Sand $\mu$ data/MC comparisons for widths

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Compare data and MC for width variables using sand muons

- Used oaAnalysis files from runs 1 and 2
  - About 65k stopping, 100k throughgoing
- Reco PID variables charge-based: wait for charge-rescaling processing
- Widths not so sensitive to that, and $\nu_e$ analysis specific
- Everything here is stopping $\mu$ (unless stated)
Mean width from fit ("PosNo" in oaAnalysis files)

Effect is "robust": shows up in mean, throughgoing, with $\cos\theta_z > 0.98$
cut, singlets, doublets, fiducial events

Possible culprit: alignment
Alignment

MC is perfectly aligned, data is not
Reco uses perfectly aligned geometry
Try generating misaligned MC:
  Each P0Dule\(^1\) translated by value randomly chosen from \(N(0, 5\text{ mm})\)
  Generate MC with misaligned geom, but reconstruct with nominal geom

\(^1\)well, not all: bug in nd280mc, fixed in HEAD
Misaligned results: mean width

- On right: aligned misaligned

- 5 mm is implausibly large, but so is resulting width change
Misaligned results: node widths

- On right: aligned and misaligned
- OK, but maybe we weren’t going to use fit width anyway...
Width from hits: mean and median

- Excess at high widths
- (More MC stats would be nice, but won’t fix disagreement)
- Excess at high widths: follows shape reasonably
- Possibility: noise hits clustered with physics hits?
  - How well is noise rate/spectrum modelled?
- Could it be $\delta$ rays?
Widtths from hits: all nodes, throughgoing $\mu$

- Excess at high widths, but follows shape very well
- Wild speculation: something we model well, but at the wrong rate?
"Inputs" to width from hits

- Left: number of hits per node. Right: fraction of nodes with $n_{\text{hits}} > 2$
- Excess of singlets shouldn’t affect width (with or without fit), excess at $n_{\text{hits}} > 2$ will
What to do about it...

- Drop width altogether?
  - But there are equally bad disagreements in PID variables
- Try fiddling noise, $\delta$ rays, . . .
- Could scale up $\mu$ BG in analysis by factor given from sand $\mu$
- Or just eat it as a systematic