Track efficiency from 2-prong “tridents”

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Rafo made a nice, simple ntuple and a few cuts set up to select events based on clusters in the ECal…

…this plot shows all pairs with cuts on individual cluster times and $|\Delta t|$. No tracking requirements.

Even though the WAB peaks at beam energy (minus sampling fraction here) and 160°, there is a long tail that leaks into the tridents…

These WABs are a pain! I’d like to use this sample to get track efficiency from tridents. For electrons it’s ok (since even if it’s a WAB, the electron is still an electron), but for positrons it will dilute the sample.
Tag & Probe of 2-prong tridents to get efficiency

- **Pass the Tag:**
  - 2 clusters, top/bottom & left/right
  - $30\text{ns} < t_{CL} < 50\text{ns}; \ |\Delta t(E_{sum})| < 3\sigma$ (Rafo’s parameterization)
  - a track matched (loosely) to positron/electron cluster (depending which tag)
    - includes all of the cuts used to define a “track” and a “cluster match”
    - track charge must match the “charge” of the side (i.e. left-side cluster must be +ive)

- **Pass the Probe:**
  - a track matched to the electron/positron cluster
  - Efficiency = $N(\text{tag+probe})/N(\text{tag})$

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**Diagram:**

- Electron Side
- Positron Side

- Typical WAB photon

- $E_1 = 496\text{ MeV}$
- $E_2 = 763\text{ MeV}$
• for the tag-and-probe, require that the cluster-side matches that charge (i.e. a cluster on the positron side is matched to a positron)...gets rid of large $\theta_x$ WAB electrons!

Other than this, still require top/bottom + left/right clusters with tight relative-timing cut

...everything I show will be in the full acceptance (unless marked)
2-prong track efficiency: electrons, from data

- lose most tracks as low y-angle
- there’s a kink in the x-efficiency around where the hole is (??)
- gradual fall-off with lower momentum… we’ve seen this before but with bigger bins
2-prong track efficiency: electrons data vs. MC

- converted WABs have higher electron efficiency
- does data die off faster than MC at small y-angle?
- there is a low-energy hump in the efficiency vs energy from tridents… or maybe it’s losing tracks at mid-energy? Something looks funny here.
2-prong track efficiency: mid-ESum & superFid

require 0.45<ESum<0.65...gets rid of a lot of the WAB conversions

...looks like a hump!

require superFid

maybe not a hump, but fall off quicker in data than MC.
• again, definitely looks like there’s some inefficiency in data (compared to MC) at higher-|X| (=~lower momentum)...locally, ~10-20% difference
Hand scanning: typical case

did some hand-scanning on events that failed the electron probe…

…many of the events were like this one: lowish momentum/high $\theta_x$ electron that miss last 2 layers
Hand scanning: less typical case

- Positron track found
- +x electron track found
- -x p electron
- Low p track not found (missing mod. 3 axial, mod 6 out of acceptance)
Hand scanning: garbage case

...this one has nice $e^+e^-$ tracks in the bottom and 0 SVT hits in the top...

- triggered because of in-time photon in top-electron side
- this shouldn’t be counted as an inefficiency, but in my tag/probe it is
- fortunately, didn’t see this very often
2-prong track “efficiency”: positrons

Lots of (non-converted) WABs in data so positron efficiency looks quite poor…don’t be fooled!

Still, it’s a bit troubling that wab-beam-tri efficiency doesn’t match data at low E…
Conclusions

• Tracking inefficiency isn’t a yuge problem
  - data/MC disagreement looks to be ~0 - 20% depending on momentum/trajectory
  - still should try to understand this discrepancy
• Can really only check the electron efficiency with the 2-prongs… positrons are too contaminated by WABs
  - electron result is pretty solid though…we have the best electrons
• From event display, our inefficiencies mostly make sense…
  - particles that don’t get tracked typically are missing hits because they are out of tracker acceptance
• We should probably measure data/MC differences wrt p/\theta/\phi and apply some sort of correction to MC
  - this will be a tremendous job!
The ECAL electron hole really confuses the issue...it makes distributions look weird even when they are correct and is sensitive to alignment & material data/MC differences.

My solution is to take out layers 1 & 2 == superFiducial region...this gives a nice uniform area that is definitely well covered by the tracker.