Track reconstruction efficiency in forward region

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http://www-d0.fnal.gov/~rakitin/d0_private/tex/2007.Apr.05.Calgo/tr.pdf

Outline

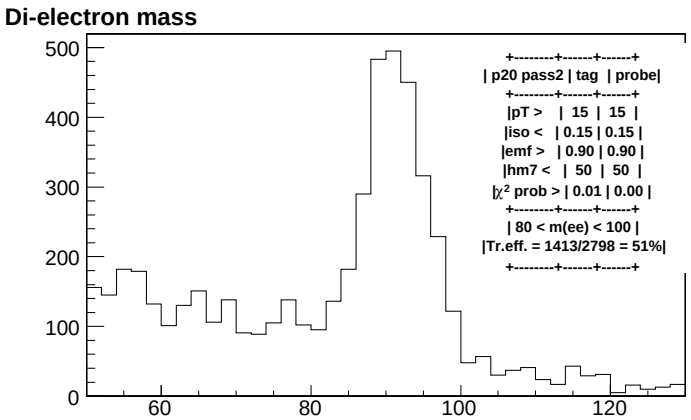
I am working on improvement of AA tracking algorithm in forward region.

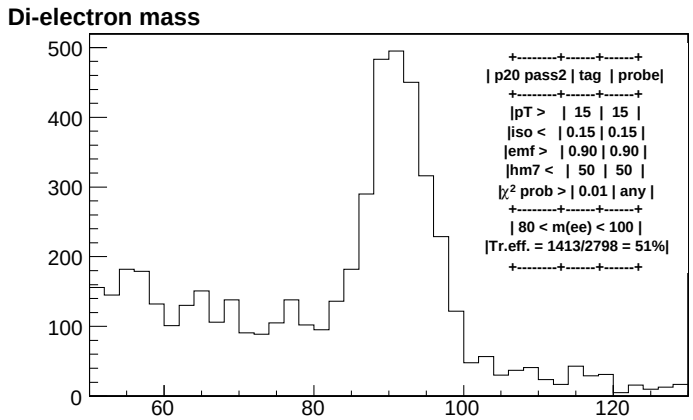
- Current AA tracking algorithm:
  - Selects 3 two-dimensional SMT hits
  - Makes track hypothesis out of them
  - Adds other hits within 3σ around the track hypothesis to it
  - Refits track hypothesis including new hits and completes the track
- Sometimes AA misses tracks in forward region ($2 < |\eta| < 3$) due to lack of SMT hits:
  - 1) Check dependence of tracking efficiency on η in data and MC
  - 2) Change AA algorithm to reconstruct more tracks in forward region (data and MC)
- Use $Z \rightarrow e^+e^-$ sample (p20 2EMhighpt data, 6K events):
  - One electron in central calorimeter $|\eta| < 1$ - “tag”
  - Another electron in forward region $|\eta| > 1$ - “probe”
  - Probe electron has track in 50-60% of cases - current tracking efficiency in region $|\eta| > 1$
  - Old (p17) similar data sample (©Jan Stark) yields 66% tracking efficiency in this region
- Use p20 Monte Carlo γZ (+jets) $\rightarrow ee$ (+jets)
  - MC requests 40815 (100K events) and 40727 (200K events)
  - Same “tag and probe” method
  - Tracking efficiency in region $|\eta| > 1$ is 80-87%

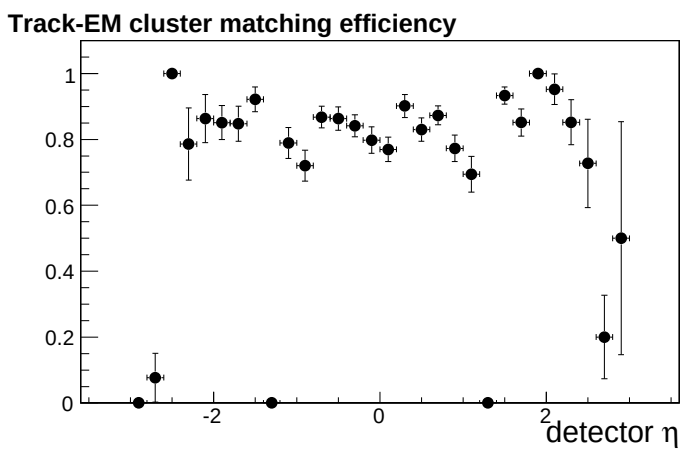
Outline

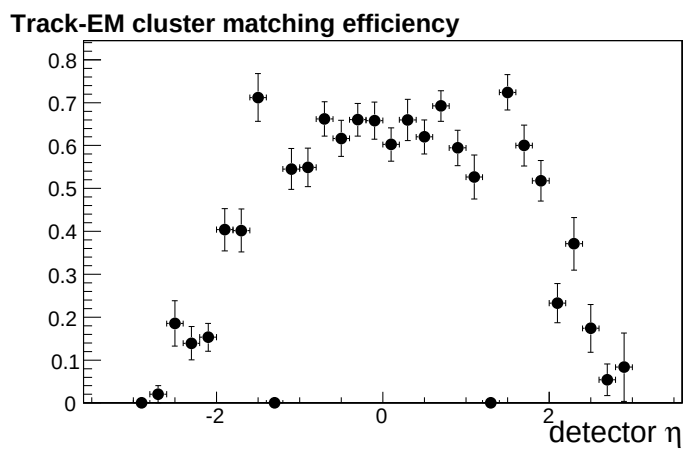
p20 2EMhighpt data, pass2

Mass histogram and track matching effi ciency vs. detector η:



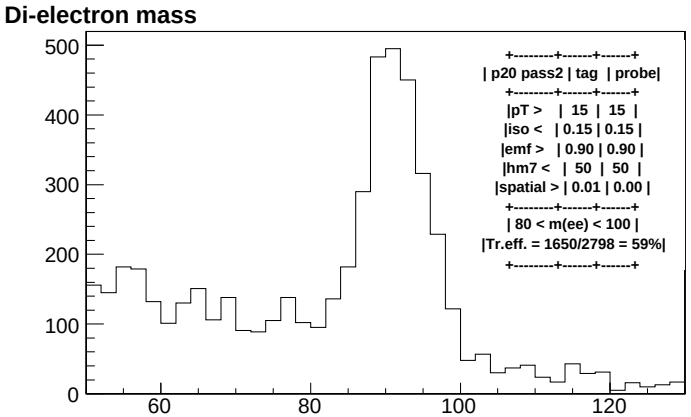


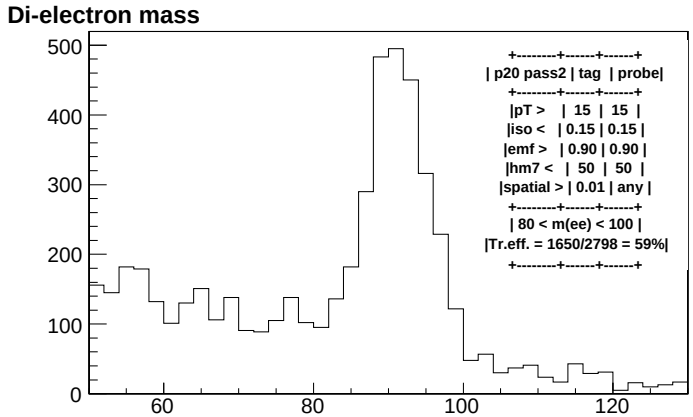


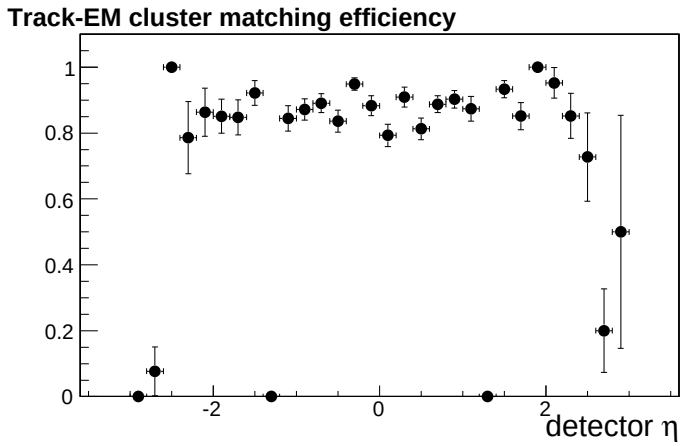


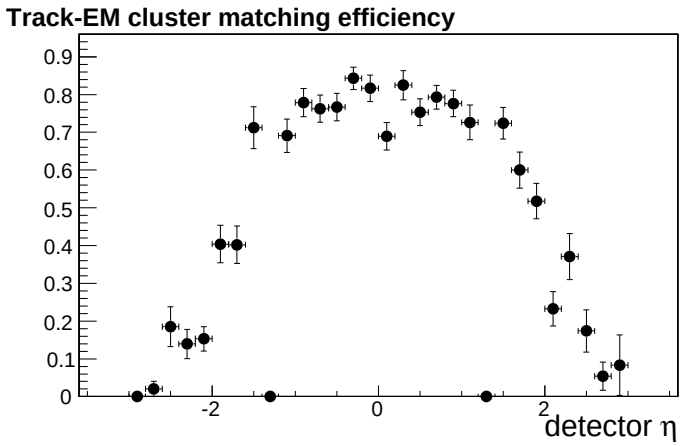
- Probe “has track” if chi2prob> 0.01
- χ^2 includes E/p
- Difference due to tracks with chi2prob = -1 (no track in $|\Delta\phi| < 0.5$)

p20 2EMhighpt data, pass2



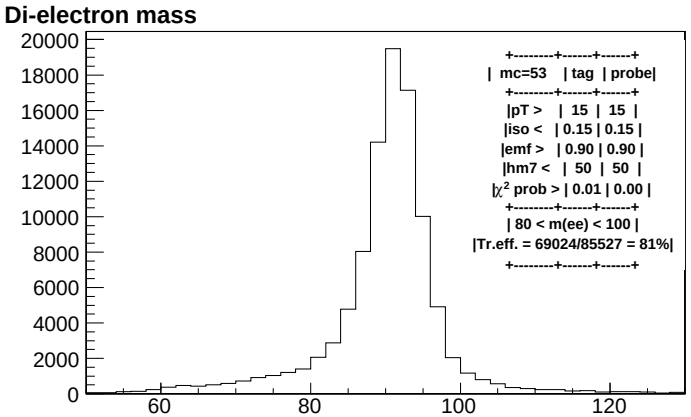


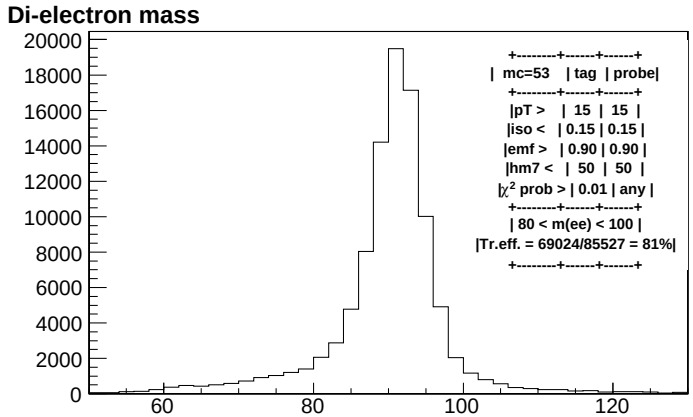


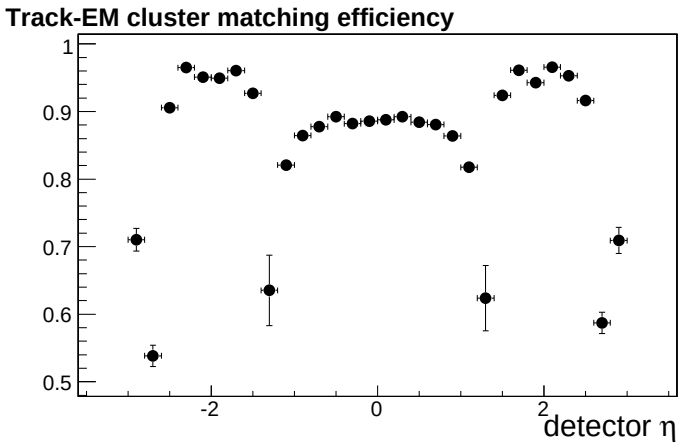


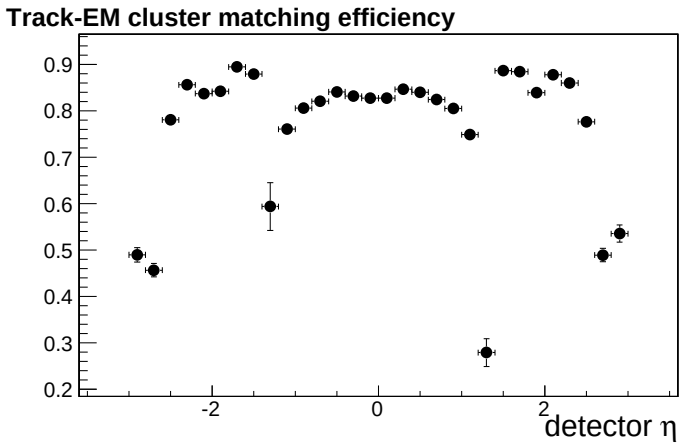
- Probe “has track” if spatial_chi2prob> 0.01
- χ^2 does not include E/p (spatial only)
- Again, difference due to tracks with spatial_chi2prob = -1 (no track in $|\Delta\phi| < 0.5$)

Monte Carlo



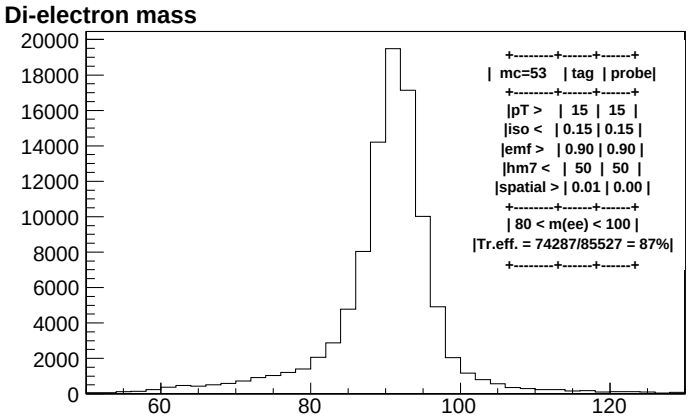


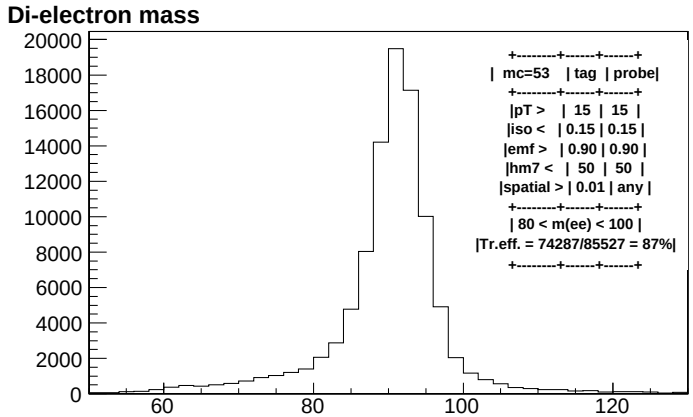


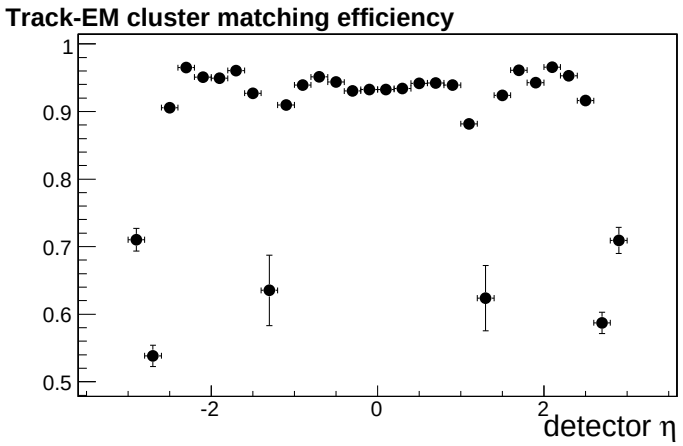


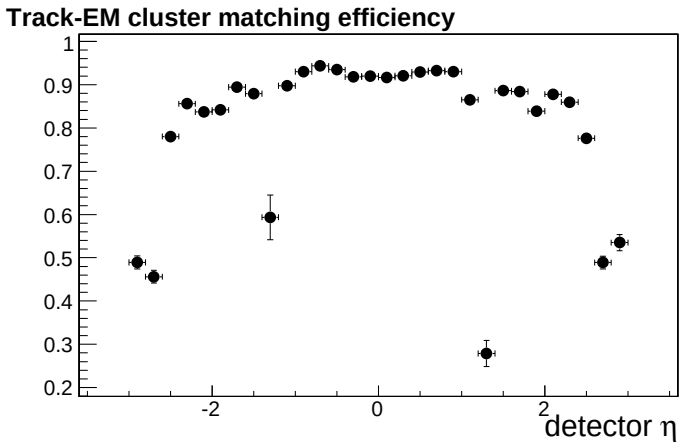
- Probe “has track” if chi2prob> 0.01
- χ^2 includes E/p
- Difference due to tracks with chi2prob = -1 is not so significant as for data

Monte Carlo



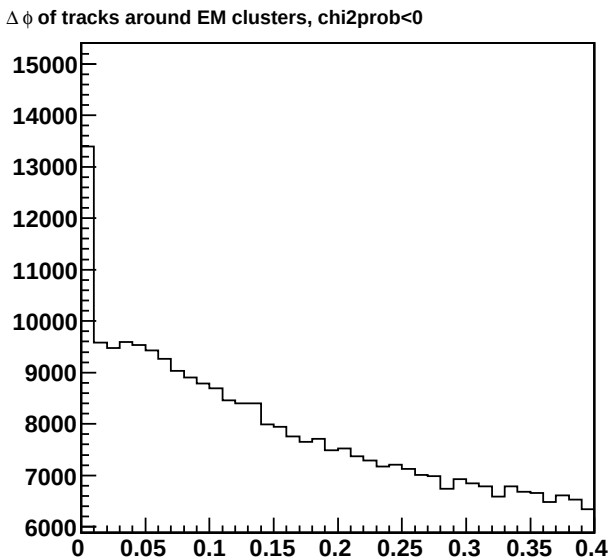


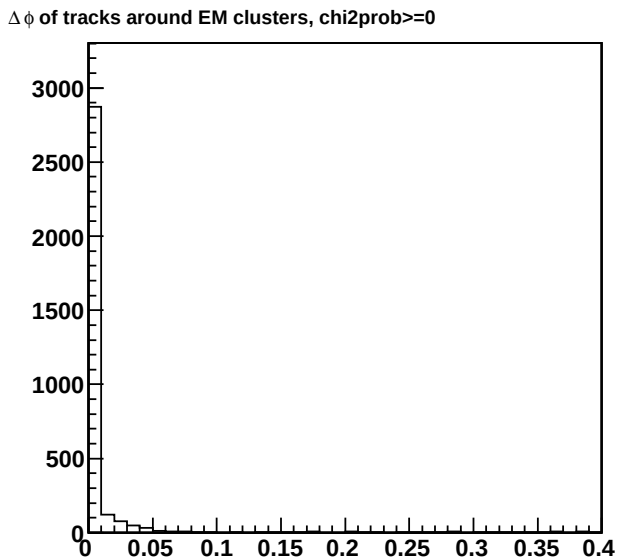


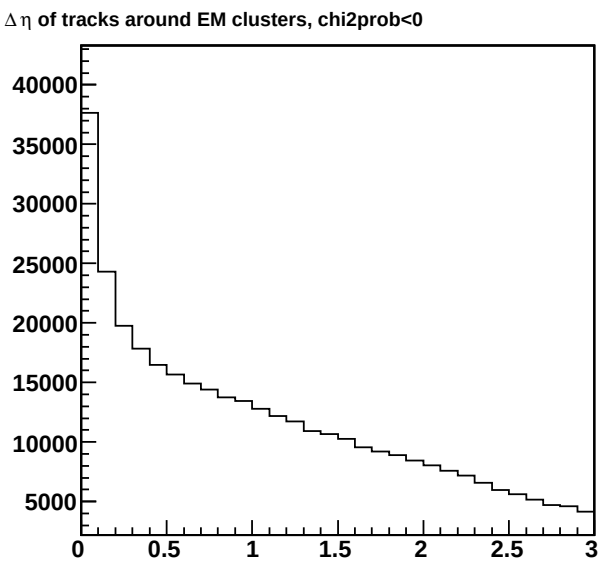


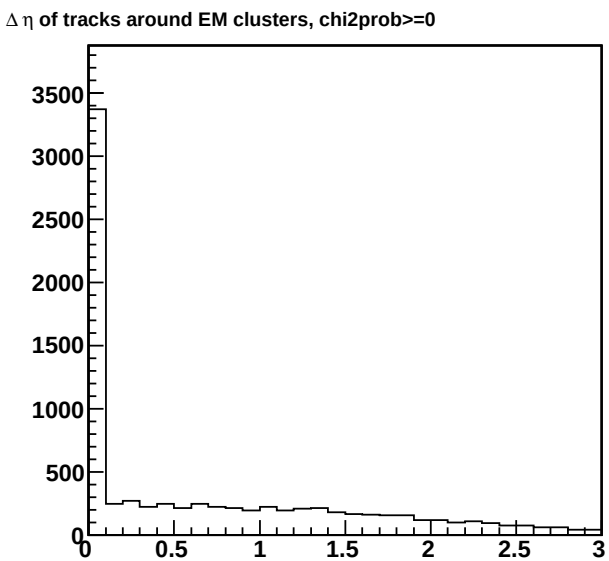
- Probe “has track” if spatial_chi2prob> 0.01
- χ^2 does not include E/p (spatial only)
- Difference due to tracks with chi2prob = -1 is small again

$\Delta\phi$ and $\Delta\eta$ for tracks with chi2prob=-1

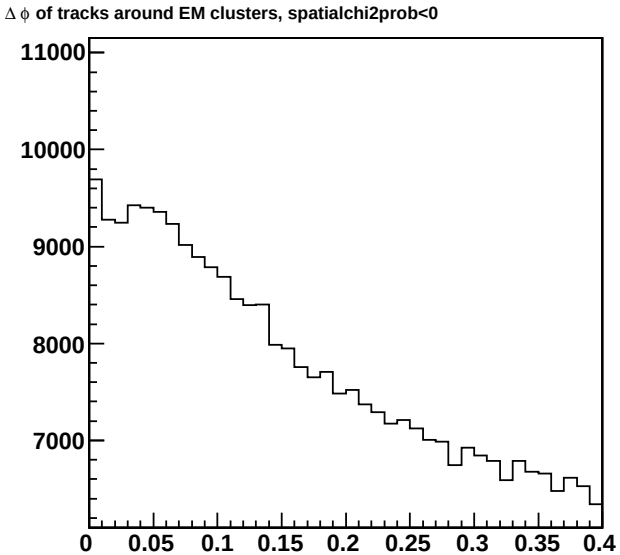


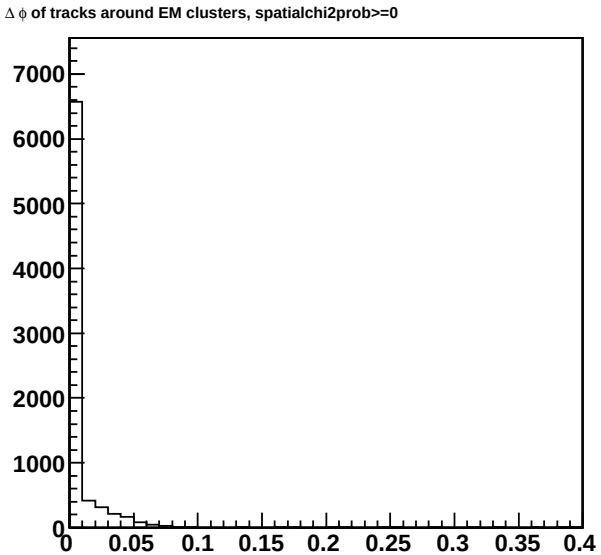


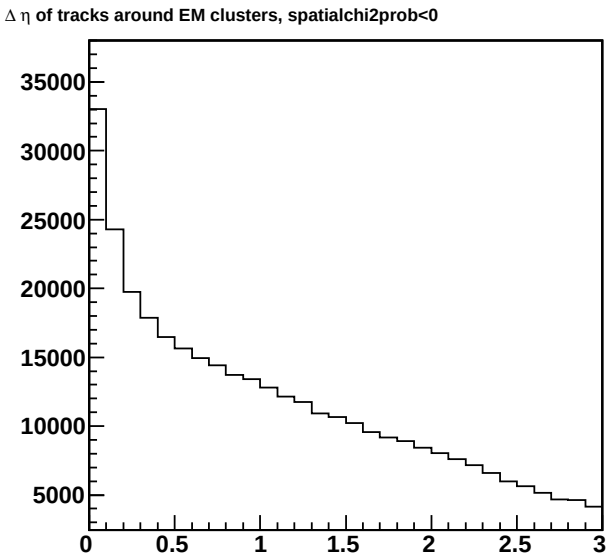


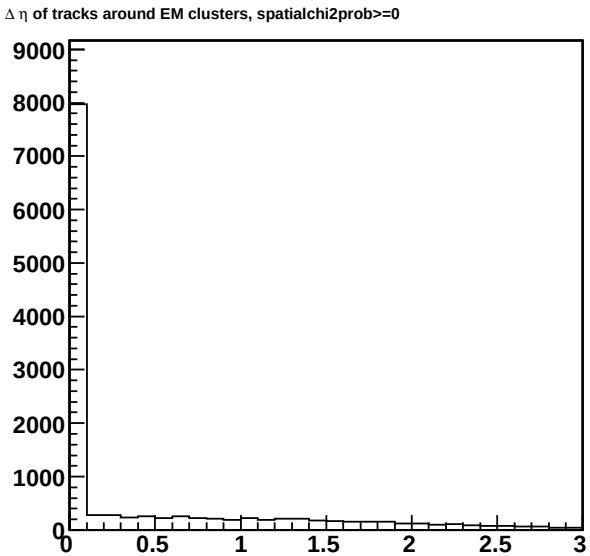


$\Delta\phi$ and $\Delta\eta$ for tracks with spatial_chi2prob=-1

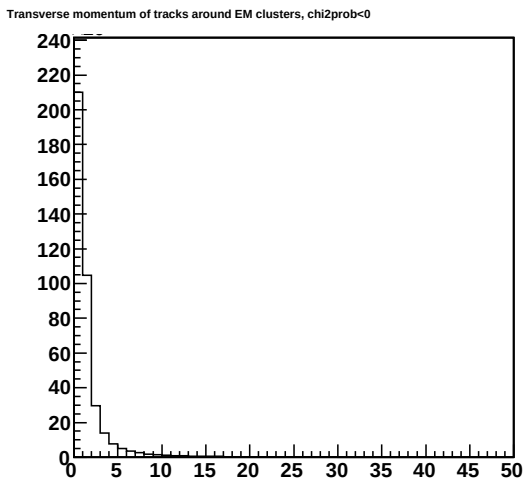


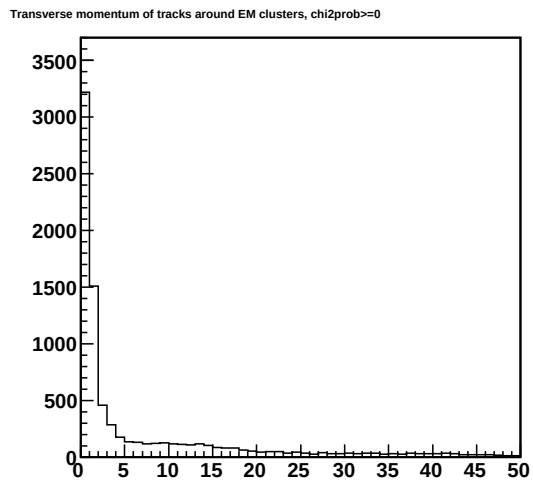


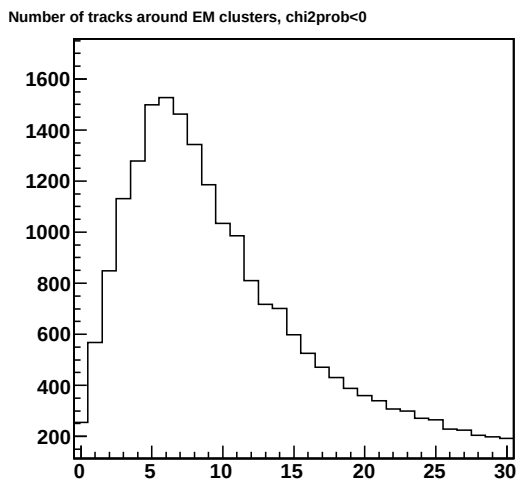


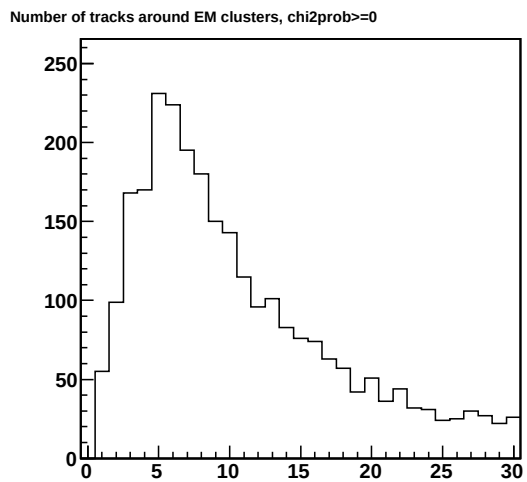


p_t spectrum and number of tracks







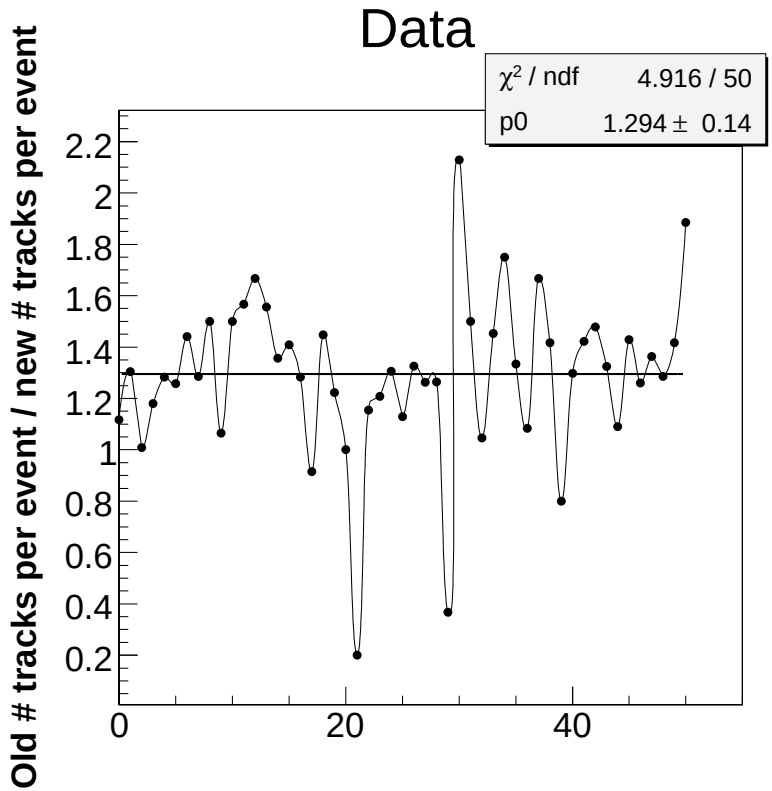


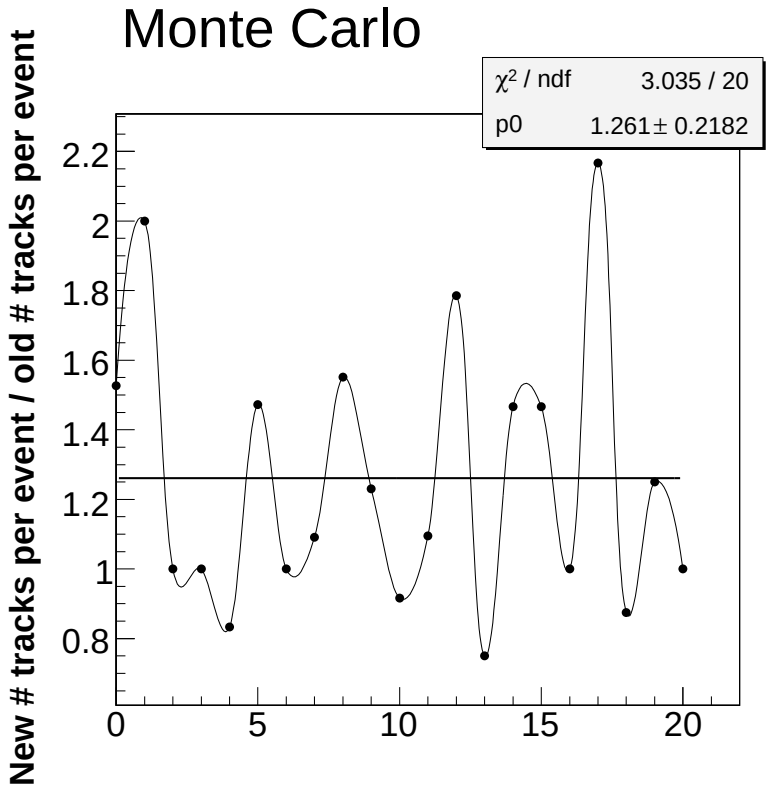
No peak at zero....

Changes to AA algorithm

- Current AA algorithm starts with selecting 3 hits in SMT barrels or 3 hits in disks
- There is significant number (34%) of tracks with 2 hits in barrels and 1 in disks (or vice-versa)
- By allowing three hits anywhere we can reconstruct some (not all) of these tracks: ~ 20% (remaining 14% left unreconstructed)
- Numbers above are based on small subsample of 47 events (to be increased)
- BUT:
  - The number of tracks per event is increased (fake rate study needed)
  - The timing per event is also increased

Number of tracks per event

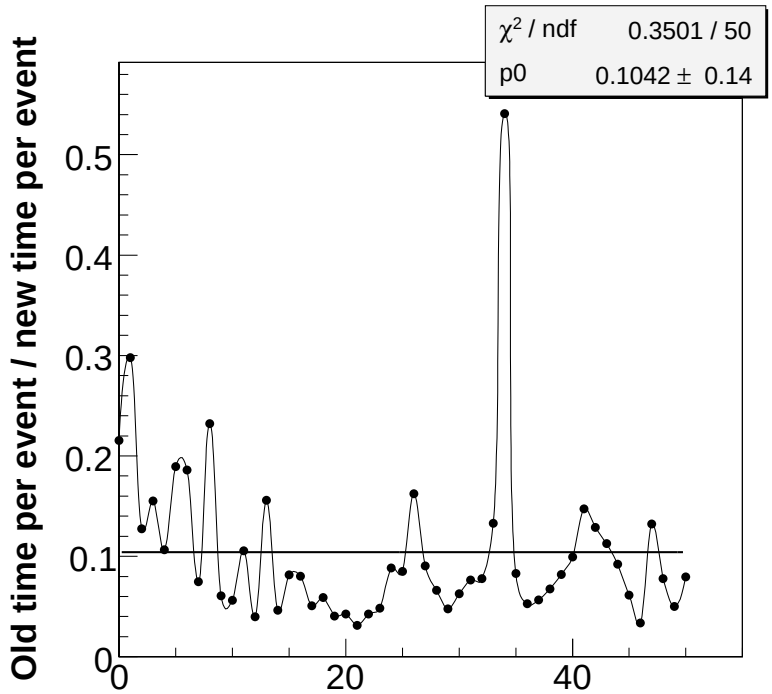




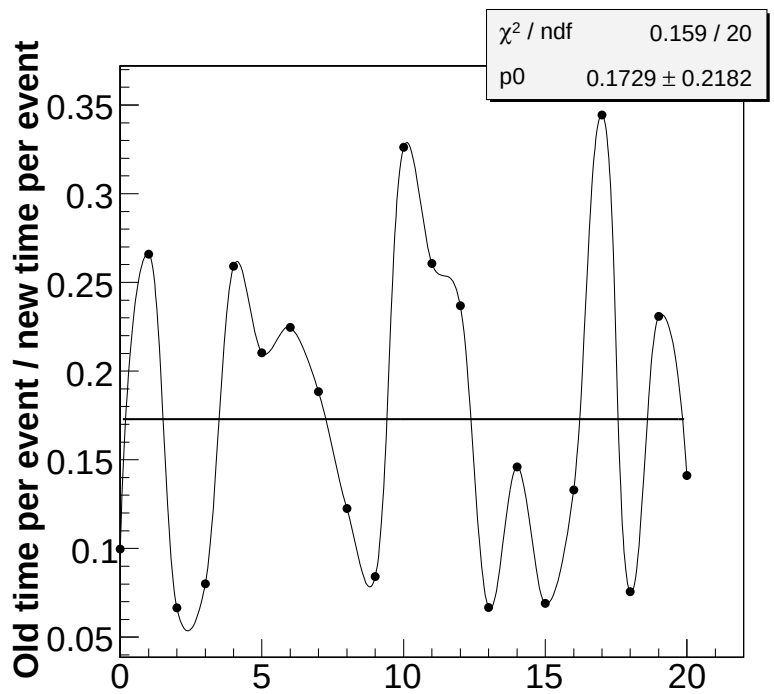
- Average ~30% increase in the number of tracks in both data and MC

Timing per event

Data



Monte Carlo



- Average ~10 times increase in timing in data and ~5 times in MC
- Difference is to be understood

Conclusion:

- Study AA tracking in region $|\eta| > 1$ in p20 data and MC samples $Z \to e^+e^-$
- Tracking effi ciency in this region is 50-60% for data and 80-87% for MC
  - ☞ Difference is to be understood
- Shape of tracking effi ciency vs. η is different due to tracks with $\chi^2 = -1$
  - ☞ Tracks with $\chi^2 = -1$ are to be studied
- Change in AA algorithm can increase tracking effi ciency
- Achieved tracking ineffi ciency decrease (in sample $\sim$ 50 events) by $\sim$20%
  - ☞ Sample size to be increased
- Total number of tracks increases by $\sim$30% in both data and MC
  - ☞ Fake rate increase is to be studied
- AA-only timing increases by factor of $\sim$10 in data and $\sim$5 in MC
- Total D0reco timing may increase by smaller factor
  - ☞ Timing is to be improved