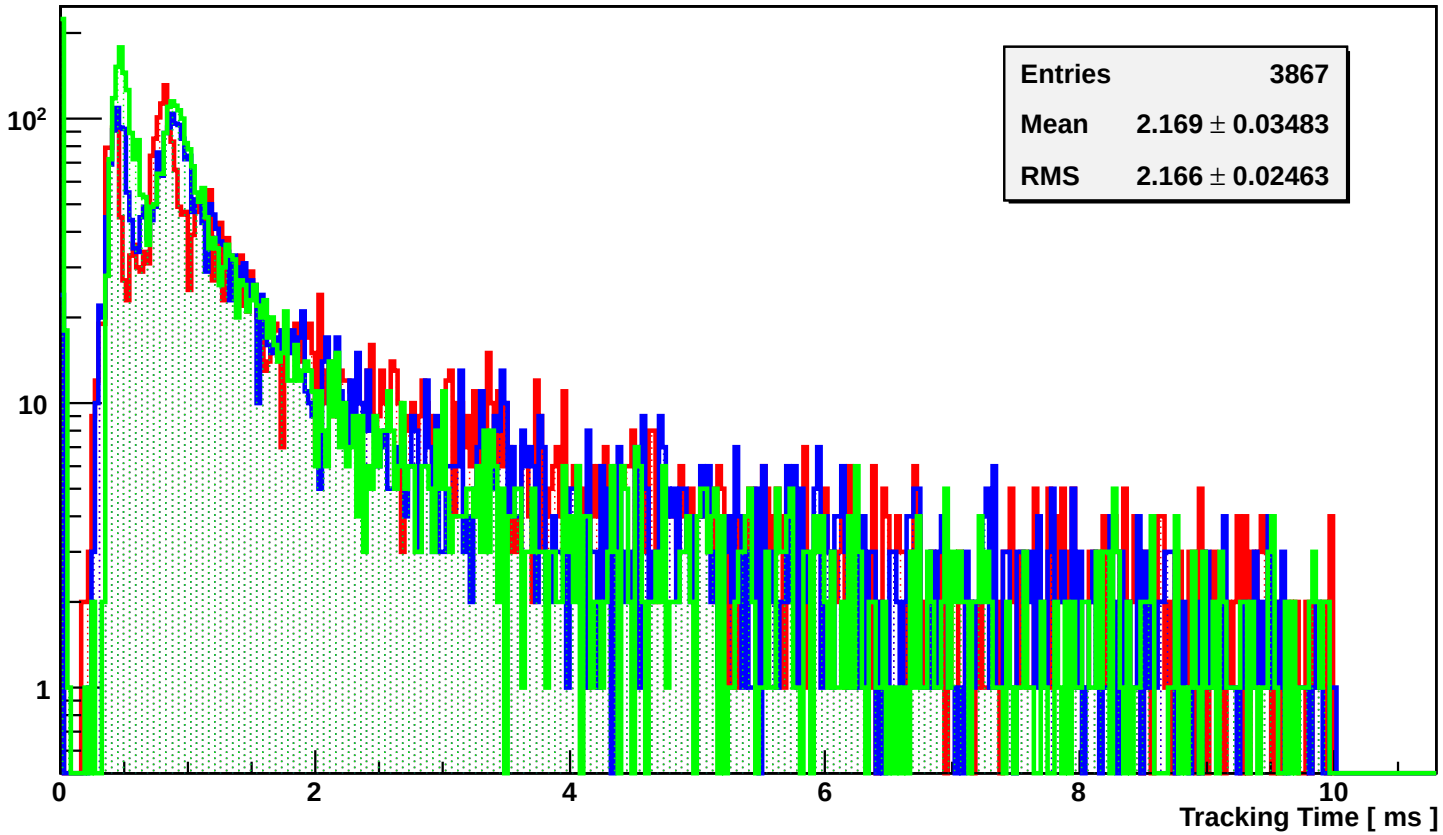
- Benchmarking was done using three different tracking strategies
  - Seed with Layers 1, 3 and 5 and confirm with Layer 7
  - Seed with Layers 5, 7 and 9 and confirm with Layer 3
  - Seed with Layers 3, 5 and 7 and confirm with Layer 1
- Cuts are imposed on some of the track kinematic variables.
- All generated plots were generated using a dataset with a beam energy of 2.2 GeV, beam current of 200 nA, beam size of $20\mu m$ by $200\mu m$.
- All benchmarking runs were done with a ThinkPad T510, with an Intel i5 processor, 4 GB's of RAM ... It would be better to benchmark either on the SLAC or JLab farm systems.
- Benchmarking of the clustering and the tracking algorithm have have been done.

Clustering Time

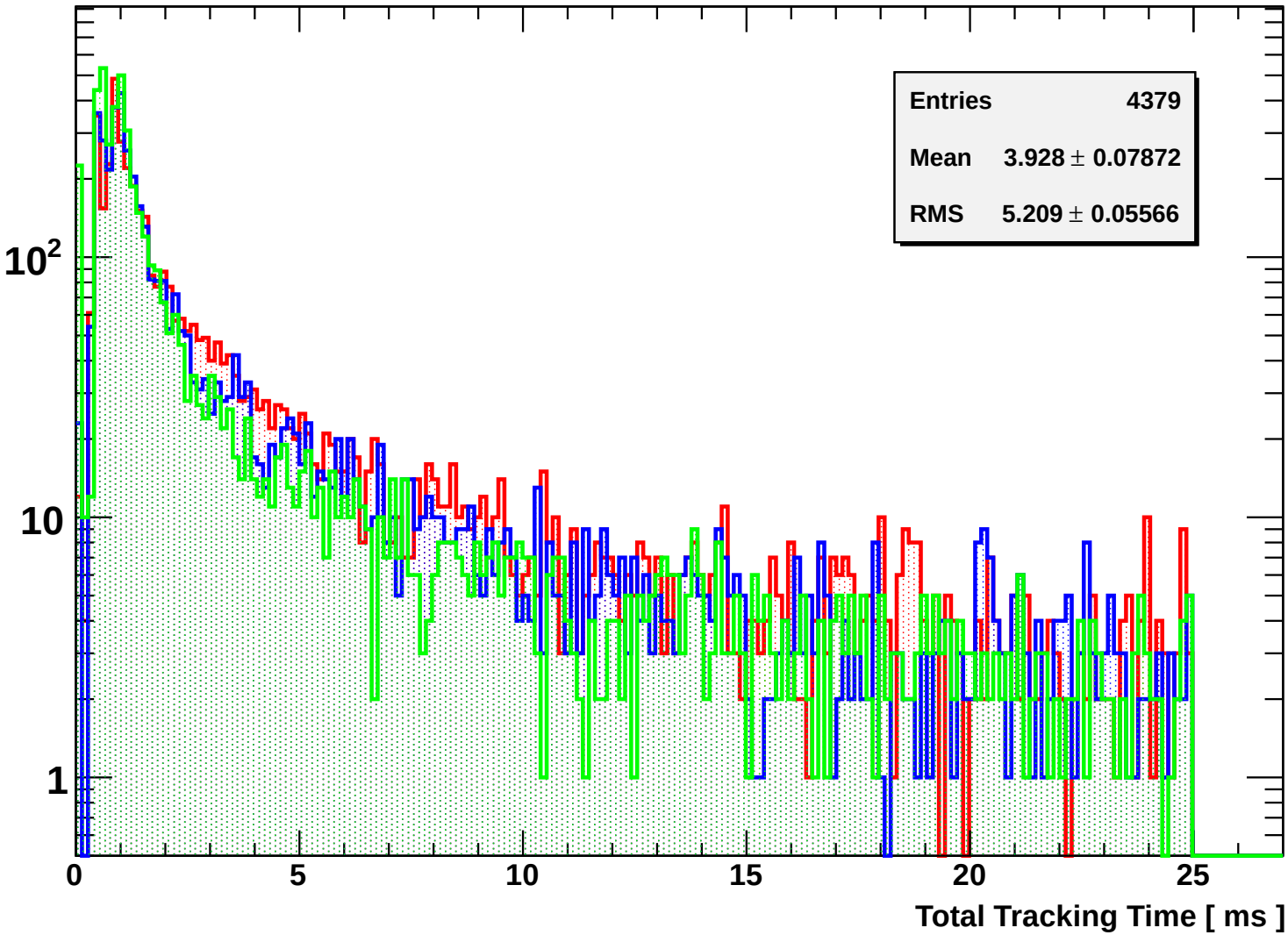


- Clustering time seems to be independent of the seeding layers

Tracking Time



Total Tracking Time

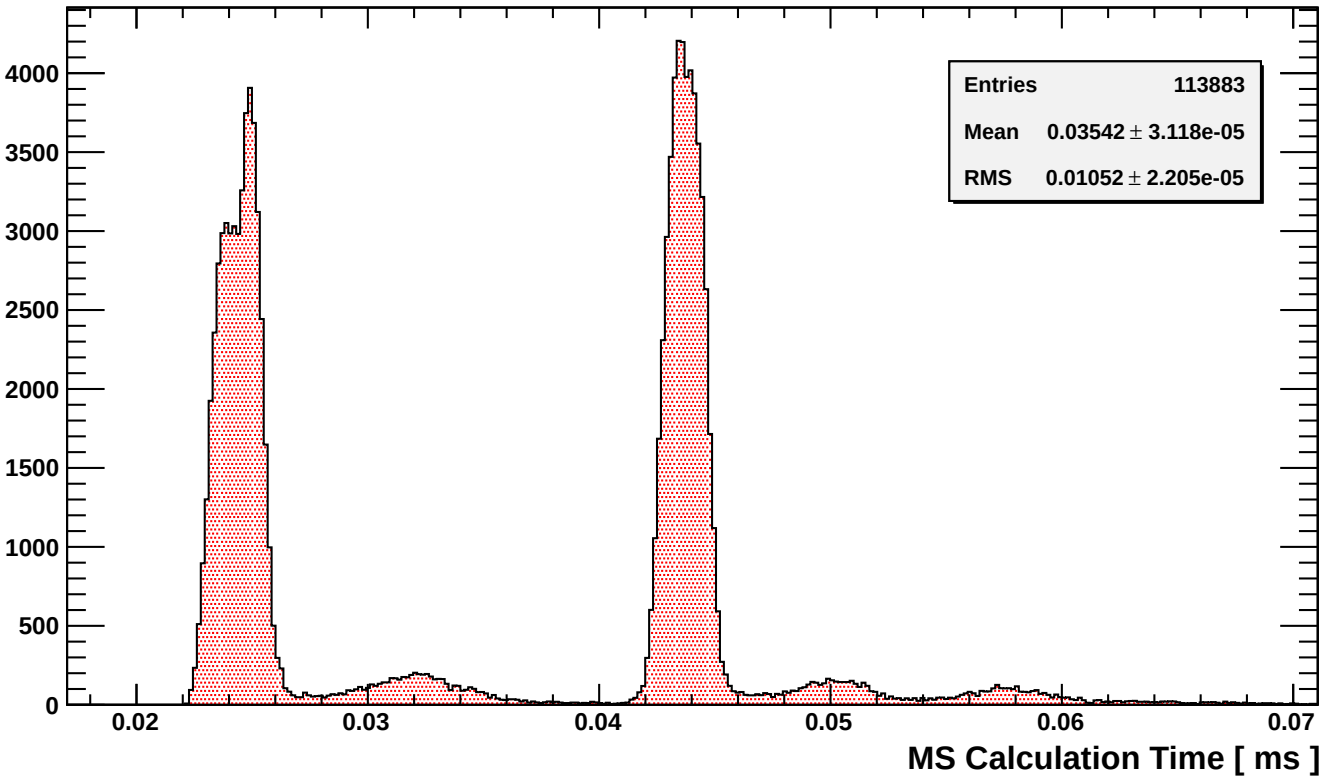


So what about the tracking efficiencies?

Seeding	Tracking Efficiency	Sample
1, 3, 5	97.4 %	sig. and bkg
5, 7, 9	76.5 %	sig. and bkg
3, 5, 7	91.0 %	sig. and bkg
5, 7, 9	82.9 %	pure

- It is necessary to try to understand why the tracking efficiency drops so much when using the out-in tracking strategy. It seems to be an issue independent of momentum.

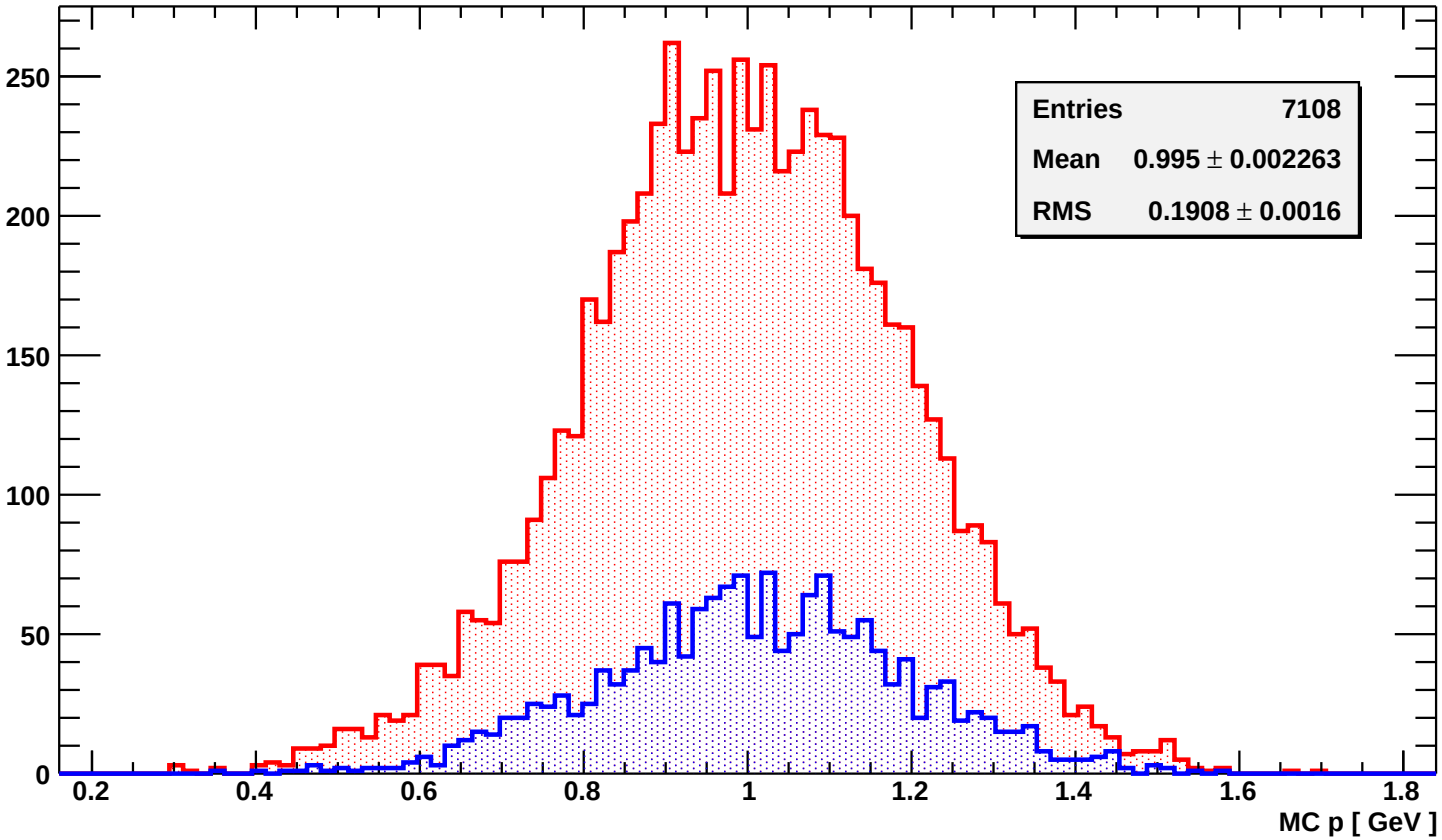
Multiple Scattering



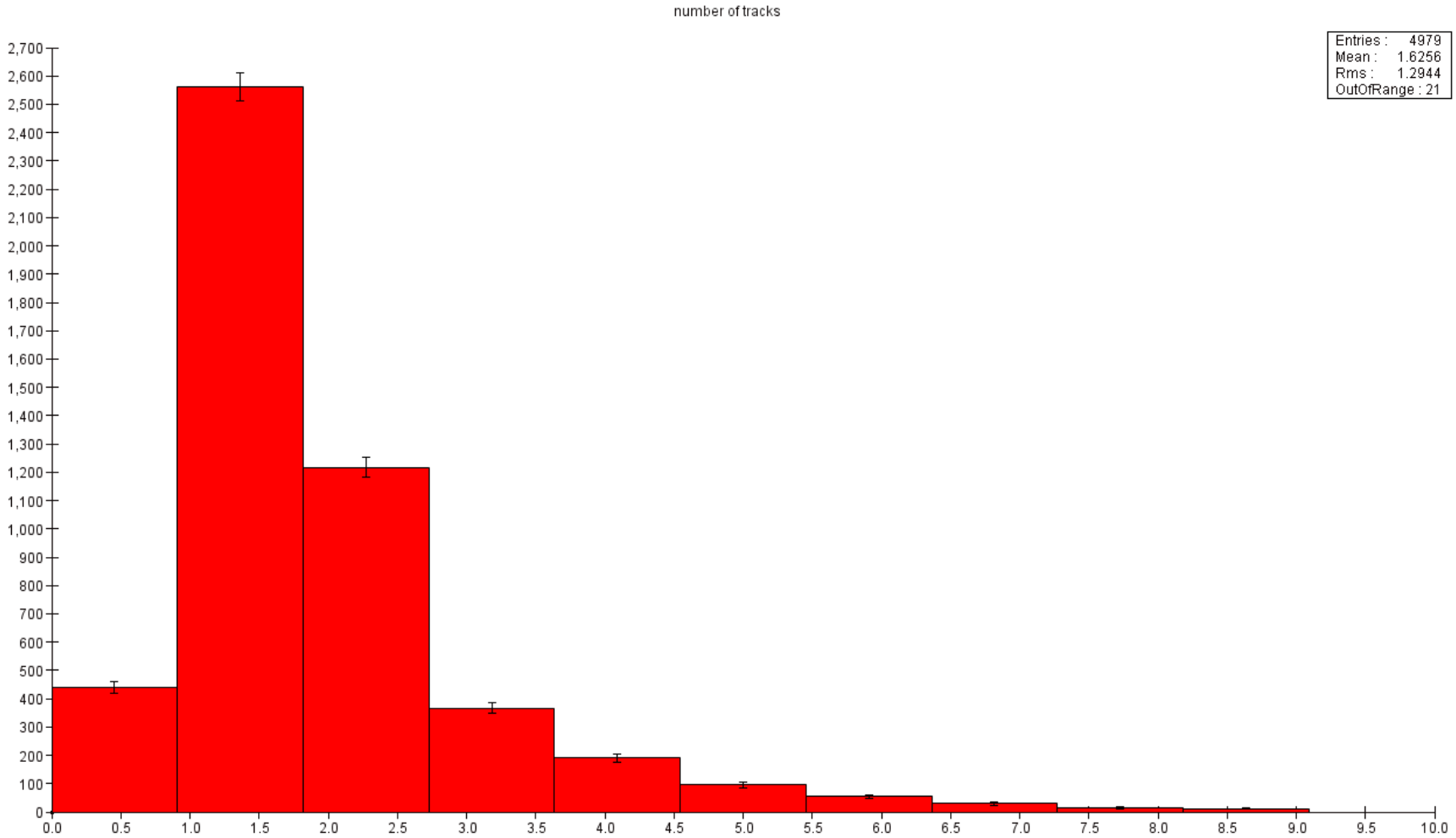
Conclusions

- A more detailed benchmark is required to find what aspects of the tracking algorithm need optimization. Especially the clustering algorithm.
- Further analysis is required to understand why the efficiencies change greatly between strategies.
- The time required to calculate the MS scattering contribution seems negligible at this point when compared to the Clustering time.
- The Biggest problem seems to be at the clustering level. Possibly make use of look-up tables to handle clustering.
- The Level 3 trigger is meant to be an event filter, so eventually a detailed understanding of background signatures will be required.
- There are obviously several other things that need to be done and suggestions are welcomed!

Backup


Entries 7108
Mean 0.995 ± 0.002263
RMS 0.1908 ± 0.0016
250
200
150
100
50
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
MC p [GeV]

Backup


number of tracks
Entries : 4979
Mean : 1.6256
Rms : 1.2944
OutOfRange : 21
2,700
2,600
2,500
2,400
2,300
2,200
2,100
2,000
1,900
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0