Tuning cuts for accidentals

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Tuning cuts

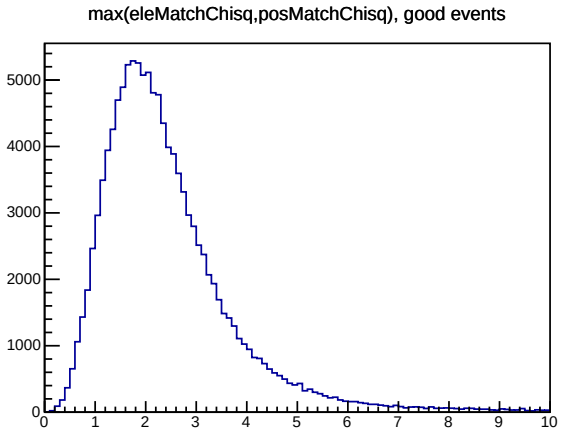
- Idea: use the cluster $|\Delta t|$ to measure the contamination from accidentals
- Make training samples:
  - Pair1 trigger
  - Rough track-cluster matches ($\chi^2 < 10$)
  - Clusters in opposite halves of the ECal
  - Unconstrained $p(V_0) > 0.8E_{beam}$
  - Signal: cluster $|\Delta t| < 1$ ns
  - Background: cluster $|\Delta t| > 3$ ns
- Define a set of cuts, pick some trial values
- For each cut, use the set of events that passed all other cuts (if testing a cut that's not in the set, use events that passed all cuts), then calculate accept/reject fractions for signal and background: "ROC curve" plots efficiencies against each other and indicates cut effectiveness
- Each cut can be optimized to maximize $S/\sqrt{S+B}$

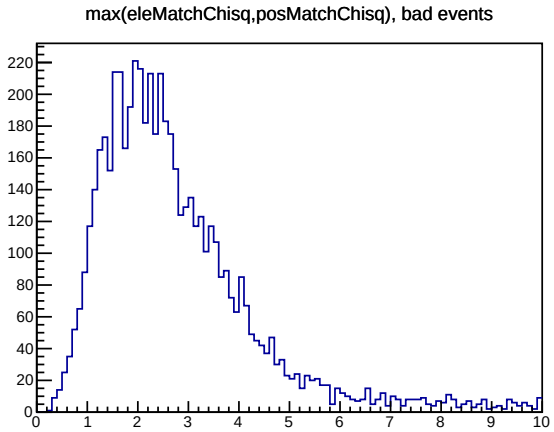
Trial cuts

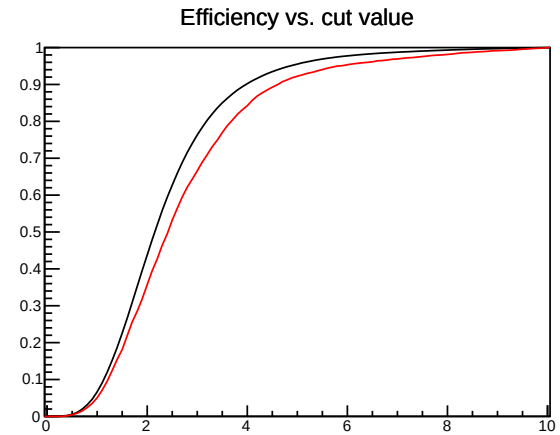
- The set used for today's plots:
  - Track-cluster $|\Delta t - 43| < 4$ ns
  - Track-cluster match ($\chi^2 < 5$)
  - $\chi^2 < 50$ for both tracks
  - Target-constrained vertex $\chi^2 < 50$
  - $p(e^-) < 0.8$ GeV
  - Target-constrained $p(V_0) < 1.2$ GeV
  - Target-constrained $|\theta_x(V_0)| < 0.025$
  - Target-constrained $|\theta_y(V_0)| < 0.015$
- Most of these aren't that great, and don't improve $S/\sqrt{S+B}$ at any cut value (because $B/(S+B)$ is pretty small)
- Big caveat: if these cuts improve mass reconstruction purity or mass resolution, they may be useful even if they don't look good here

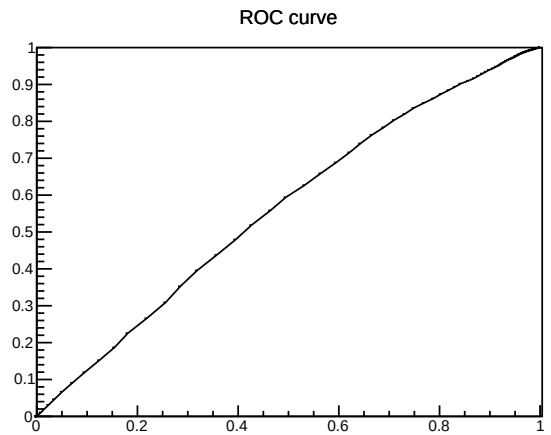
Track-cluster match χ^2

- Not very useful



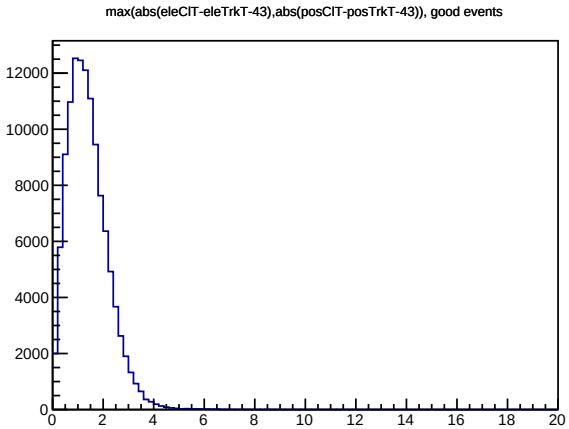


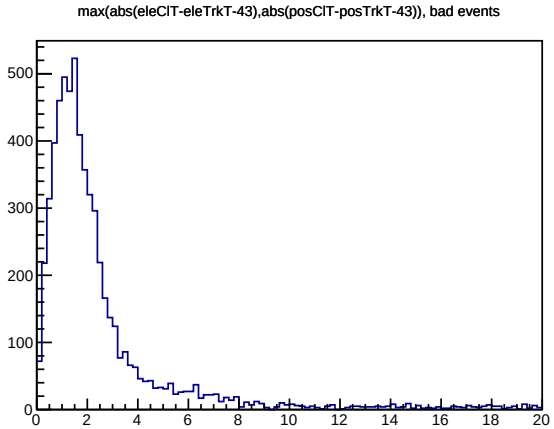


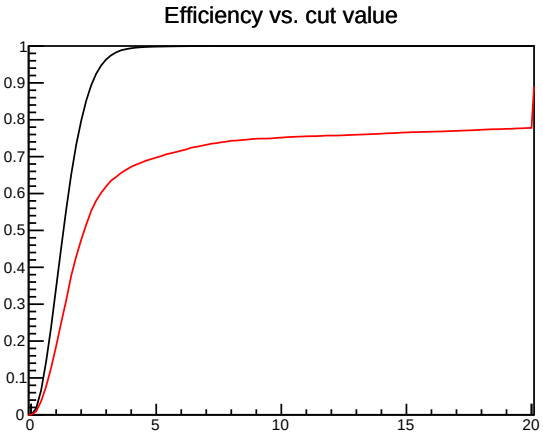


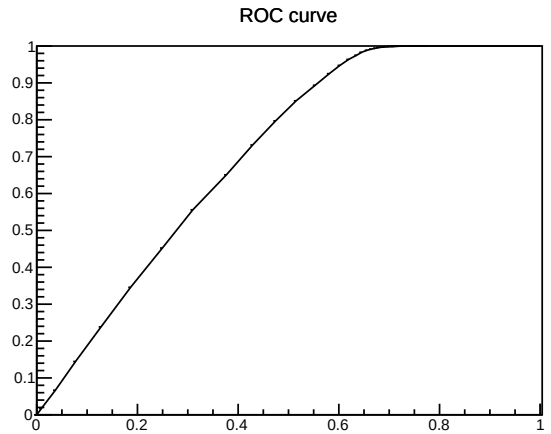
Track-cluster $|\Delta t - 43|$

- This is mostly a cut on the electron track-cluster match (can see if you plot electron and positron $|\Delta t|$ separately), and is cleaner than the position match
- Partly redundant with the cluster $|\Delta t|$ cut, obviously



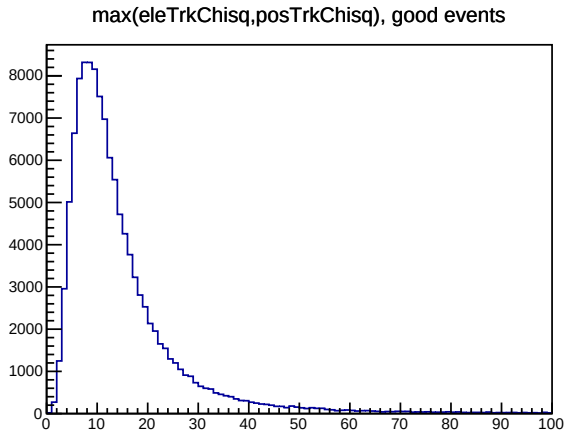


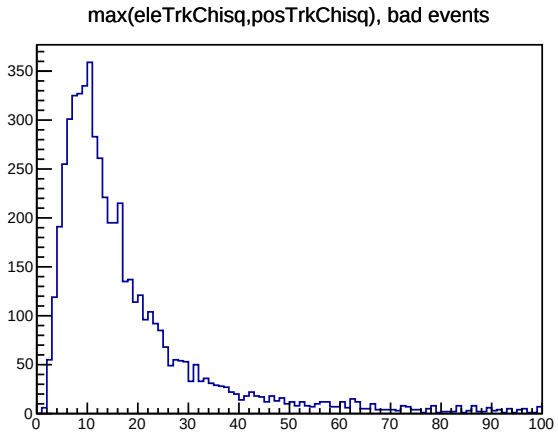


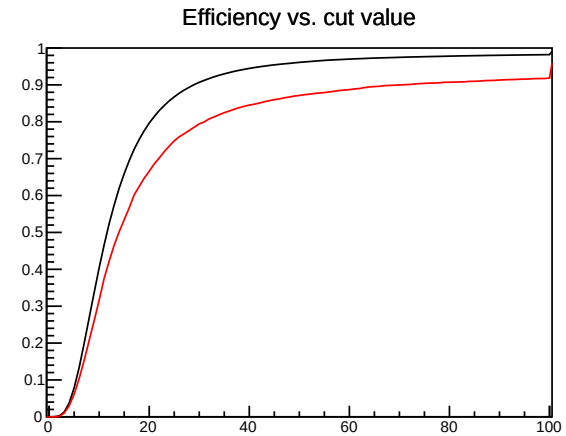


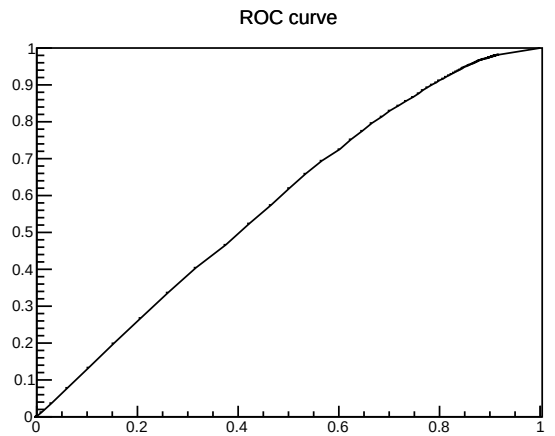
Track χ^2

- Okay, not great (rejects some garbage tracks, but that's it)



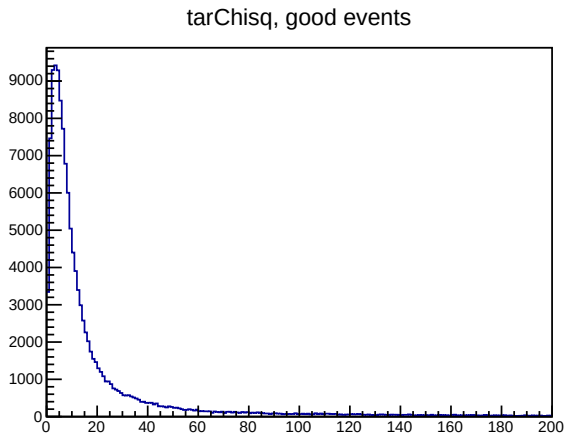


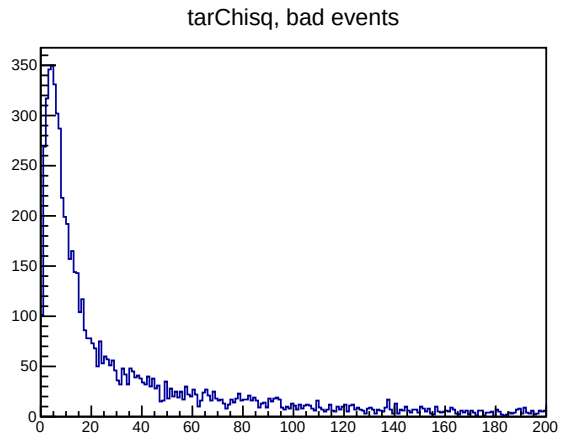


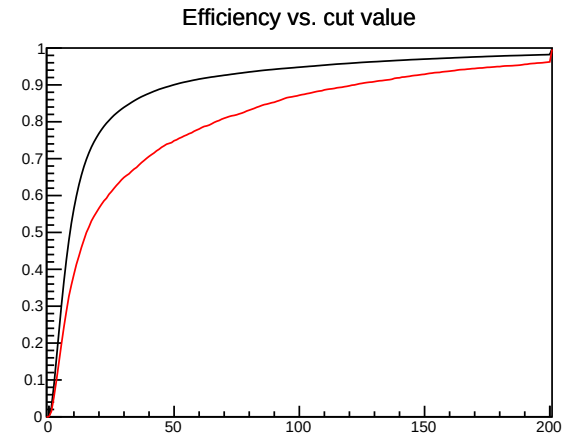


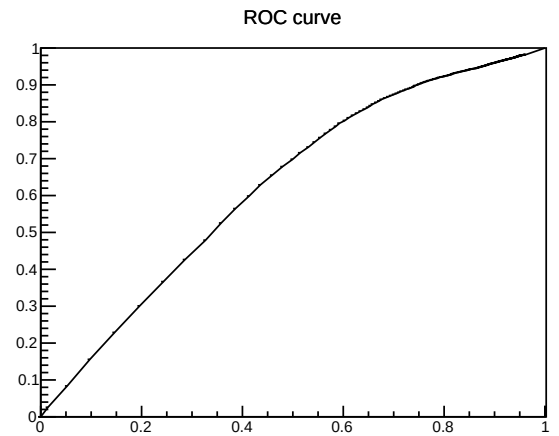
Target-constrained vertex χ^2

- Not bad, but not good enough



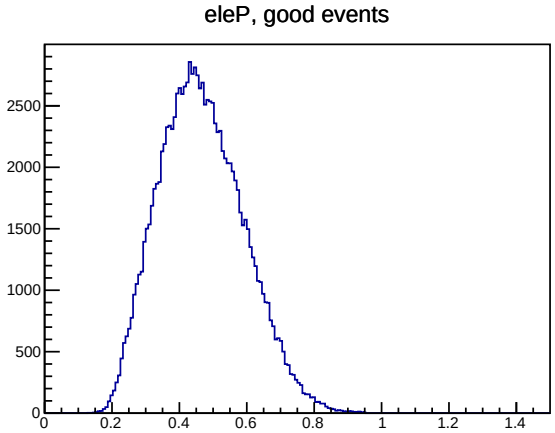


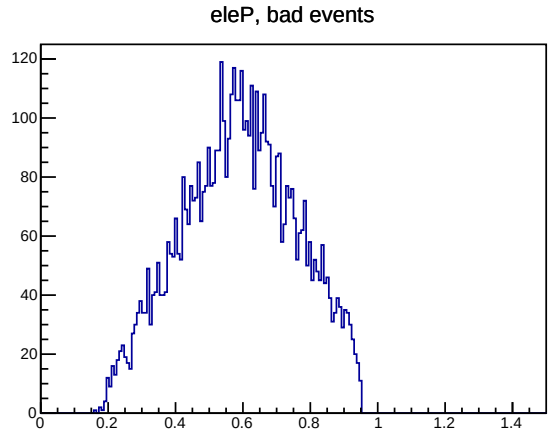


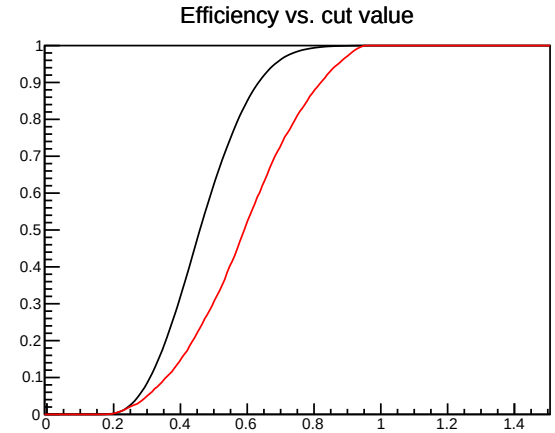


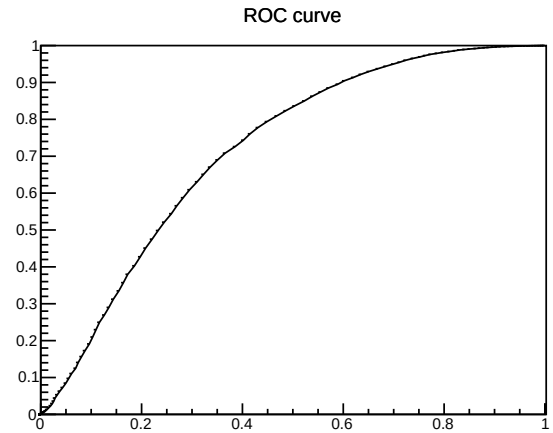
$p(e^-)$

- No surprise that this works well (rejects FEEs)



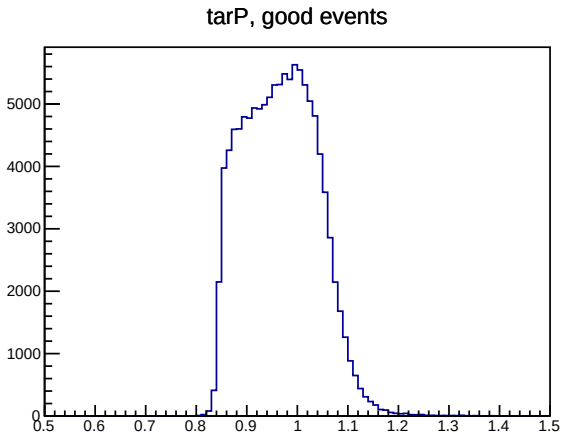


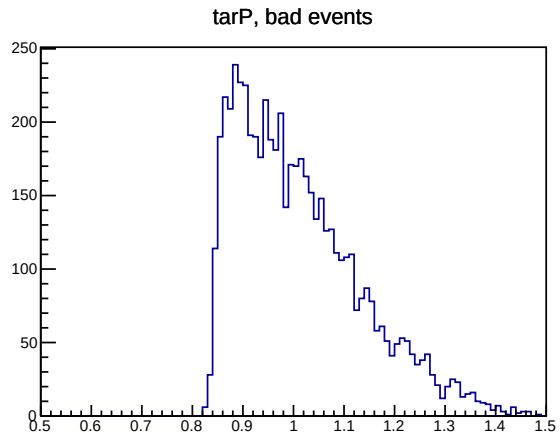


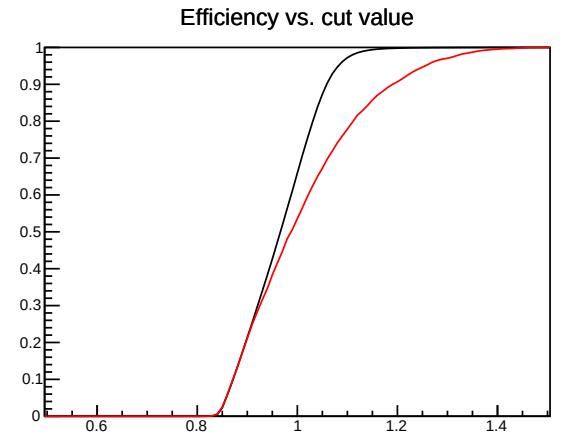


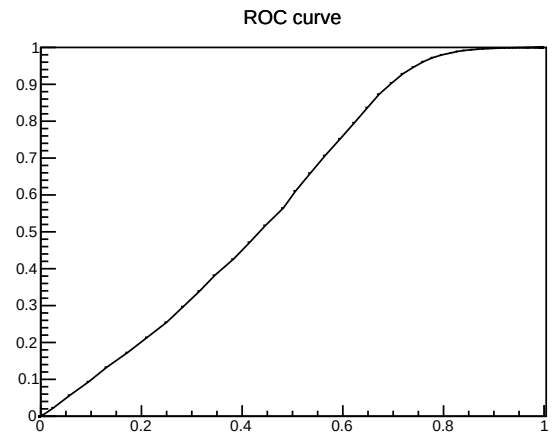
$p(V_0)$

- No surprise (even in the “good” sample, the stuff above 1.2 GeV is all accidentals)



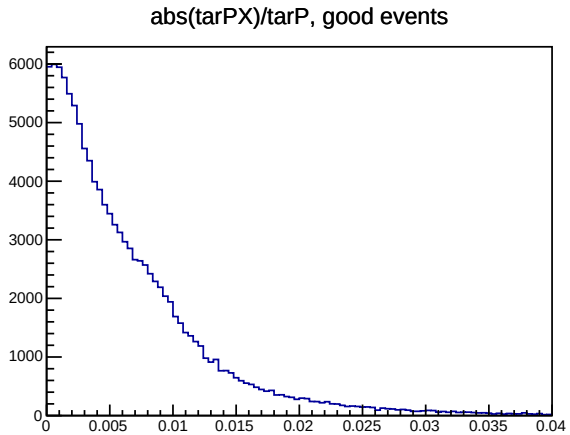


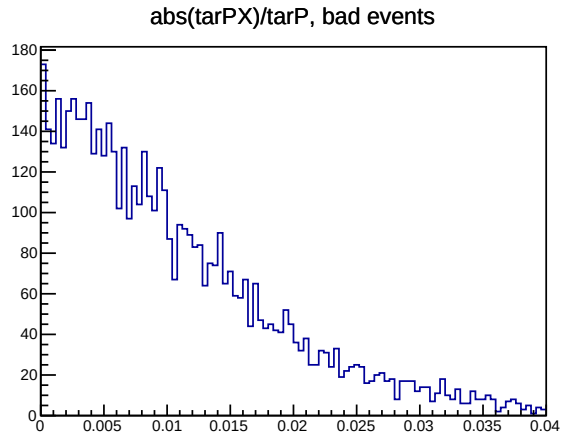


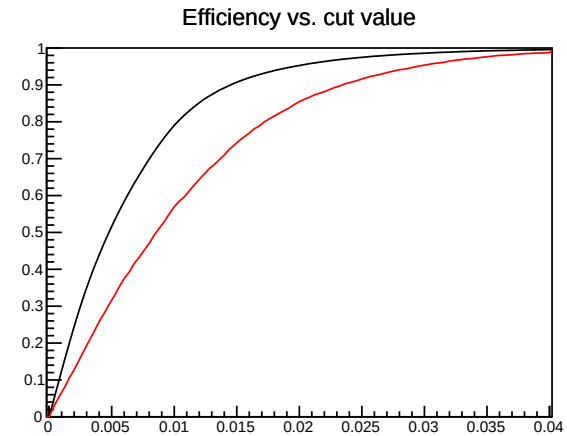


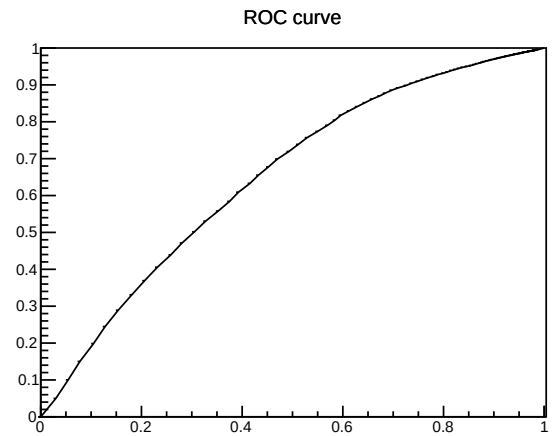
Target-constrained $|\theta_x(V_0)|$

- Pretty good, might not be good enough









Target-constrained $|\theta_y(V_0)|$

- Pretty good, might not be good enough