TRACK TOP-BOTTOM ASYMMETRY

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- WHAT WE KNOW
- WORKING HYPOTHESIS
 - ELECTRONS SHOWERING IN VACUUM CHAMBER
 - LOW-MOMENTUM TRACK ISSUES
 - BEAM ANGLE
 - TIMING
- NEXT STEPS

WHAT WE KNOW

- Alessandra reported large top/bottom asymmetry in reco efficiency (~30%) in 2015 data
- Pairs-triggered events
- GBL tracks, right after track reco
- All the way back to very old hps-java versions
- Only ~10% asymmetry present in MC
- Appears most prominently in 2 regions of Pz spectrum
- Not dependent on chi2, tanlamba, #tracks/event, ...
- Persists when considering only tracks matched to trigger-clusters
- Appears in #SVT hits, but not in #ECal clusters

GBL TRACKS ASYMMETRY ~30-35% IN DATA, ~10% IN MC



PERSISTS IN MATCHED TRACKS, RECO PARTICLE TRACKS



0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00 1.05 1.10 1.15 1.20 1.25 1.30 1.35

YES, IT WAS THERE IN OLD HPS-JAVA VERSIONS



PERSISTS ACROSS MANY OBVIOUS TRACK VARIABLES



APPEARS IN PAIRST BUT NOT SINGLEST TRIGGER







SVT CHANNEL OCCUPANCIES



Pairs-triggered Occupancies

Sensor (axial)	Bot Occ	Тор Осс	Ratio T/B
1	0.240	0.177	0.74
2	0.155	0.107	0.69
3	0.117	0.075	0.64
4 hole	0.076	0.048	0.63
5 hole	0.055	0.037	0.67
6 hole	0.039	0.028	0.72

Ratio worsens from layer 1 to 4

WORKING HYPOTHESIS

Studied special sample of pairs-triggered data events:

- Exactly I reco cluster in top, I in bottom (matched to trigger clusters)
- No more than 2 reco tracks



Hypothesis: two different populations (issues)

- I. Low-momentum tracks: timing problem(s) + beam angle? Related to long-standing inefficiency?
- 2. Higher-momentum tracks: WABs / near-full-energy electrons that shower in ECal vacuum chamber
 - ✓ Tracks point just inside ECal "hole"
 - ✓ Create lower-energy clusters at edge of ECal
 - ✓ Low-ESum events
 - ✓ Electron tracks, not positron tracks
 - $\checkmark \quad \mathsf{Not included in MC}$
 - Beam angle & acceptance causes this to happen more often in Bottom than Top?





Top vs Bottom ClusE with track in top





Define HighEsum as event with Cluster ESum > 700 MeV

Define LowEsum as event with Cluster ESum < 550 MeV

Look at cluster positions in events with:

- Only bottom track
- Only a top track

Note co-planarity cut in Pairs trigger







Define HighEsum as event with Cluster ESum > 700 MeV

Define LowEsum as event with Cluster ESum < 550 MeV

Look at position of track extrapolated to Ecal, in events with:

- Only bottom track
- Only a top track

Note co-planarity cut in Pairs trigger

TIMING ISSUES

Timing distribution of StripHits in volume "missing" the track



TIMING ISSUES: SATELLITE PEAK



Pelle's theory: more likely to pick up accidentals on bottom because of how trigger time is defined

TIMING ISSUES: SATELLITE PEAK IN LAYERS 7-12



TIMING ISSUES: SATELLITE PEAK IN LAYERS 7-12



TIMING ISSUES: TRY LOOSENING RECOTIMING CUTS

- With loosened timing cuts (15, 20, 24ns instead of standard 12ns) in making HelicalTrackHits from StripHits, examined the tracks gained
 - Ignored any new track flagged by AmbiSolver as ambiguous (shares at least 4 hits with an old track)
- Asymmetry persists: gain more bottom than top tracks
- Seem to be reasonable tracks... but are they tracks we really want?



TIMING ISSUES: TRY LOOSENING RECOTIMING CUTS

- With loosened timing cuts in making HelicalTrackHits from StripHits, examined the HelicalTrackHits and tracks gained
- Mostly gained entirely new tracks, rather than completing partial tracks ... are these new tracks out-of-time?



NEXT STEPS

- Beam angle MC
 - Sebouh: beam θ_y may be ~Imrad
 - Takashi: θ_v had always been set to 0 in MC
 - Bradley: produced some MC samples with non-zero θ_v values. Need to be re-produced and analyzed!
- Follow bump-hunt analysis cuts, but without the top-bottom track pair requirement
 - Examine signal-like events where one cluster is missing a track, but re-gains the track when timing cuts are loosened
 - Two low-energy clusters with Esum ~ beam energy
 - Tracks point to clusters [need to improve track-cluster matching to use full 3D magnetic field]

• ...

- Will loosening timing cuts just clutter datasets with out-of-time pileup/garbage tracks, or actually regain events we want?
 - In latter case, exactly what timing mechanism is at fault?

CONCLUSIONS

- Confused? You should be.
 - Which is why a rabbit(-hole) immediately appeared outside my SURA room ...



• Sorry John, there is no conclusion yet!