Trident rates & shapes (tracking heavy & lots of plots)

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HPS Collaboration Meeting
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Samples

- Data:
  - ran over pass 3 unblind run 5772
- MC:
  - full tridents="tritrig"
    - generated σ=1.76mb
    - ran over ***6 Million*** total generated events
    - uses the all trident diagrams (including exchange & interference)
  - radiative tridents="RAD"
    - generated σ=0.12mb
    - ran ~ 5 ***Million*** total generated events
  - Bethe-Heitler tridents = "BH"
    - generated σ=0.12mb
    - ran ~ 3 ***Million*** total generated events

Event Selection

- Prelims:
  - pairs1 trigger
  - pass-3 recon
- Tracks:
  - ***#of tracks < 5;*** # of positrons == 1
- V0:
  - $\chi^2_{unc}<10$
  - $1.2 > P_{v0}(z) > 0.55$ GeV
  - $|V_{v0}(x)|<2$ mm & $|V_{v0}(y)|<2$ mm & $|V_{v0}(z)|<25$ mm
  - 50 MeV$<P_{trk}<900$ MeV
  - $P_{pos}(y) \times P_{ele}(y)<0$
  - ***exactly 1 V0 candidate passes all cut***

MC vs data summary (take 4)

	Run 5772	tritrig	Bethe-Heitler	Radiative
# tridents generated	xxxxxxx	6M	3.00 M	4.82 M
generated trident XS	xxxxxxx	1.76 mb	8.28mb	0.12mb
integrated lumi	4.8/nb	xxxxxxx	xxxxxxx	xxxxxxx
# of triggers (pairs1)	9.7M	81.7k	56.4k	656.4k
# of events passing cuts	288.5k	38.3k	20.4k	364.1k
detected cross-section	60.1 μb	112.5 μb	56.3 μb	9.1 μb

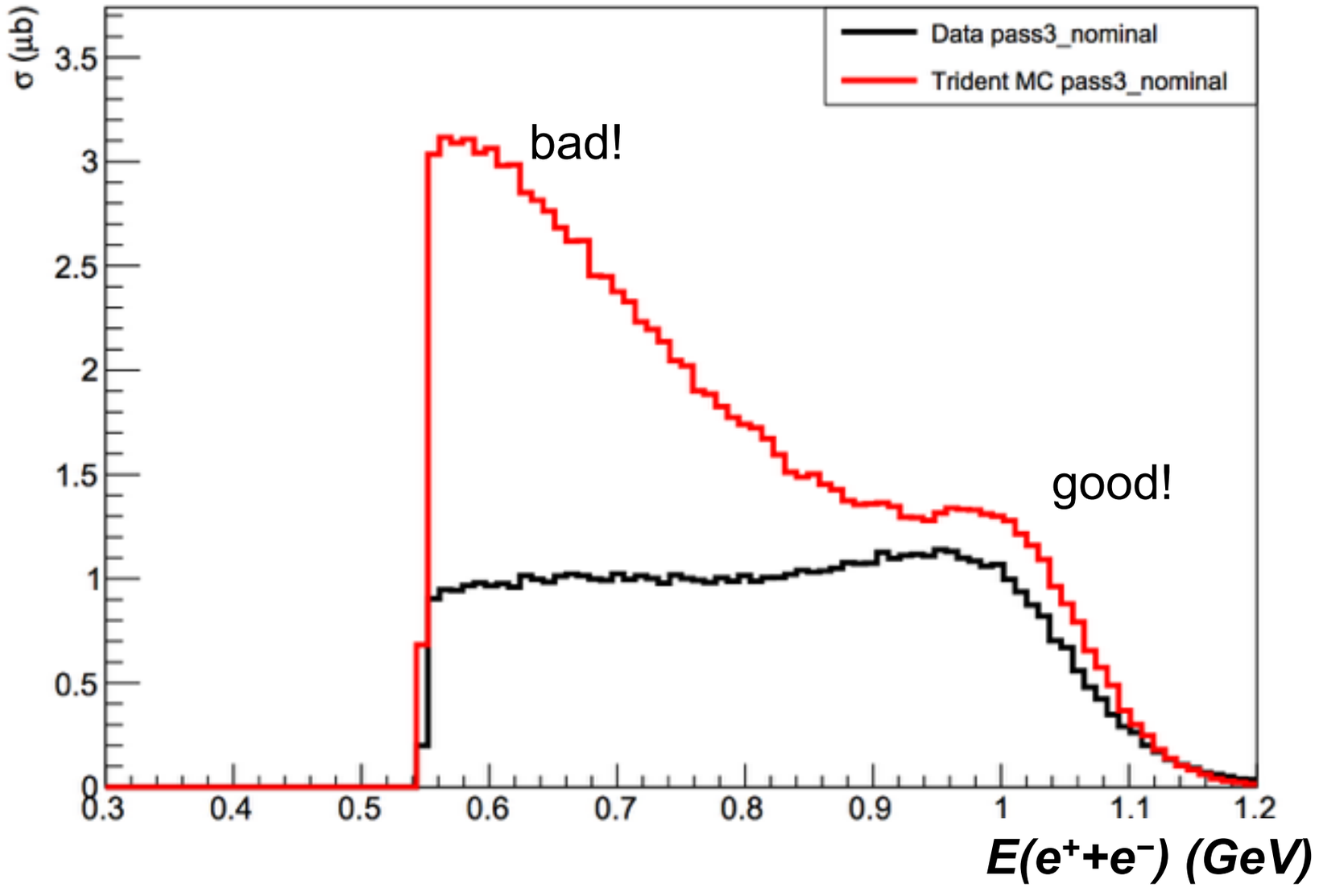
Data vs tritrig XS: next slide
tritrig vs BH+Rad: constructive interference

Full trident vs data comparison

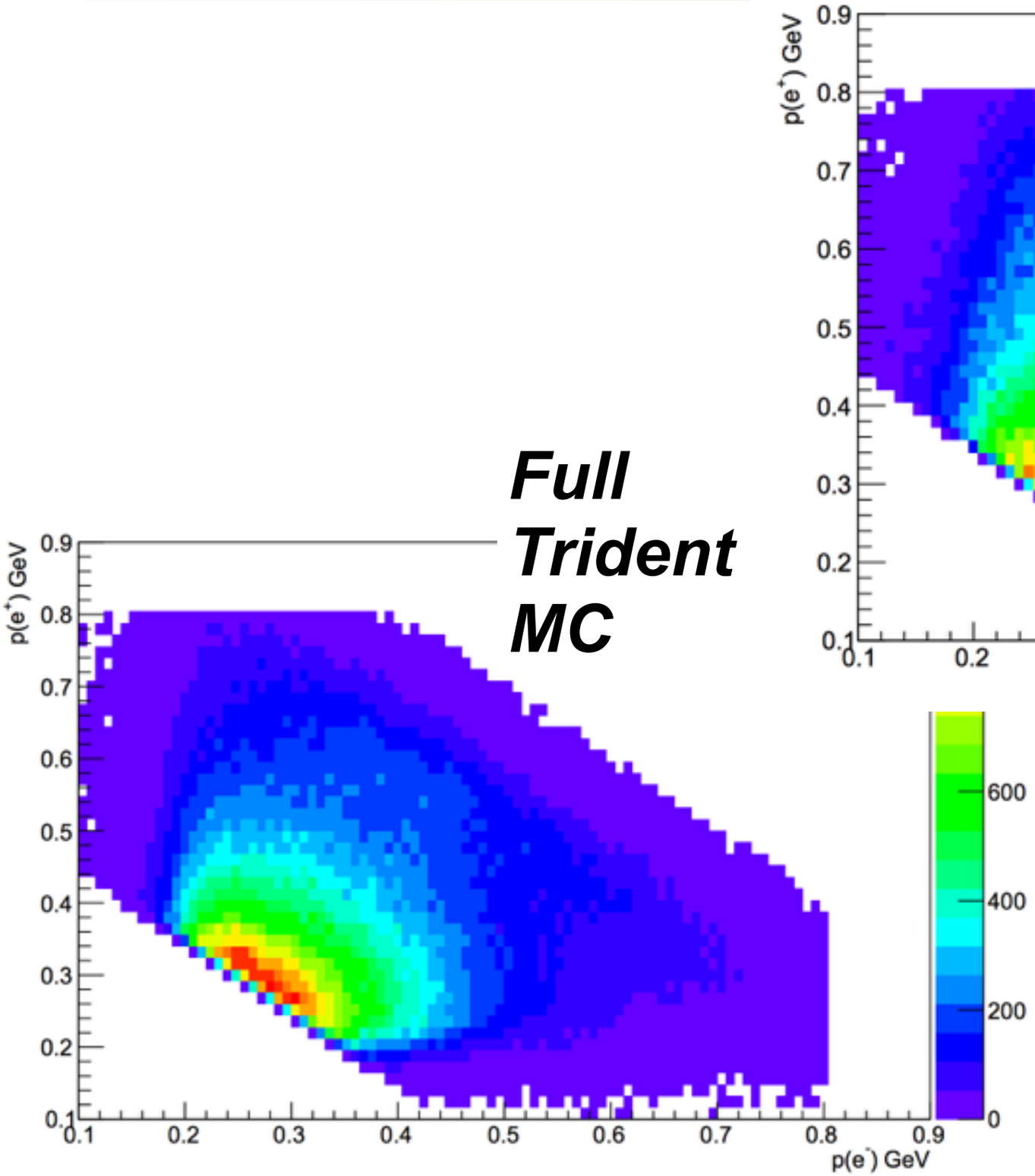
Black=Data
Red=pure full tridents

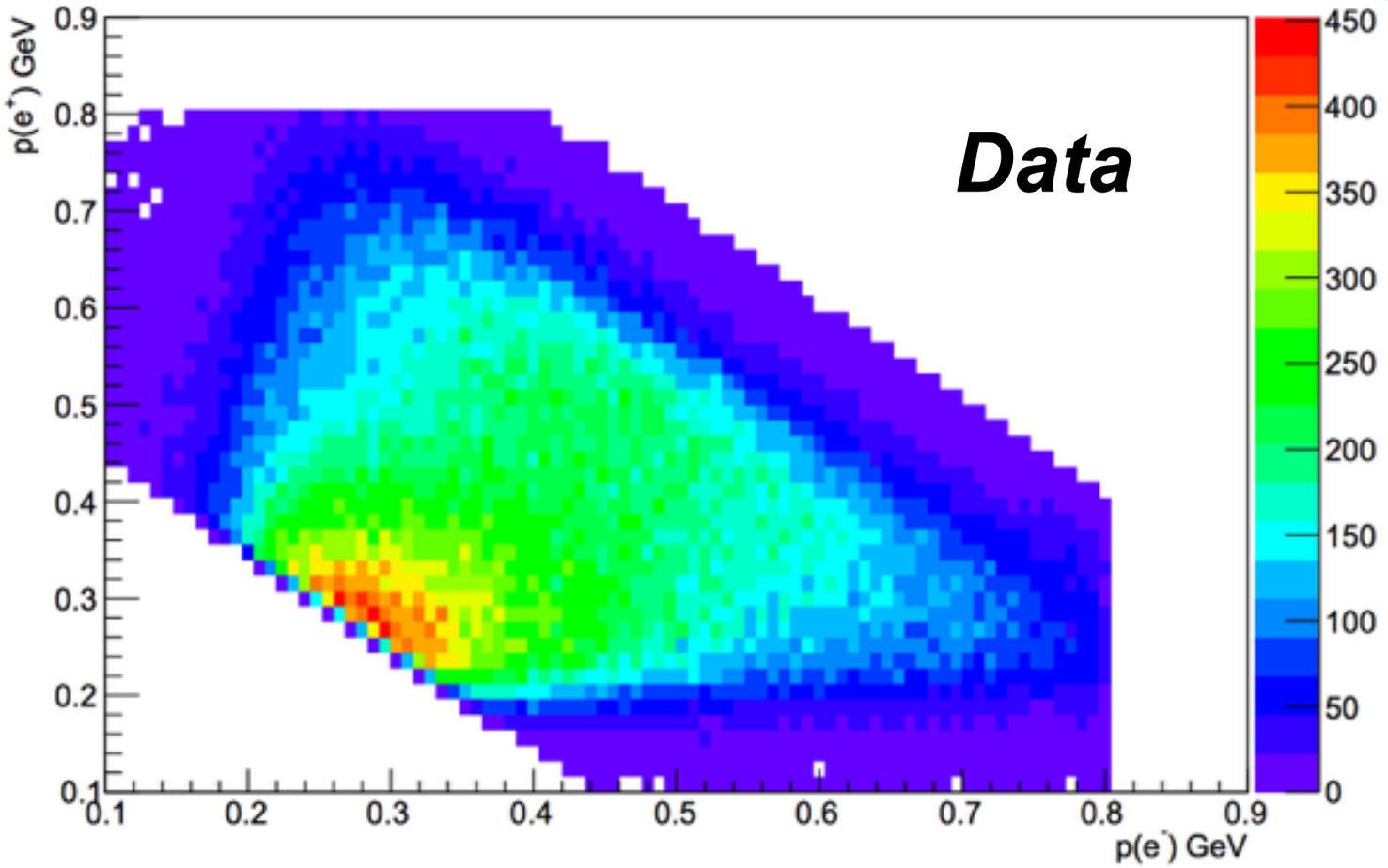
plots are normalized to detected cross-sections on previous page

for $E(e^+e^-)>0.8$
σ(data)=32.5μb
σ(MC) =42.4μb

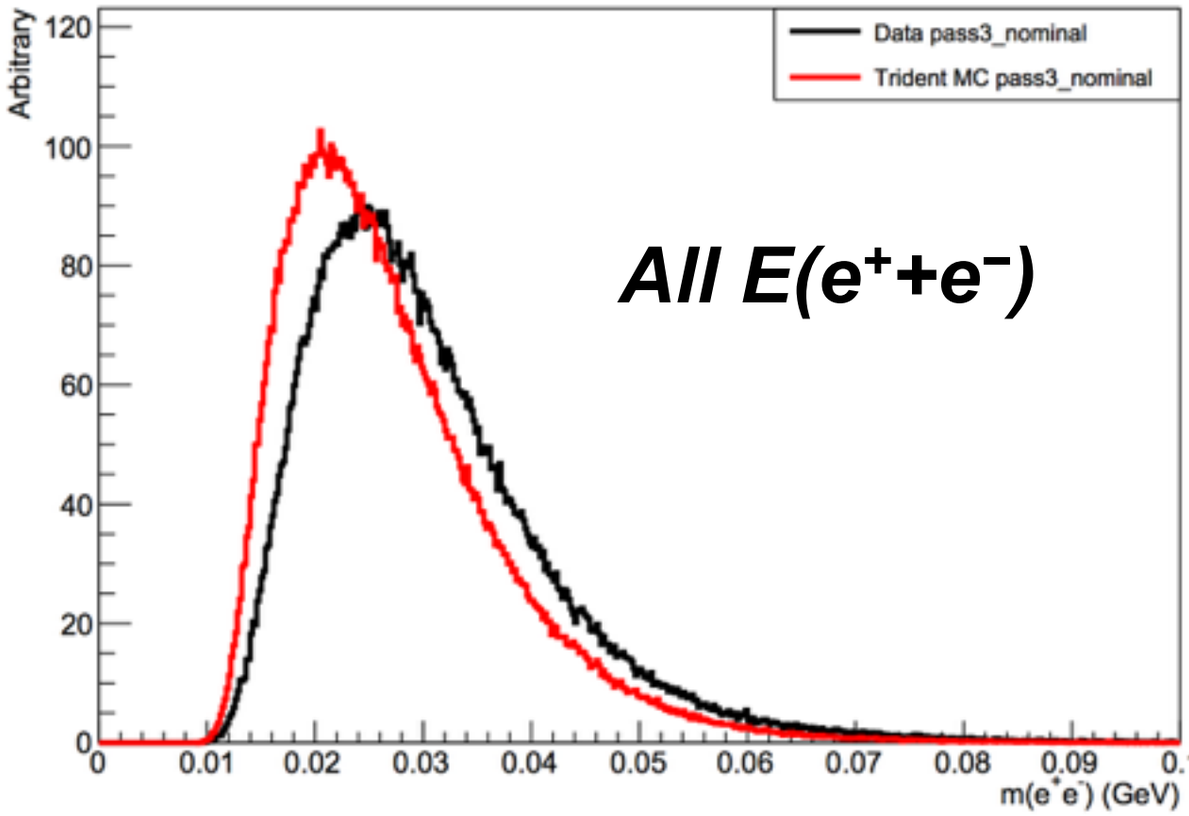


Electron vs Positron Momentum





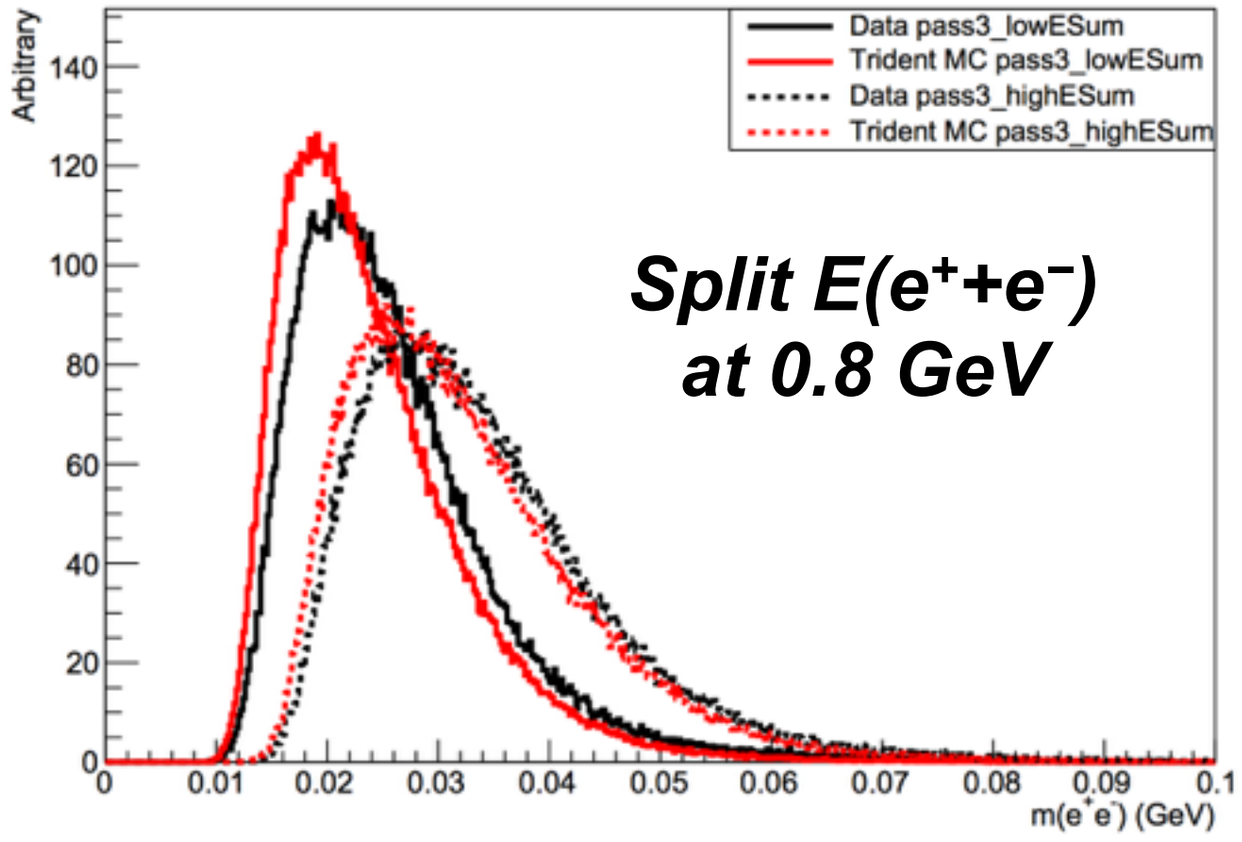
Invariant mass distributions



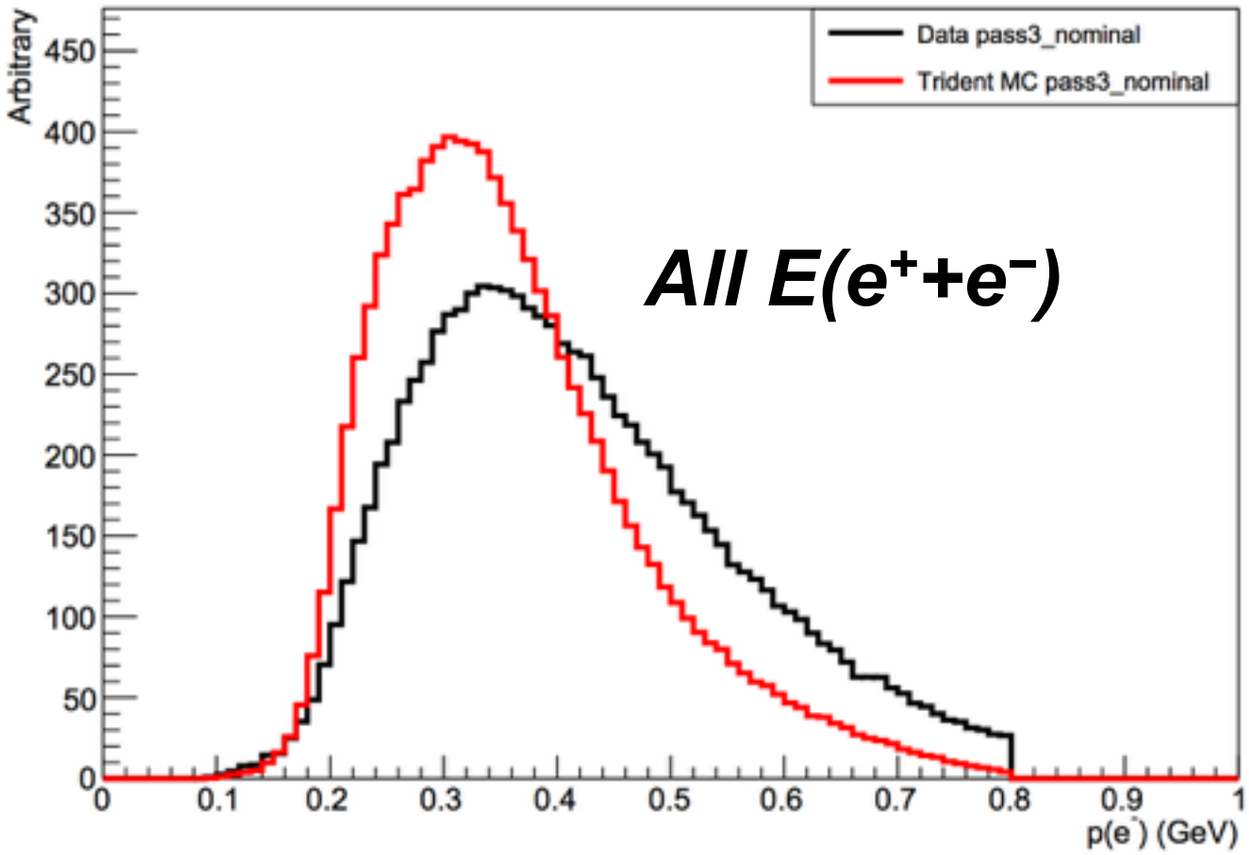
all plots are normalized to total area

…higher E(e⁺+e⁻) → higher mass (no shocker there)

…within the split, data pushed higher than MC



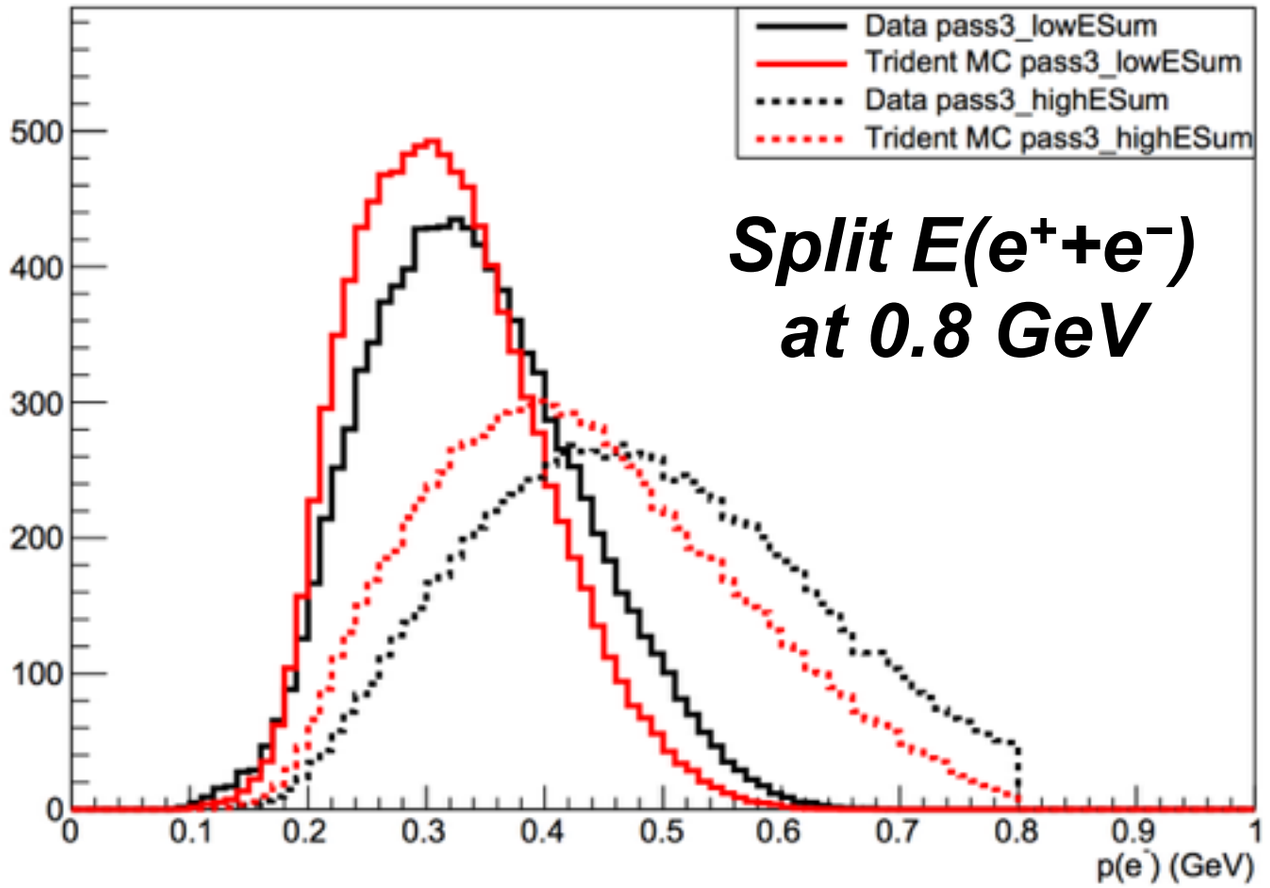
Electron momentum distributions



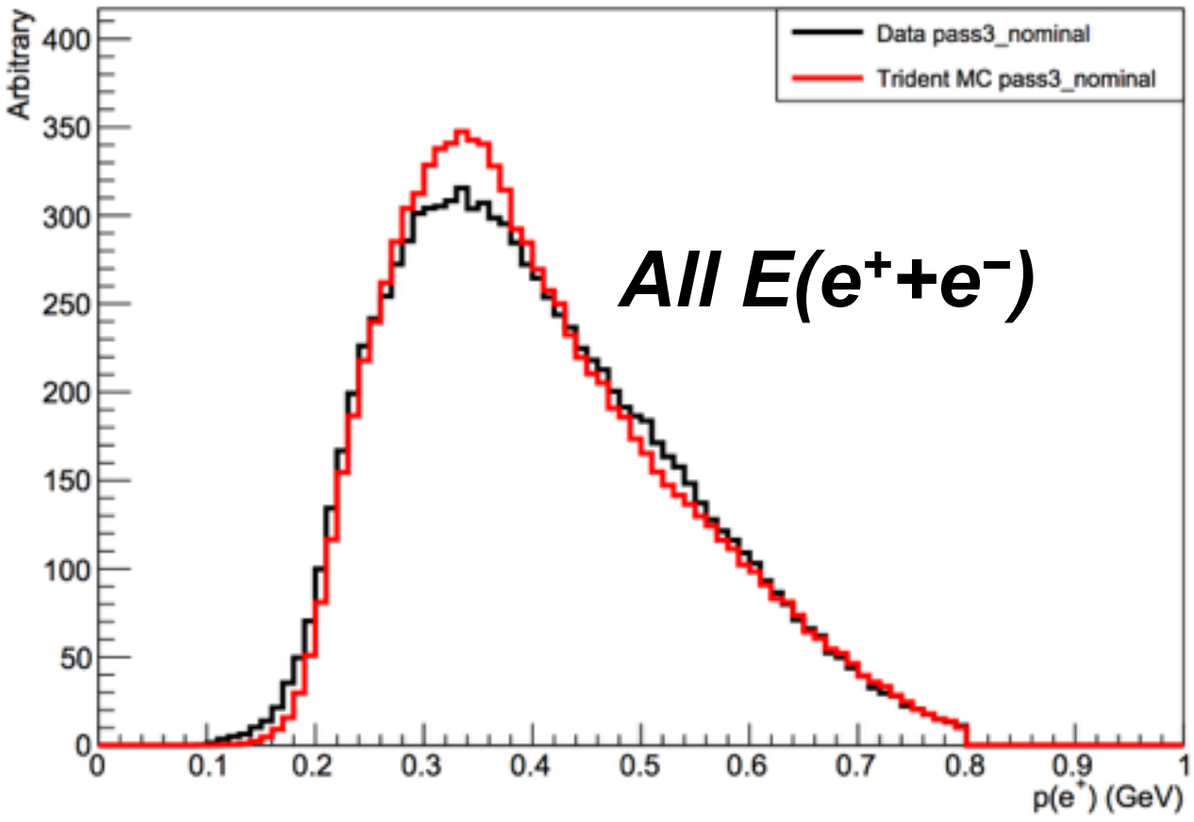
all plots are normalized to total area

…higher electron energy

…within the split, data pushed higher than MC (again)



Positron momentum distributions



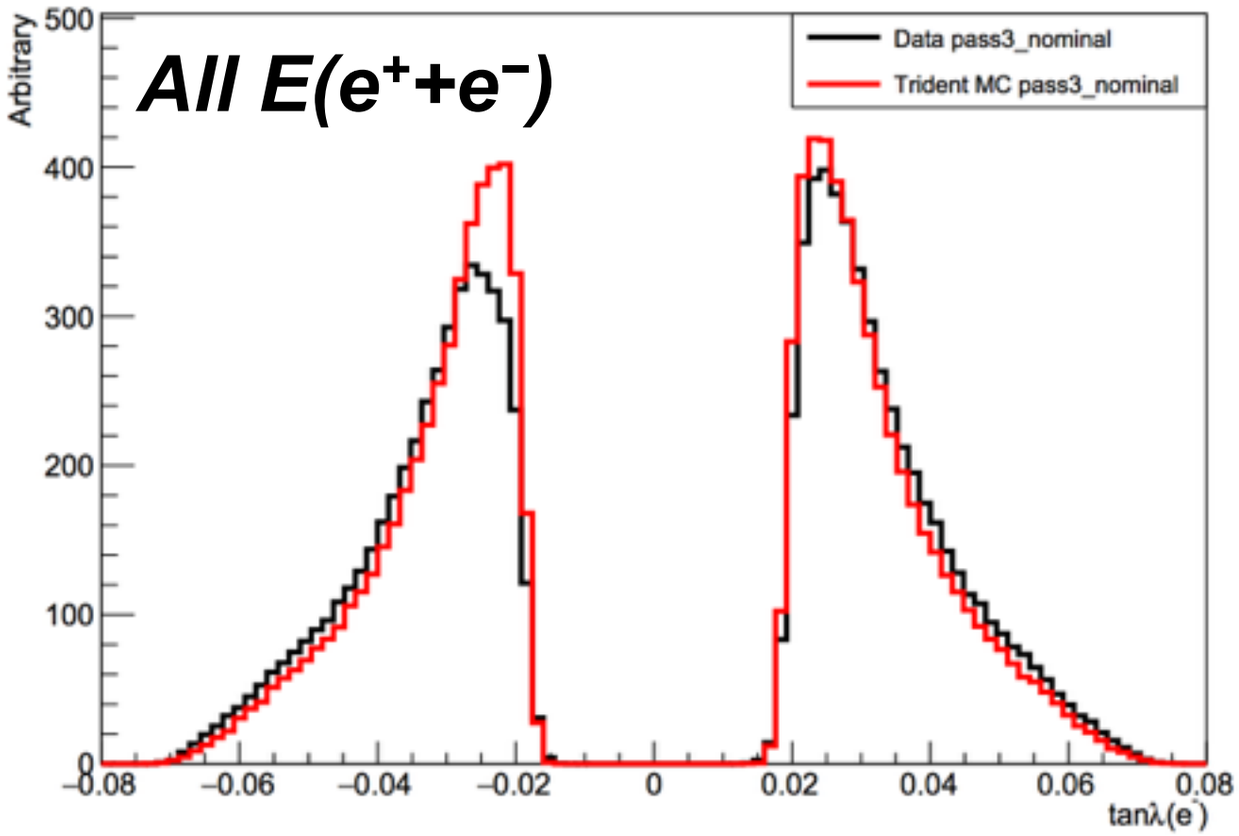
all plots are normalized to total area

…overall good agreement

*…within the split, data pushed **lower** than MC (again)*

I'm using SeedTracks everywhere, but conclusion same for GBL

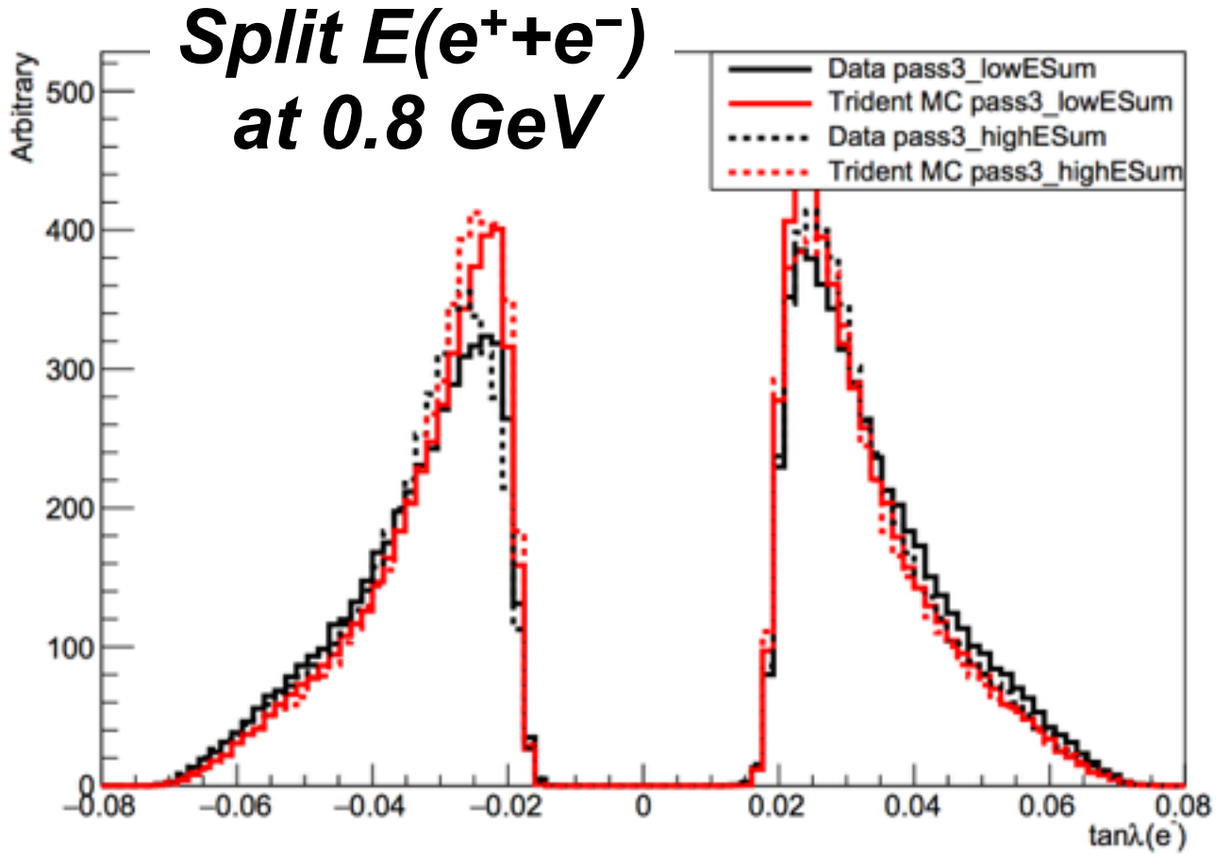
Electron y-angle



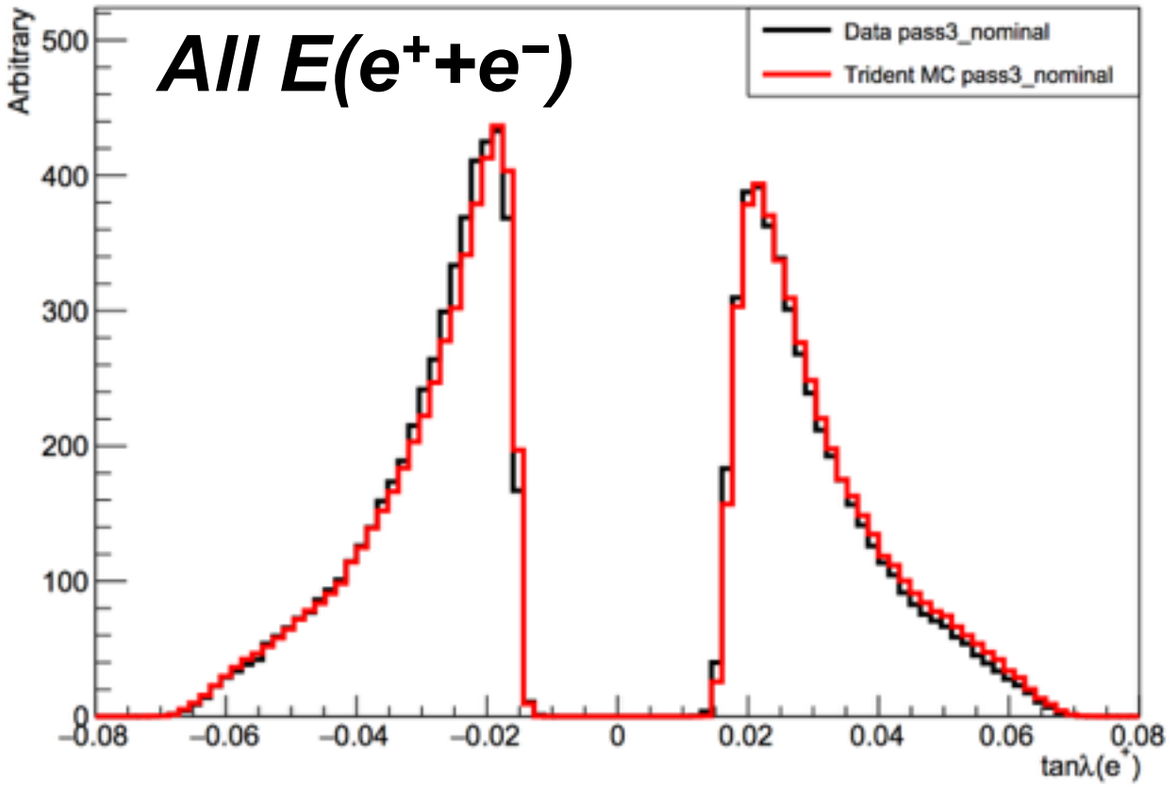
all plots are normalized to total area

…electrons pushed out a bit compared to MC

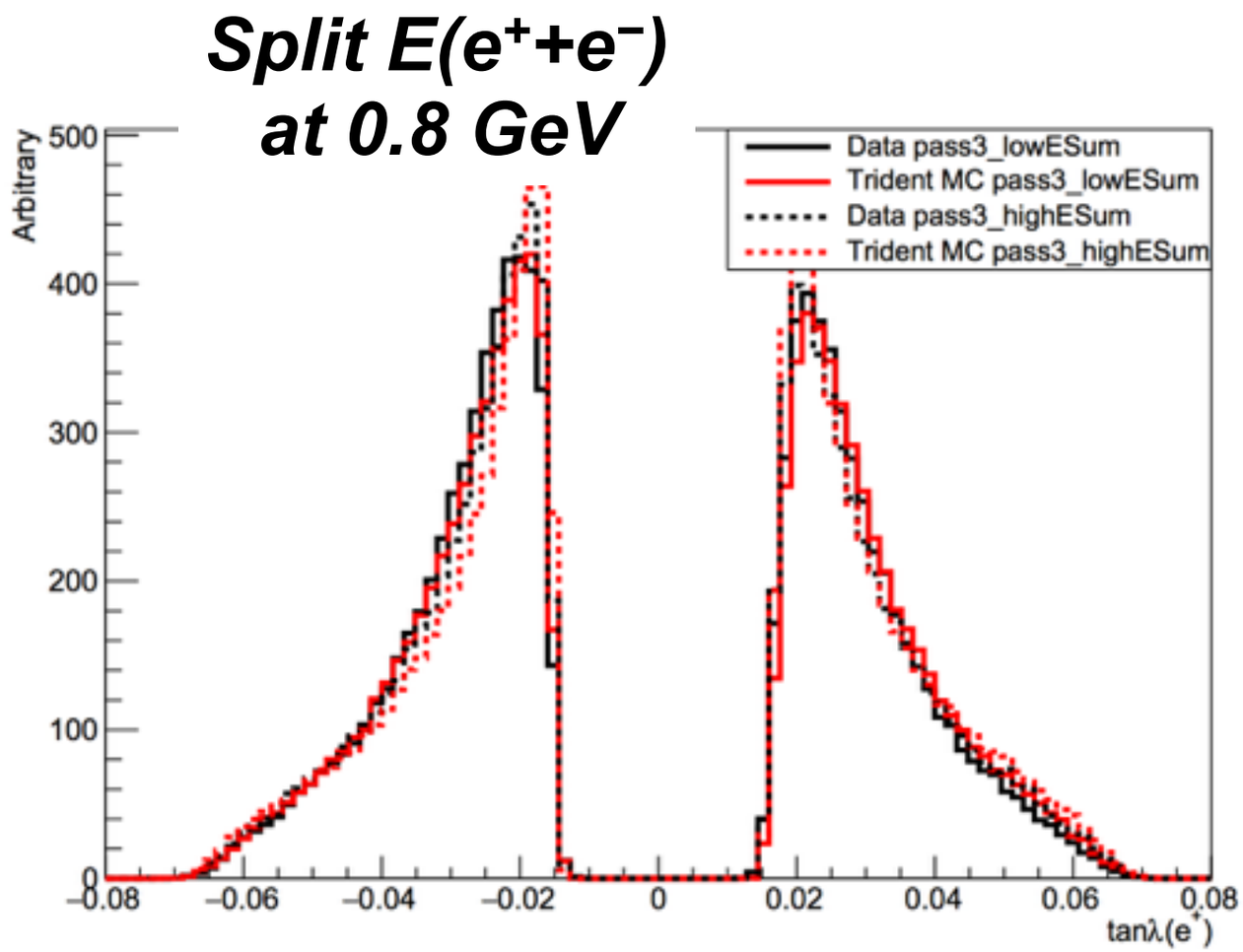
…funny business at −ive angle?



Positron y-angle

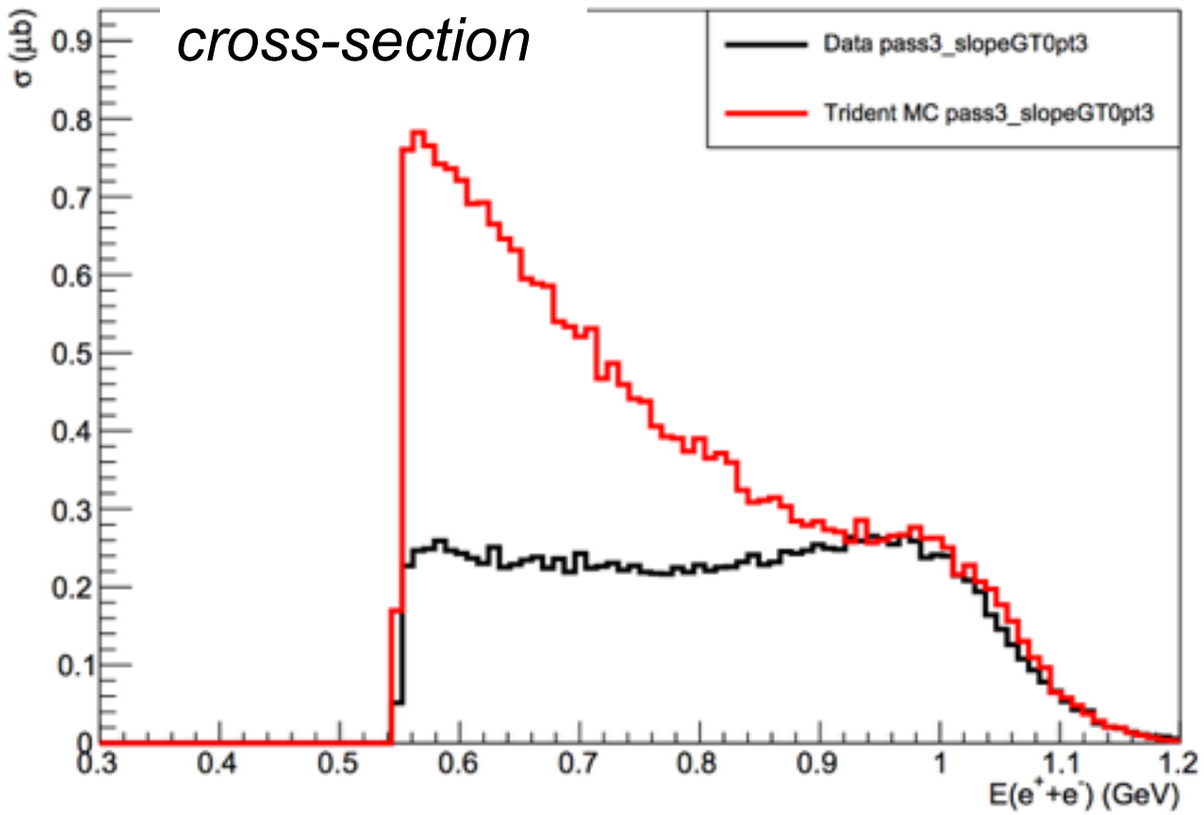


…positrons actually look pretty good?



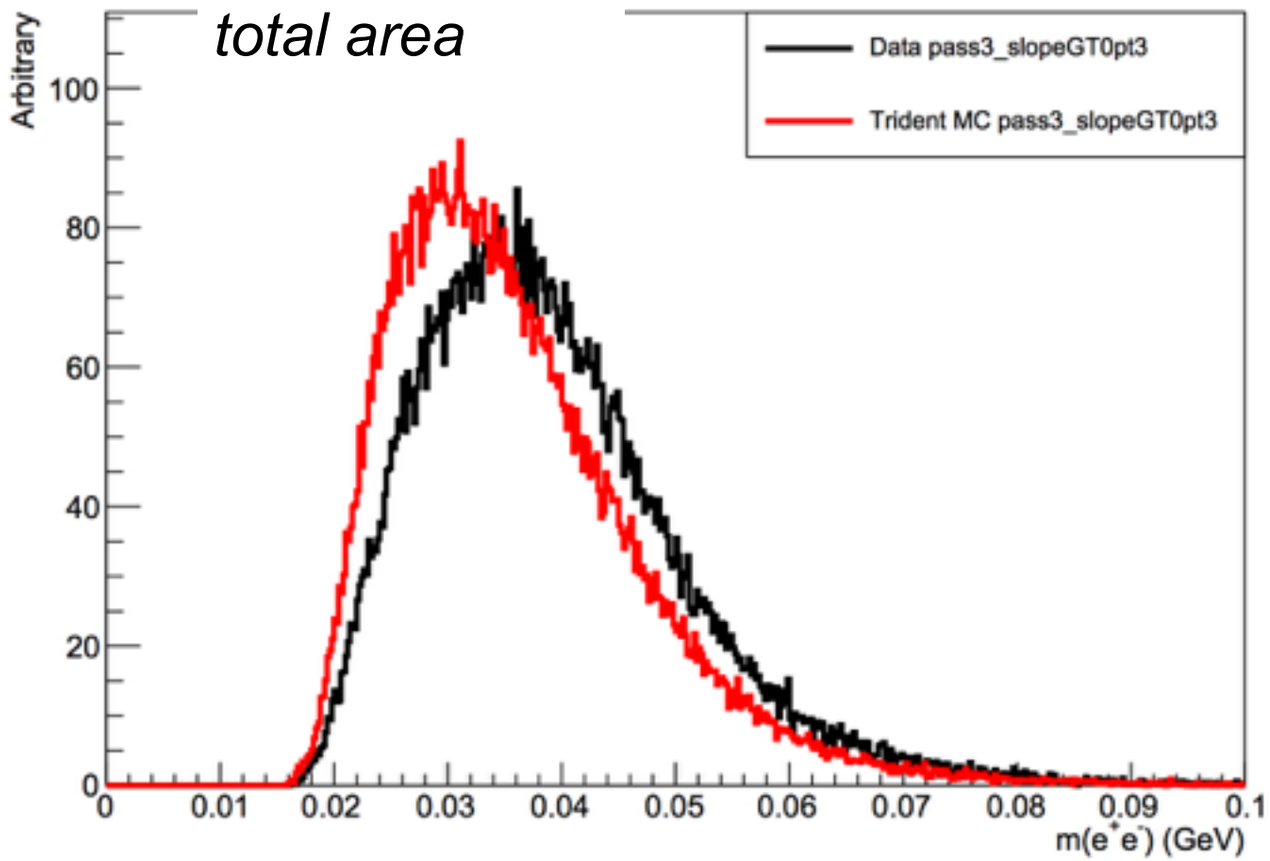
Electron y-angle > 30 mrad (Esum and Invariant Mass)

normalized to cross-section

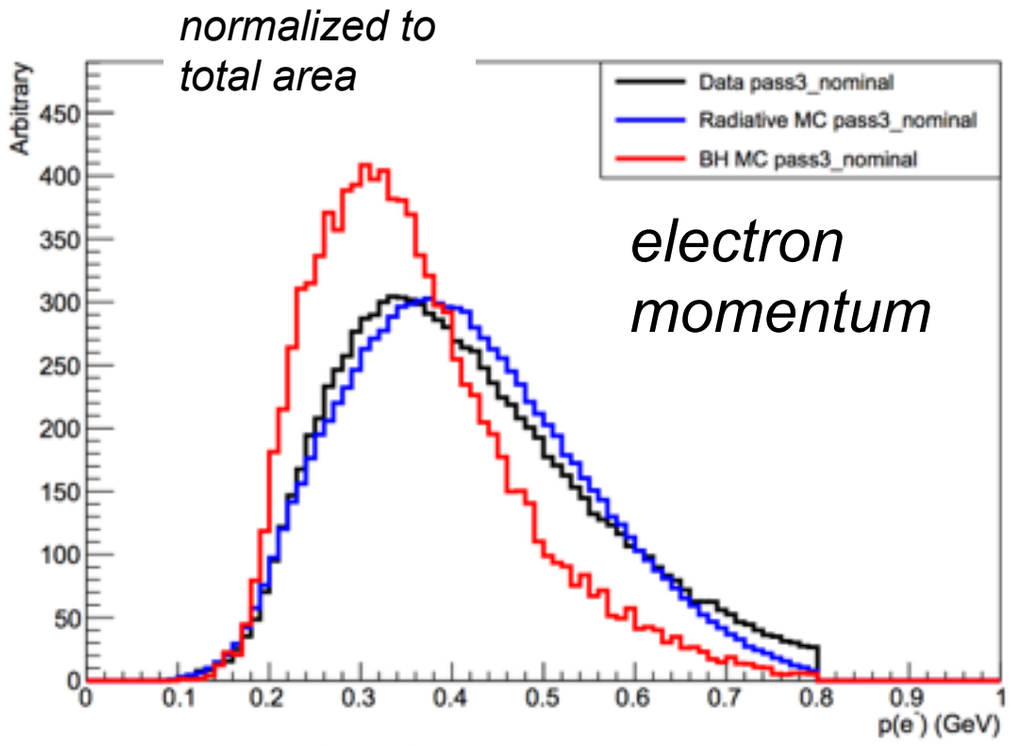


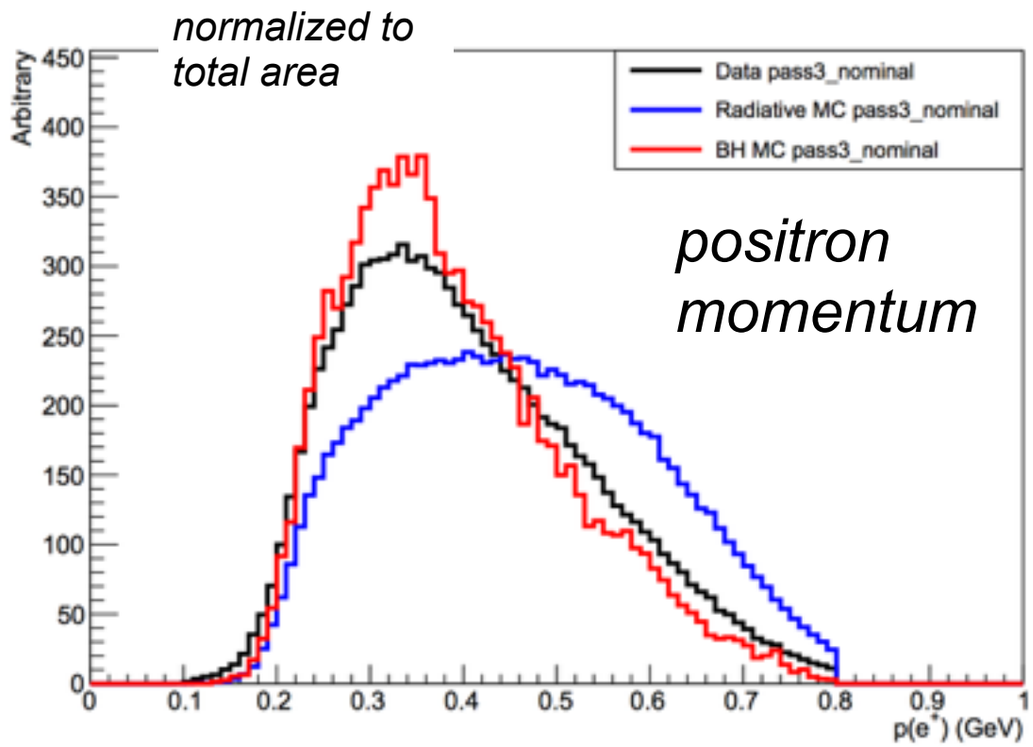
try cutting out events small angle tracks (either electron or positron)

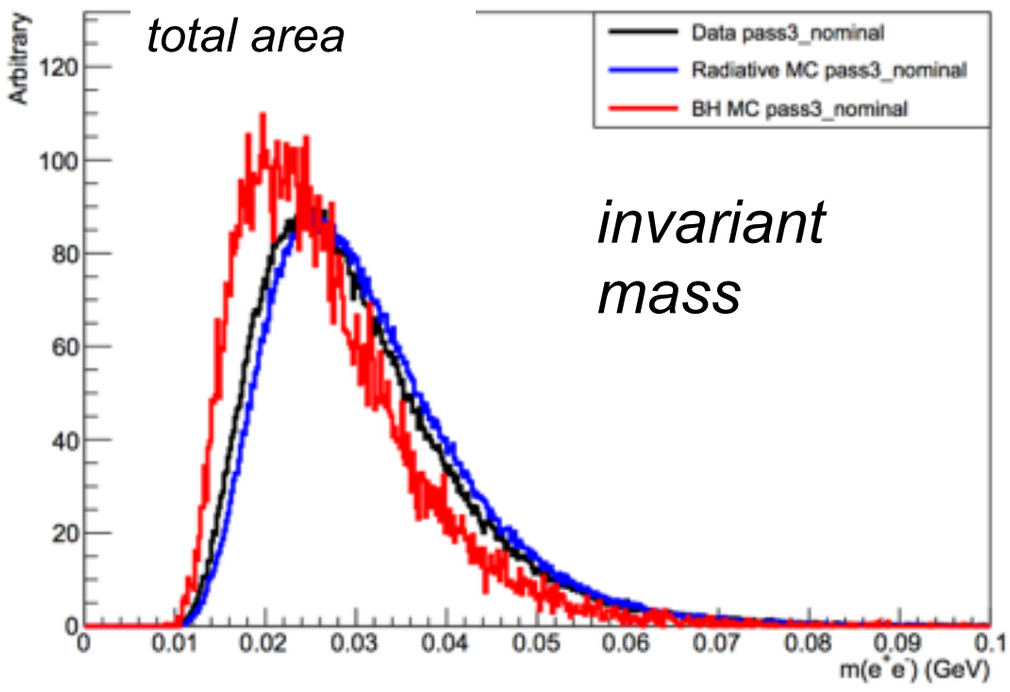
normalized to total area

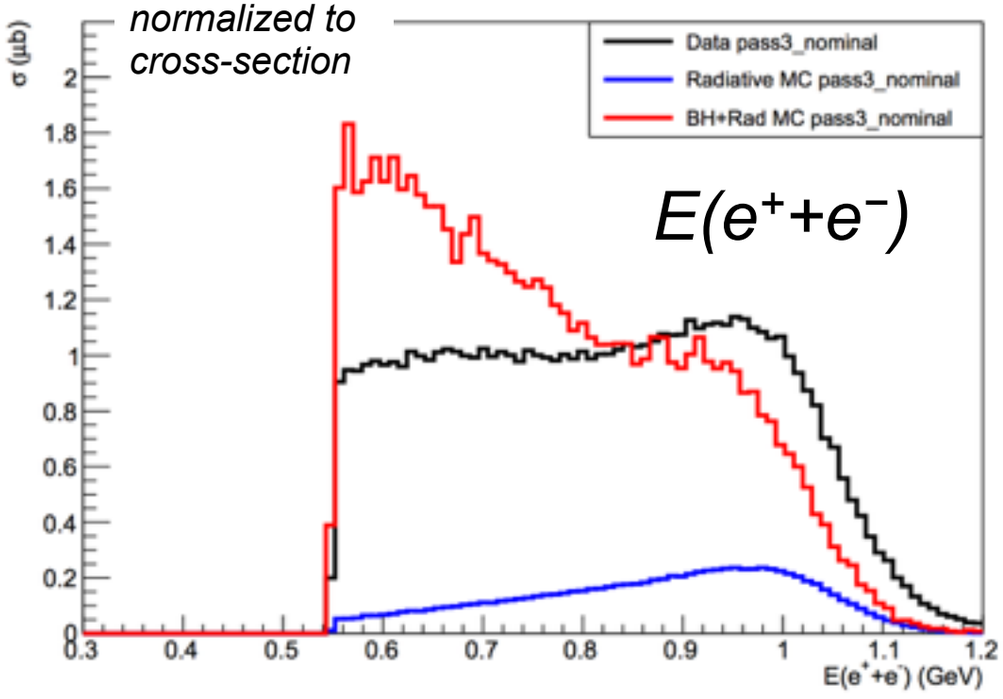


Data compared to BH & Radiative (not full $|A|^2$)

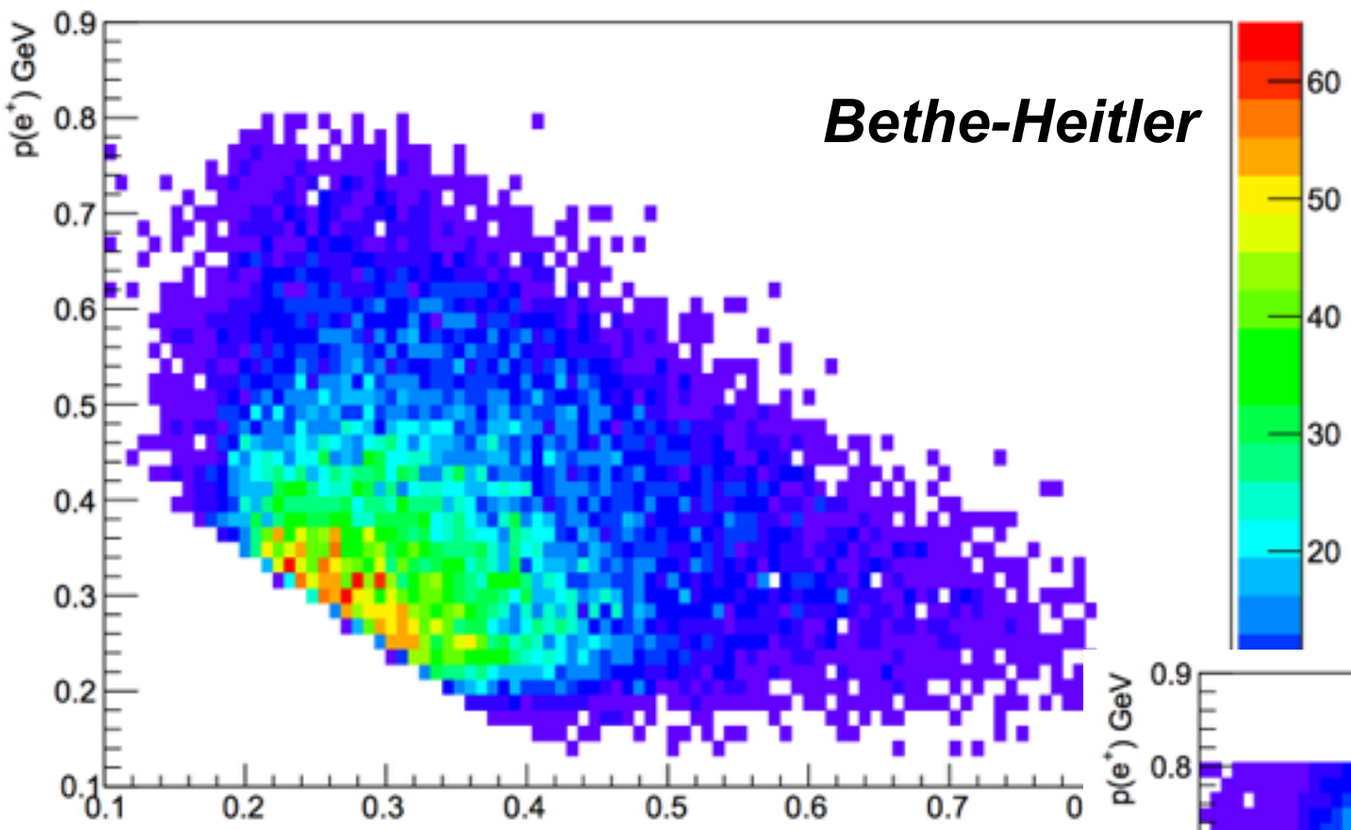


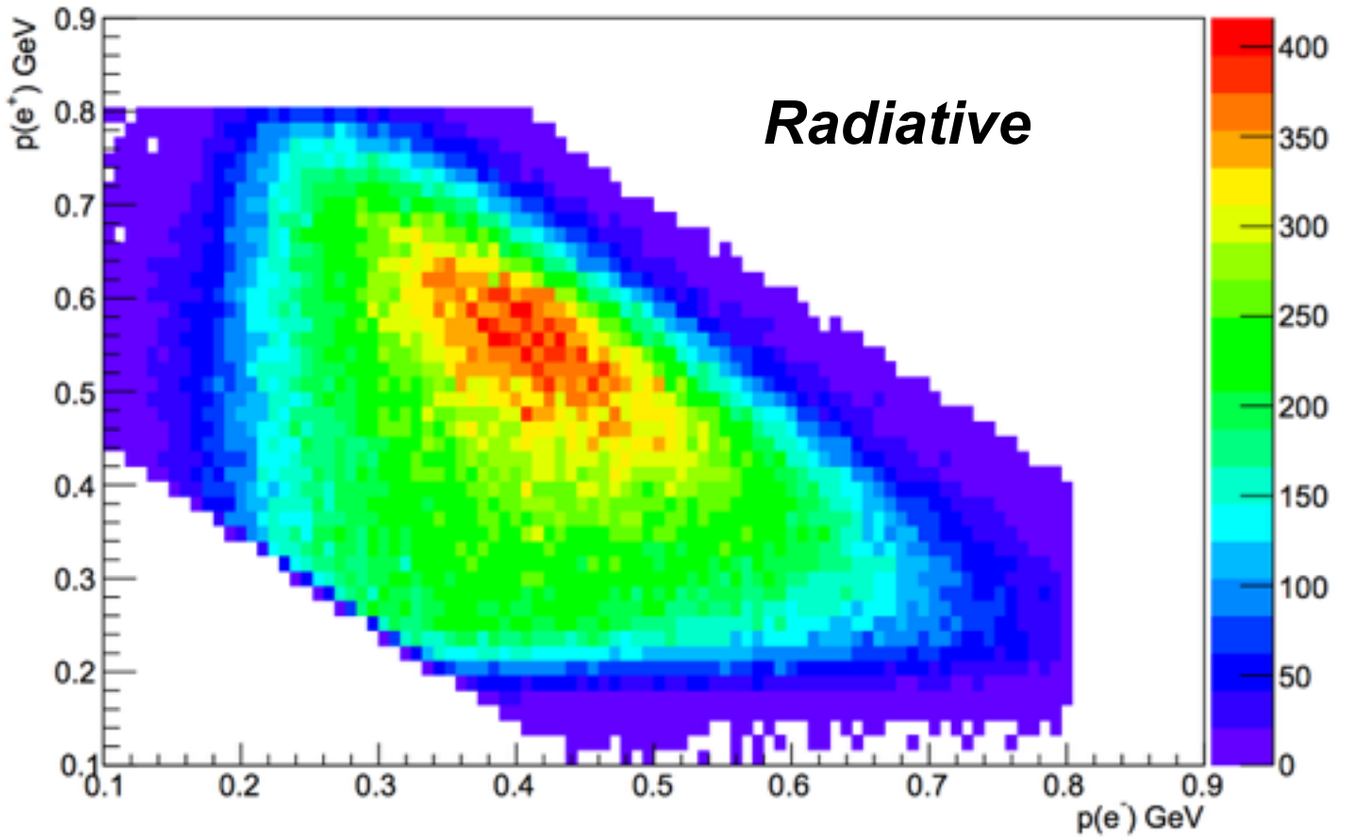






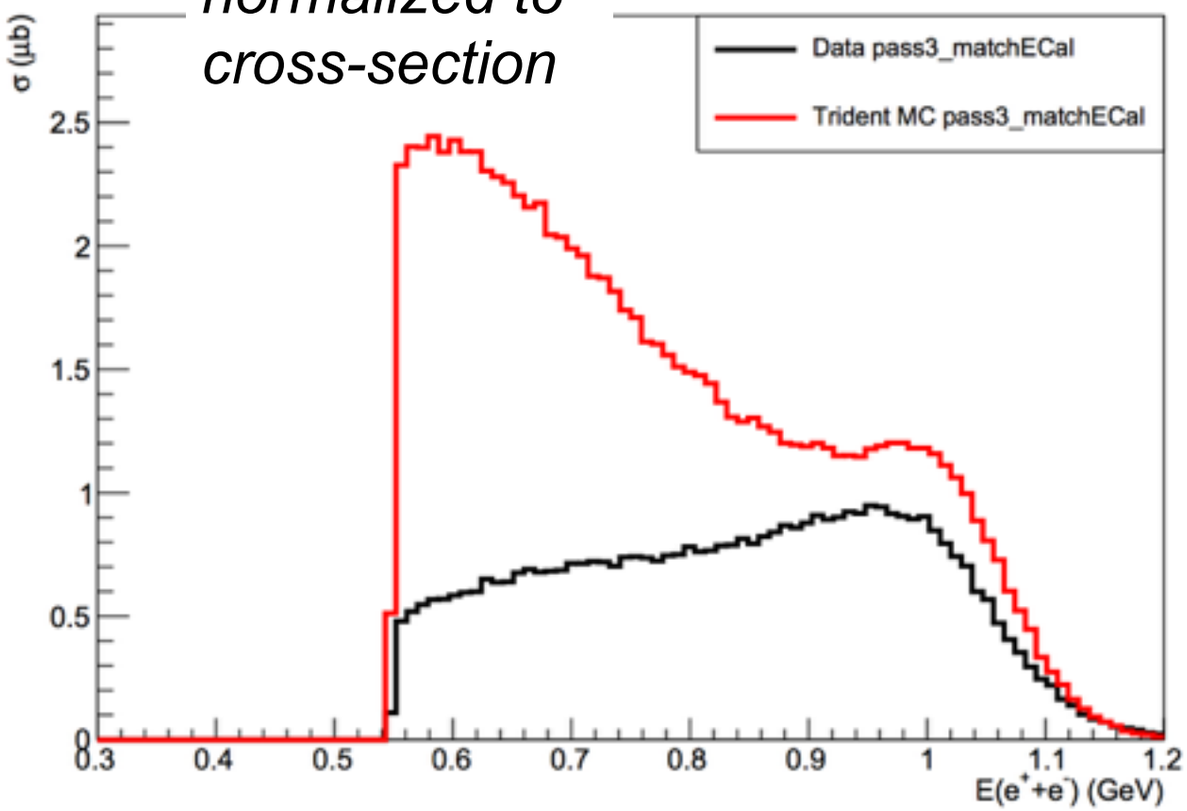
Colorful plots (compare to slide 6)



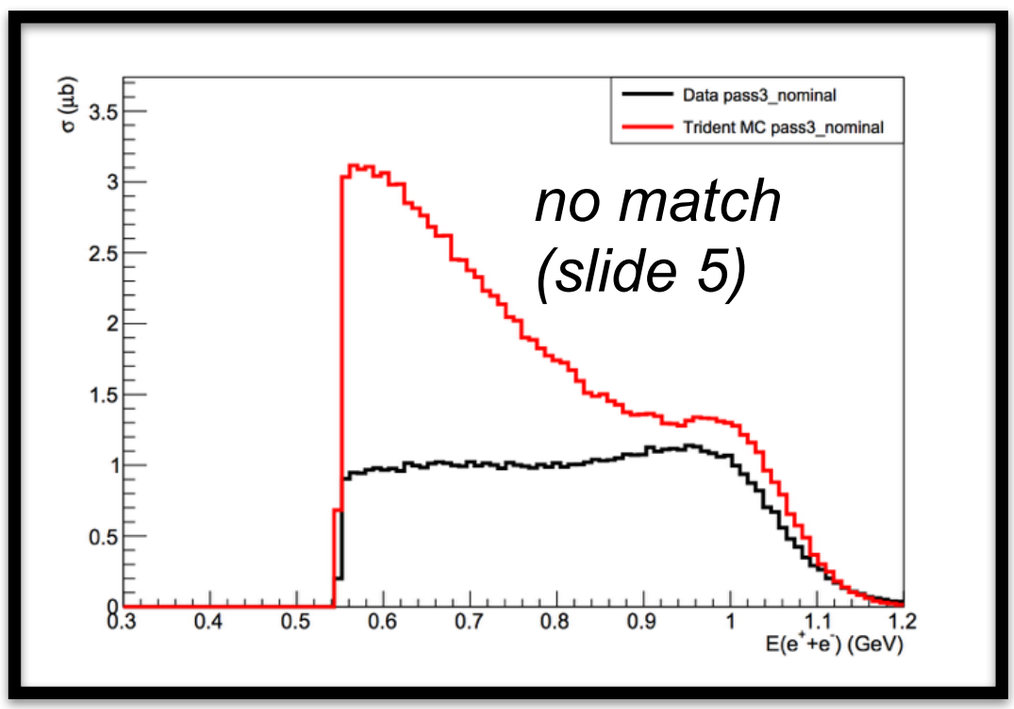


Requiring an ECAL match to both tracks

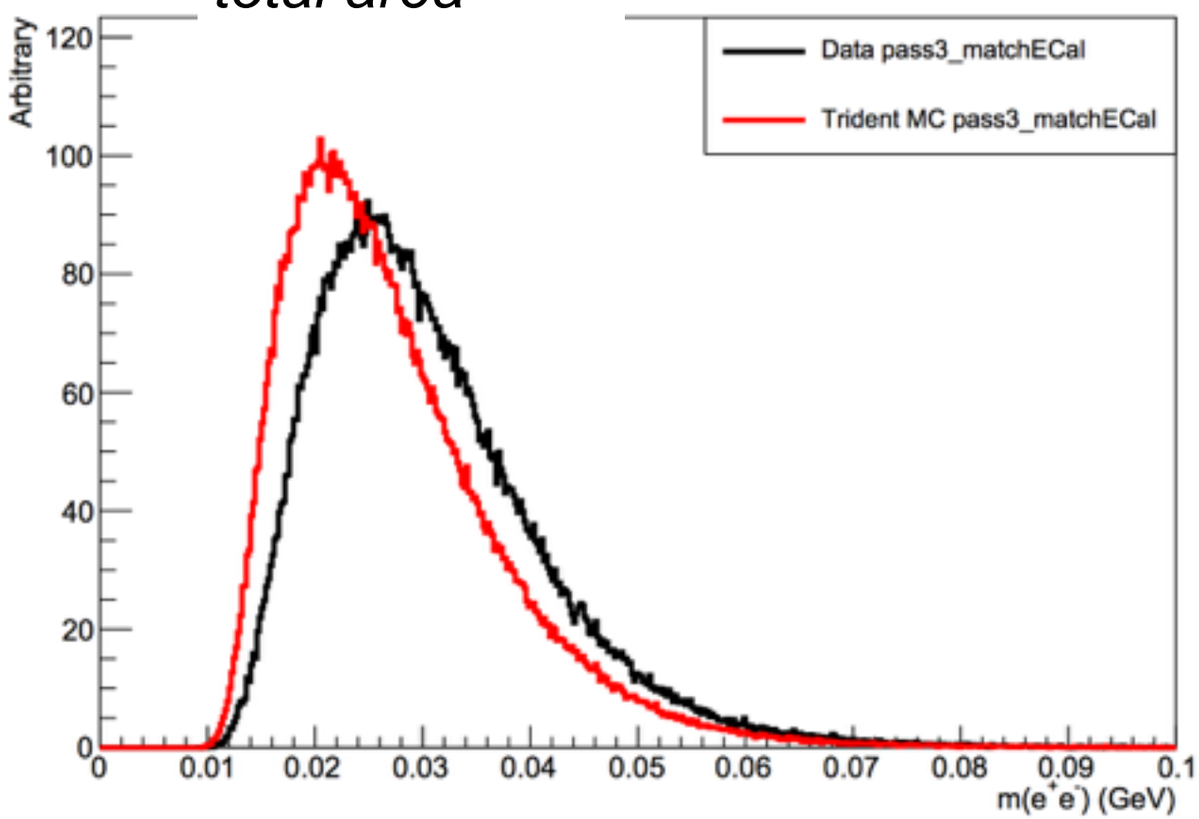
normalized to cross-section



match requirement efficiency:
data = 0.81
full trident mc = 0.84



normalized to total area



Now what?

- At high E_{sum} data and MC seem to match up well…this is good! High E_{sum} is where the dark photons are.
  - the cross-sections about E_{sum}>0.8
    - radiative MC ~ 6.3 μb vs 8.0 μb in the reach plot (~80%)
    - full trident (background) ~ 42 μb vs 97 μb in the reach plot (~43%)
    - we win !??!
- Low E_{sum} is still (still) a mystery
- I'm starting to think we should take another look at MadGraph generator…how do we know it's correct? APEX got good shape (and rate?) … but small bite …