



Lessons learned in CSA07

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2 November, 2007



From our CSA07 results, we discovered a mistake in our procedure. We know how to correct this mistake, but it will increase our computing requirements.

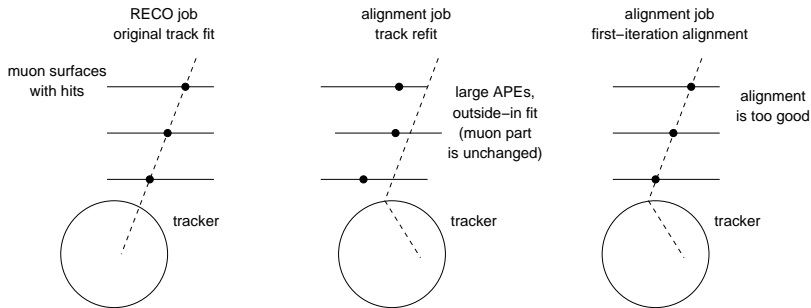
Original procedure	Modified procedure
4 CPU-hours (10k events) tens of MB	tens to a few hundred CPU-hours same

Because our original procedure required so few resources, we used the CSA resources to explore the parameter space in 40 parallel jobs.

We had a problem with limited quota on scratch0, so we re-ran our jobs on /tmp disks and copied the results to CASTOR.

We also had problems with jobs crashing because rf_open failed (intermittent, couldn't reproduce)

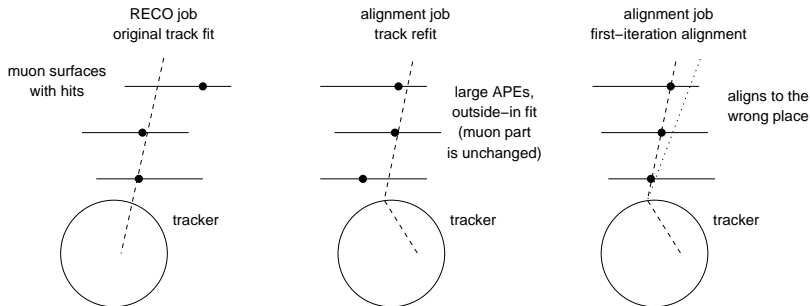
Mistake in the old procedure



Ideal RECO geometry creates ideally-fitted tracks. These should be re-fit in the alignment algorithm, but because the APEs were large *and* the fit was outside-in, that part of the track was not changed.

Alignment output was too good because information about the ideal geometry was stored in the unchanged part of the track

How we found it with CSA07



CSA07 event samples are misaligned at the RECO level, so we get a non-ideal tracking seed. The muon part of the track is again not changed, so we incorrectly align to whatever was used in RECO.

(At first, I thought this was because a misaligned scenario was used in simulation.)



Verification process: to be certain that this is the problem

We isolated the cause by reconstructing and aligning our own $Z \rightarrow \mu\mu$ sample under every combination of CMSSW version

- ▶ 1_5_4

- ▶ 1_6_4

and geometry (ideal, misaligned) at each stage of reconstruction

- ▶ local RecHit reconstruction

- ▶ muon track-fitting

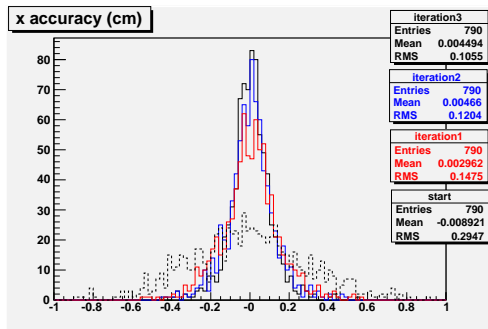
- ▶ muon id

The problem is 100% correlated with misaligned geometry in muon track-fitting



Alignment quality with inside-out refitting (preliminary)

100k events, 8 mm APEs in the muon system, 3 iterations



1

2

3

4

Muon barrel stations

490 μm 680 μm 960 μm

1.4 mm

Muon endcap MEx/1 stations

510 μm 670 μm 980 μm

1.1 mm

Muon endcap MEx/2 stations

830 μm

1.2 mm

1.5 mm

Further improvements

- ▶ More iterations and an optimized descending-APE scheme (naturally)
- ▶ Accuracy is limited by extrapolation through material: can make better use of tracks by aligning one station at a time
 1. Set APEs for each station to 8 mm, ∞ , ∞ , ∞
 2. Align station 1
 3. Set APEs for each station to 0 mm, 8 mm, ∞ , ∞
 4. Align station 2...
- ▶ More resources will be required, probably tens to a few hundred CPU hours

Conclusions

- ▶ Very good news: we found this mistake in time to fix it
- ▶ Bad news: all of our results, systematics studies, etc. need to be updated with a new procedure