Supernova pointing and DAQ

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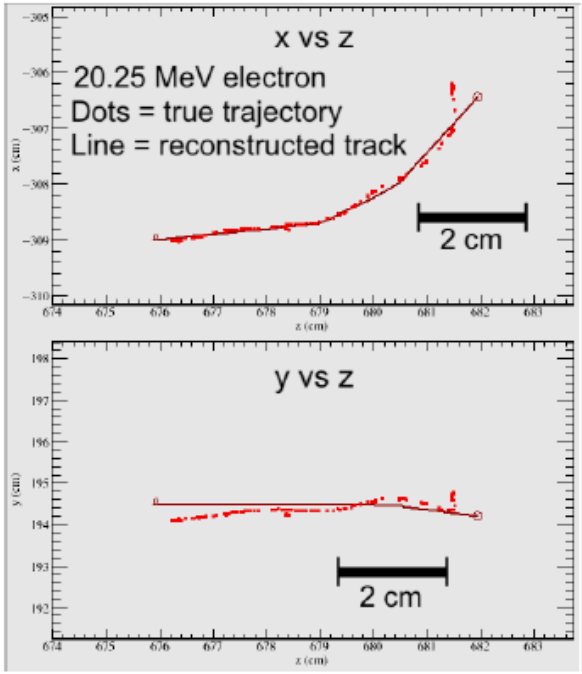
Introduction

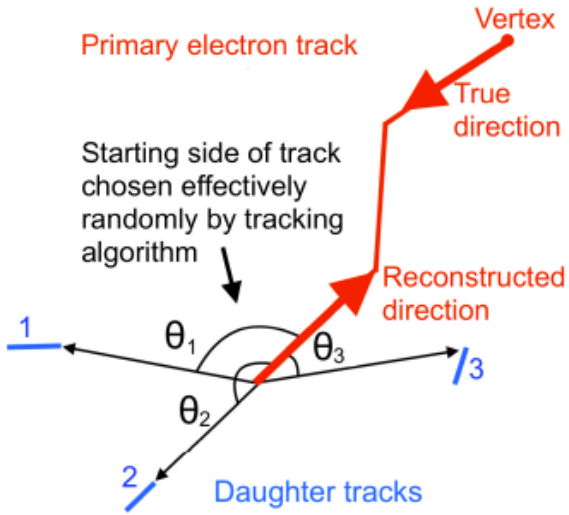
- Why supernova pointing?
- Offline results (AJ Roeth, Duke)
- Implications for DAQ design

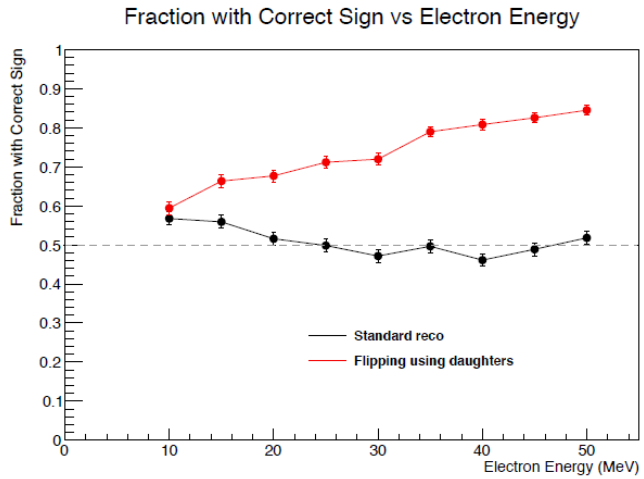
Why supernova pointing?

- Produce a SNEWS (SNEWS 2?) alert
- Followup observations of shock breakout, *early* light curve, spectrum. (Without neutrino burst, have to rely on serendipity)
- Timescale: SN1987A neutrinos were a few hours before visible light. SN1987A was unusual: I'm told days is more likely

Offline results 1



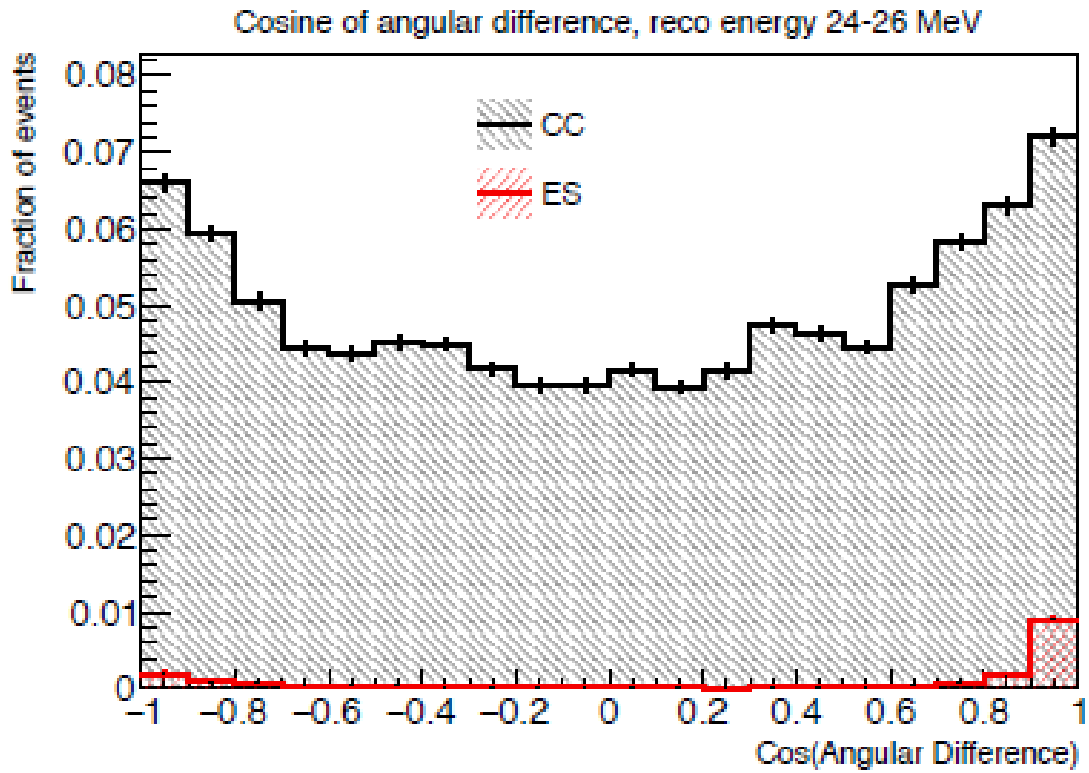




- All plots taken from AJ Roeth's collab mtg talk:

  https://indico.fnal.gov/event/18681/session/6/contribution/160/material/slides/0.pdf
- FD MC, full offline reco. All three views. No noise or radiologicals
- Pick end of track with smaller angles to daughters as vertex
- Upshot: a relatively-straightforward technique improves directional disambiguation (shown for single electrons)

Offline results 2: charged-current and electron-scattering events



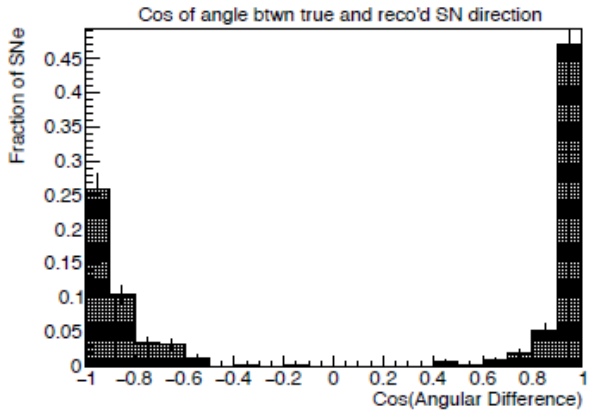
AJ Roeth

- Electron-scattering events have very good pointing, but there's *some* information in the CC events too

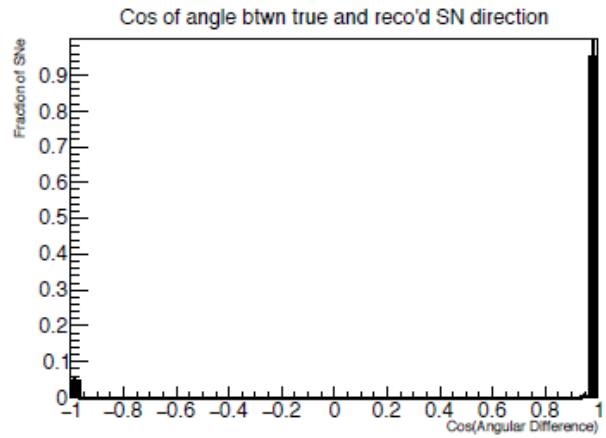
Supernova pointing resolution

- Daughter flipping & likelihood function help a lot
- Difference after adding CC events probably just small fluctuation (low statistics), but shows CC events don't drastically drown out directionality of ES events

	ES only No extra flipping, maximum bin is SN direction	ES only Daughter flipping, maximum bin is SN direction	ES only Daughter flipping + likelihood function	ES + CC Daughter flipping + likelihood function
Pointing resolution	147.2°	30.6°	9.7°	7.5°



ES only, no directional disambiguation, no likelihood function



ES + CC, daughter flipping, using likelihood function

AJ Roeth

Implications for DAQ

- I think AJ's studies tell us that online supernova pointing is probably feasible
- Current DAQ design doesn't include a path to do this though
  - TP stream only has collection wires: no pointing
  - SN dump stream too big(?) to process online; no tee in design
- Some options:
  1. Tee SN dump stream somewhere else to do processing for pointing
  2. Make full-APA readout of small time windows around clusters identified in collection channels; process this data for SN pointing
  3. Do TP-finding on all views; use TPs as input to pointing reco
- Might need extra CPU at SURF, or could send reduced data to FNAL with 100 Gb WAN(?)