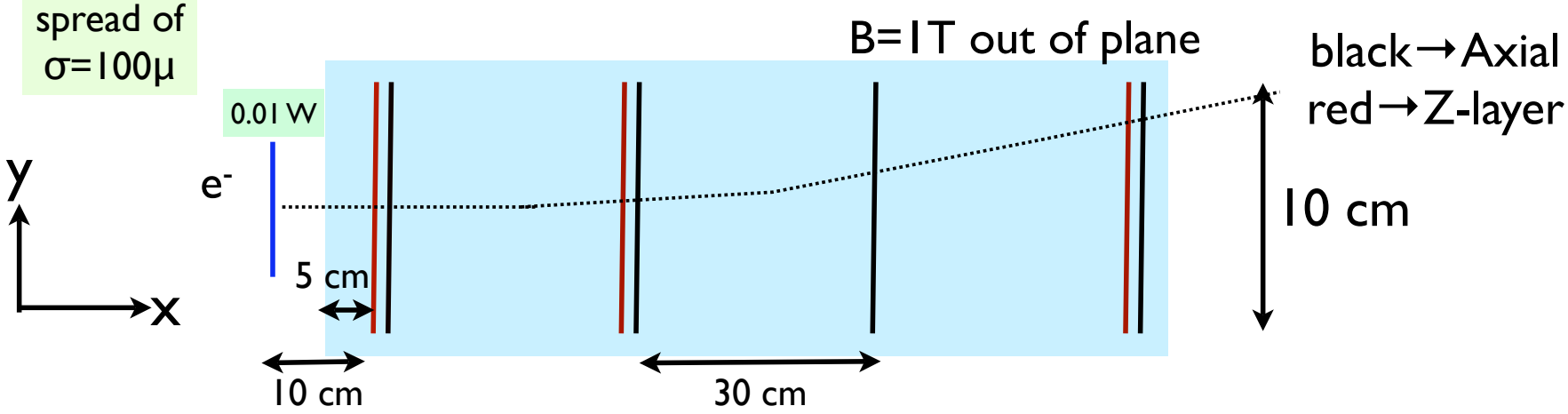
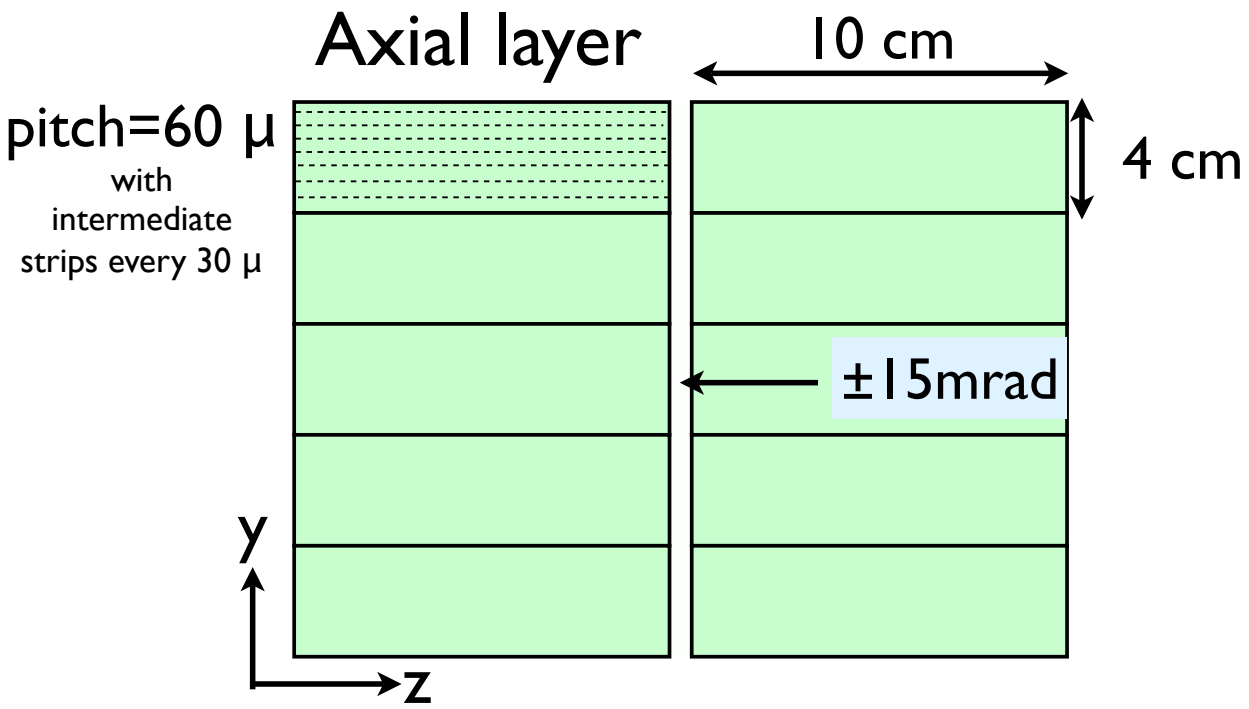
Layout and Setup (out of date)...

x-y beam spread of σ=100μ



Silicon is 300μ thick, no services; detector is in ***vacuum***

readout chip=APV25

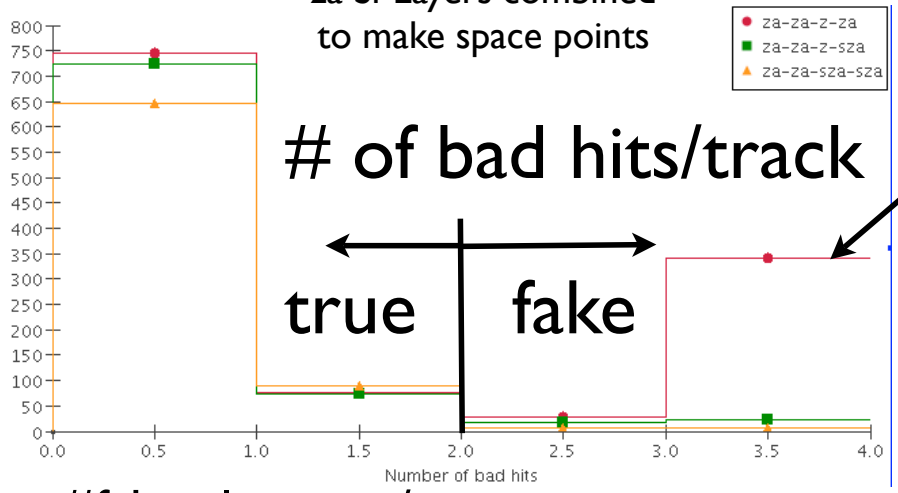


changes since last talk...

- moved to Takashi's latest layout (March 11 talk)
  - 15mrad gap
  - reduced number of sensors in layers 1 and 2
  - 100μ beam size (was using 200μ)
- Occupancies are quite a bit reduced...confusion and fake rate is quite a bit less than we've seen
- Compare 3 different layouts (a=axial=measures p; z=measures z; s=axial but tilted (1°)
  - default: za-za-a-za
  - minimal stereo: za-za-a-sza
  - maximal stereo: za-za-sza-sza
    - probably don't want to add additional layers closer in as it will hurt efficiency and resolution

200 MeV A' Signal in 25ns of beam

za Si-Layers combined
to make space points



# of bad hits/track

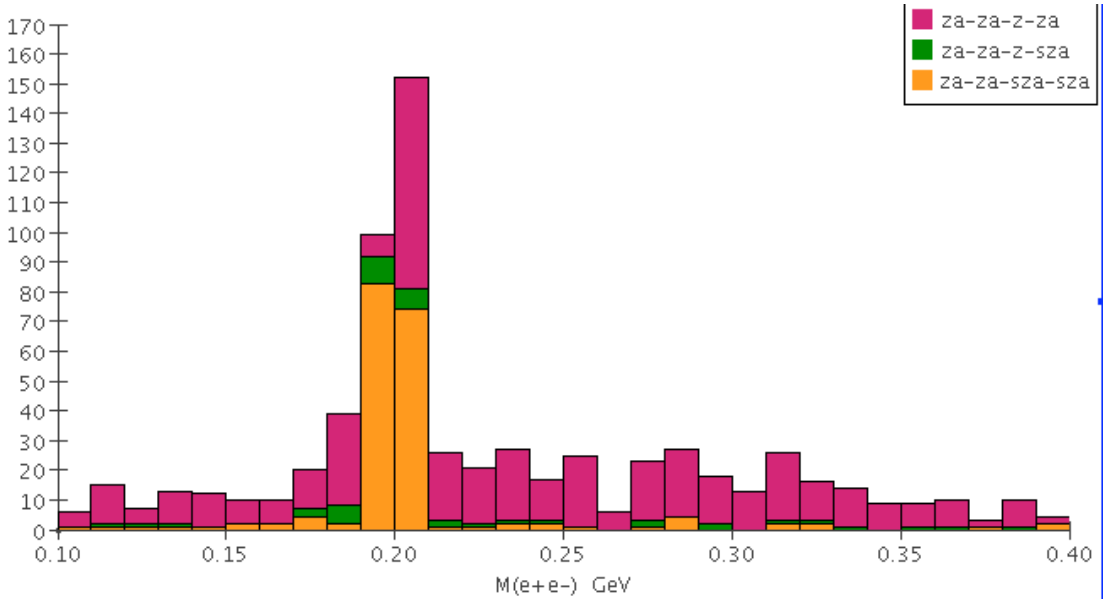
true | fake

random comb.
of hits

Adding 1 stereo layer in back greatly reduces fake/mishit rate

#fake electrons/event:
default ~ 0.25
min stereo ~ 0.025
max stereo ~ 0.01
#fake positrons/event:
default ~ 0.09
min stereo ~ 0.005
max stereo ~ 0.002

(based on only 1k events, so take absolute numbers with a grain of salt)



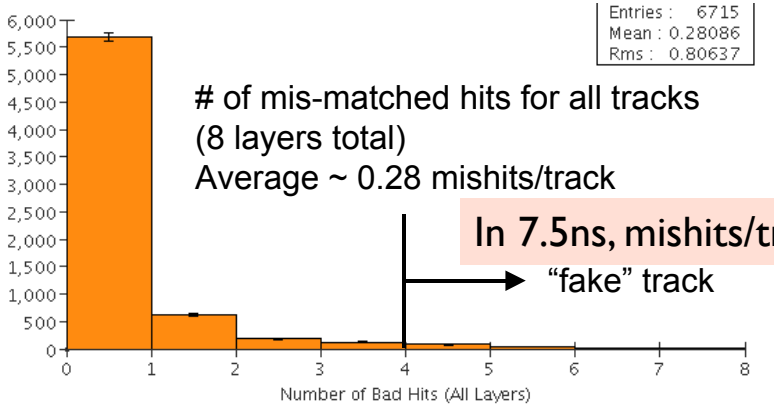
caveats and conclusions

- based on this, I'd say we need at least one stereo layer.
- Comparing "min stereo" to "max stereo" we see a slight drop in efficiency, reduction in fakes by ~2x, resolutions are ~ same (not shown)
  - drop in efficiency likely due to interactions in the 2 extra Si modules (not inefficiency in sensors themselves)
  - remember, I'm only including the Si, no services!
  - possible to get efficiency back by relaxing requirement that we have hits in all layers?
- Probably not being too clever in pattern recognition or event selection
  - strip-by-strip track finding may be a better route
  - reject particularly dirty events (i.e. reject if find>X tracks)
- I've looked at 7.5ns bunches as well and of course it's much cleaner...probably default layout is acceptable. But I think we want to be as far from the fake rate cliff as possible.

A closer look at the za-za-a-sza layout

...now, count hits in each layer separately

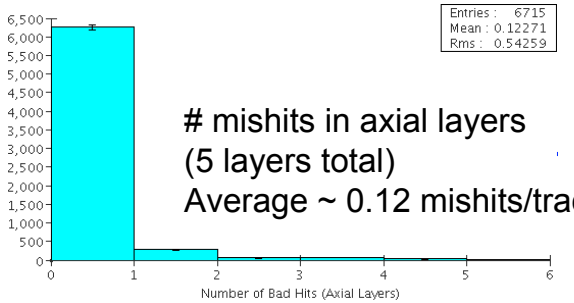
25ns beamtime



# of mis-matched hits for all tracks
(8 layers total)
Average ~ 0.28 mishits/track

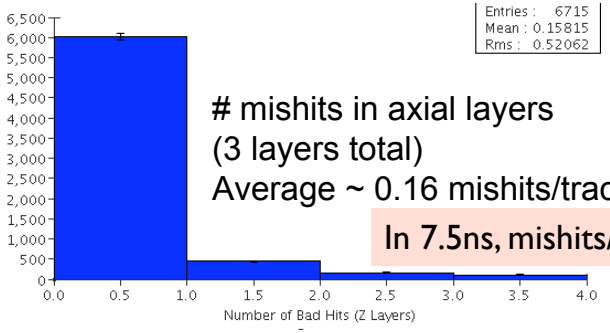
In 7.5ns, mishits/track→0.05

"fake" track



mishits in axial layers
(5 layers total)
Average ~ 0.12 mishits/track

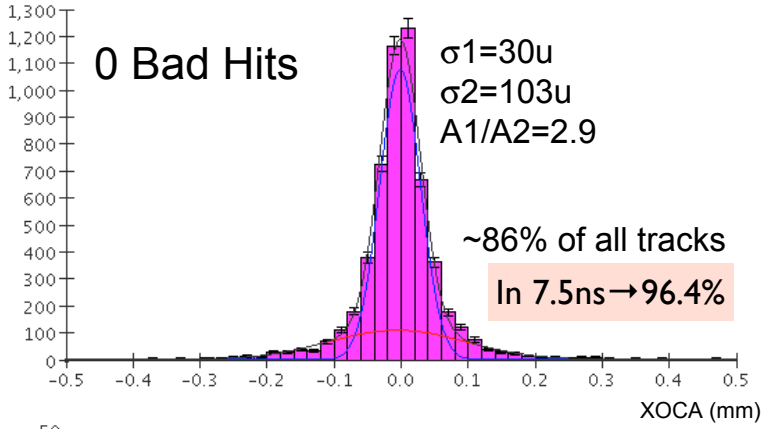
In 7.5ns, mishits/track→0.04

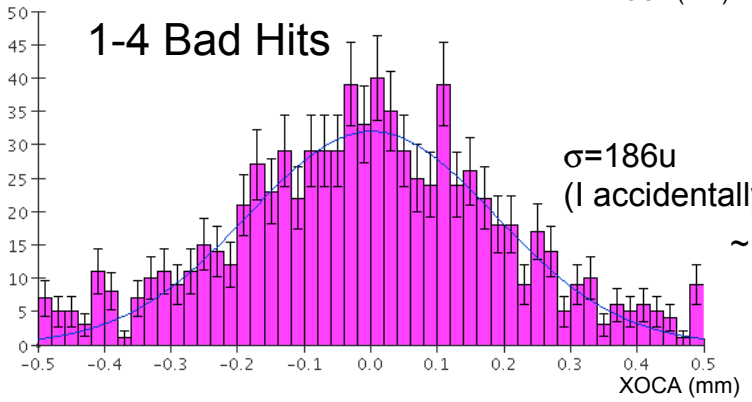


mishits in axial layers
(3 layers total)
Average ~ 0.16 mishits/track

In 7.5ns, mishits/track→0.008

XOCA Residuals

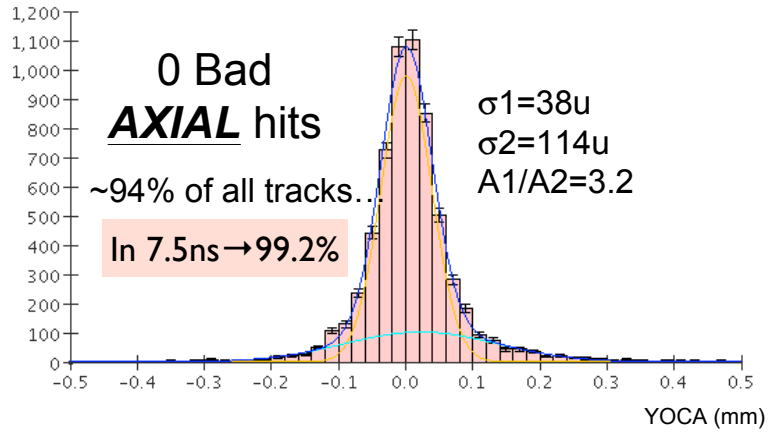




I calculate the POCA to the beam axis (X-axis)

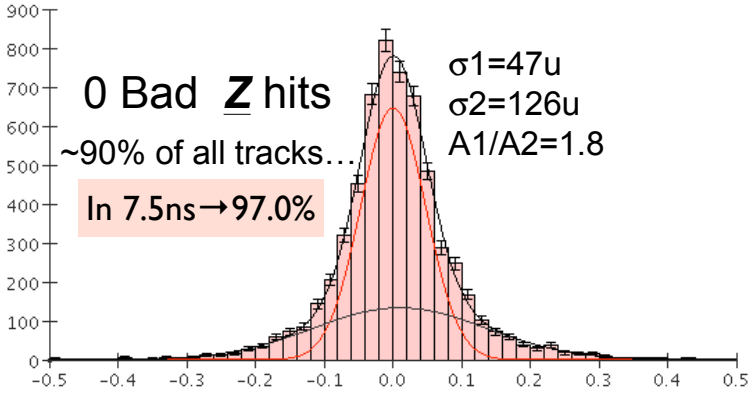
The XOCA residual for tracks with bad hits doesn't depend on whether hit was in an axial or Z-layer (to first order)

YOCA Residuals



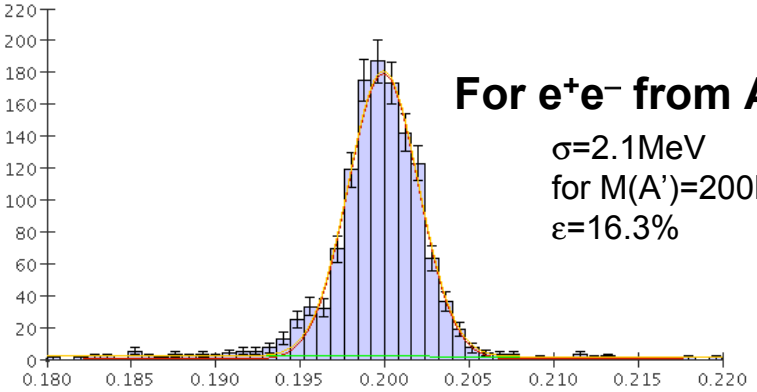
The YOCA (Y is the bend plane) distribution doesn't depend on mishits in the Z-layers…the other 6% of tracks with 1 or more mishits in the axial layers show a ~flat distribution between +/- 1mm (i.e. pretty much garbage).

ZOCA Residuals



…similarly, the resolution on ZOCA doesn't depend on mishits in the bend plane layers.

Mass Resolution

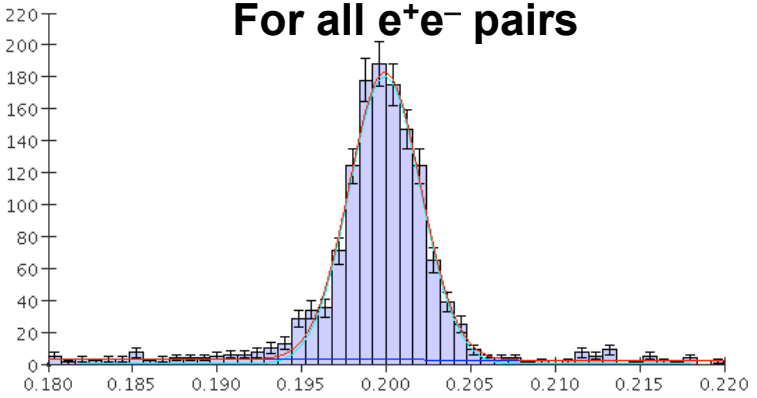


For e^+e^- from A' decay

σ=2.1MeV
for M(A')=200MeV
ε=16.3%

On the bump-hunt side, resolution is ~1%*M(A') (at least for 200MeV) and the res/bkg level isn't significantly effected by extra tracks in event …the bkg is spread out over large range of M(ee)

For all e^+e^- pairs



Summary/Conclusions

- According to this simulation, we can measure ~85% of the signal tracks with POCA resolutions of ~ (30,40,50)μ in (x,y,z)
- The other 15% of tracks have at least 1 mis-hit
  - I'm still using very loose tracking cuts…we can clean this up
  - Depending on whether the bad hit is in an axial- or Z-layer, y- or z-resolution gets worse. X-resolution is worse for either…
- The e^+e^- mass resolution is ~1%
- All of this was done with the A' decaying just outside of target…should also study what the effects are of varying the decay position
- Also, used 200MeV A'…study how these depend on mass

In 7.5ns, these improve to ~96%/4%

•so far, only looked at impact parameters...need to look at vertex resolutions (Rich is putting this in lcsim)

  •need more fully reconstructed A's → do things more efficiently

•Takashi has a new layout with 5 detector planes (shorter distance between planes)...already built this geometry, testing now

  •I doubt it will change the conclusion that we need at least 1 stereo layer (means have at least 9 Si layers total -- za-za-a-sza-a)