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# TIMING OF HITS ON TRACK

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# HIT TIME TRACK CHECK

- Question from Rafo: what timing cut is currently applied to SVT hits when making tracks?
- HitTimeTrackCheck object invoked by SeedTracker at each stage (triplet, confirm, extend)
  - Calculates RMS of timing distribution of all 3D hits in rmsTimeCut parameter settable via steering file
  - All standard steering files have rmsTimeCut = 8 [ns]
- This code has been there since ~forever (Matt G)

<https://github.com/JeffersonLab/hps-java/blob/master/tracking/src/main/java/org/hps/recon/tracking/HitTimeTrackCheck.java>

```
int nStrips = 0;
double meanTime = 0;
for (TrackerHit hit : track.getTrackerHits()) {
    for (HelicalTrackStrip hts : ((HelicalTrackCross) hit).getStrips()) {
        nStrips++;
        meanTime += hts.time();
    }
}
meanTime /= nStrips;
double rmsTime = 0;
for (TrackerHit hit : track.getTrackerHits()) {
    for (HelicalTrackStrip hts : ((HelicalTrackCross) hit).getStrips()) {
        rmsTime += Math.pow(hts.time() - meanTime, 2);
    }
}
rmsTime = Math.sqrt(rmsTime / nStrips);

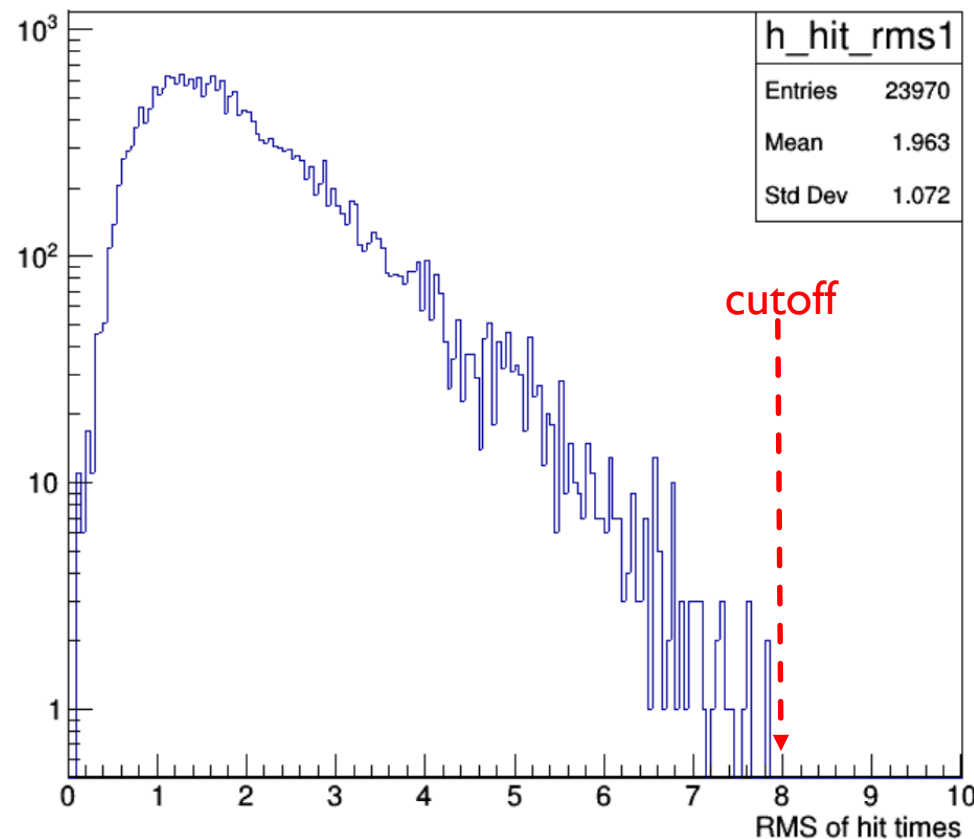
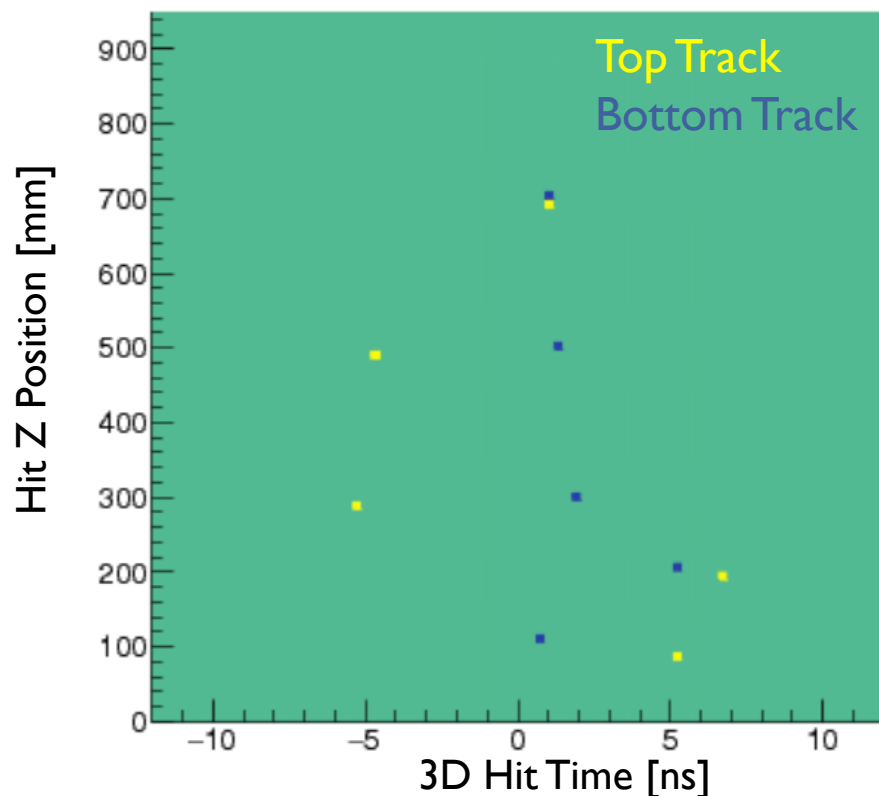
boolean passCheck = (rmsTime < rmsTimeCut);
```

# HIT TIME TRACK CHECK

- Plot from Rafo verifies HitTimeTrackCheck is working as designed
- But do we actually want to be cutting on RMS?
  - If so, at 8ns?

Old timing studies for  
T/B asymmetry:

<https://confluence.slac.stanford.edu/download/attachments/236497701/asym%20cluster%20timing.pdf?version=1&modificationDate=1529394053000&api=v2>



# SOFTWARE OPTIONS

- Modify HitTimeTrackCheck code
- Add hit-timing cut into MOUSE
  - For MatchedTrack, or GBLTrack, or ReconstructedParticle
  - Track-cluster  $\Delta t$  cut already implemented for ReconstructedParticle
- Add timing into track  $\chi^2$  calculation
  - Error on time of raw hit on a single channel is currently calculated correctly
  - But in hit clustering, timing and errors currently not treated correctly
- Tim's suggested plan:
  - Require all hits to fall within some timing window (maybe 8 ns, but maybe 12)
  - Fix the cluster timing & errors calculations, and study effects on track-cluster  $\Delta t$  distributions
  - Including timing in track  $\chi^2$  and study the effects