Proposed changes to recob::Hit

Erica Snider

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The methods in question

- recob::Hit
  - Contains two members that (in principle) estimate total charge in the hit

$$\sum_i (ADC)_i$$

```
143
144     /// The sum of calibrated ADC counts of the hit (0. by default)
145     float SummedADC() const;
146
147     /// Integral under the calibrated signal waveform of the hit, in tick x ADC units
148     float Integral() const;
149
```

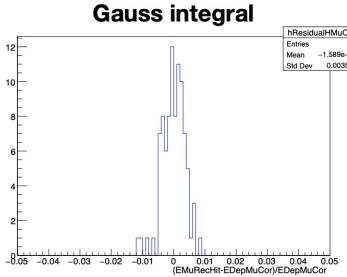
$$\int_t \text{Fit\_to\_pulse\_shape}(t)dt$$

  - Seems reasonable to expect these to track each other fairly closely
  - All experiments use GausHitFinder to find hits, fill recob::Hit

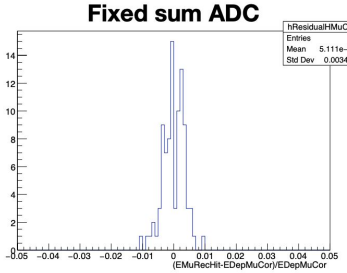
DUNE energy reconstruction studies

Anselmo Meregaglia, et al.

- In course of energy reco studies, looked at SummedADC and Integral
  - Not all hits have good values for Integral
    - Gaussian fit sometimes fails
  - Generally, found that SummedADC as good as Integral in energy reco
    - In principle still works when Gaussian fit fails



$$\int_t \text{Fit\_to\_pulse\_shape}(t)dt$$



$$\sum_i (ADC)_i$$

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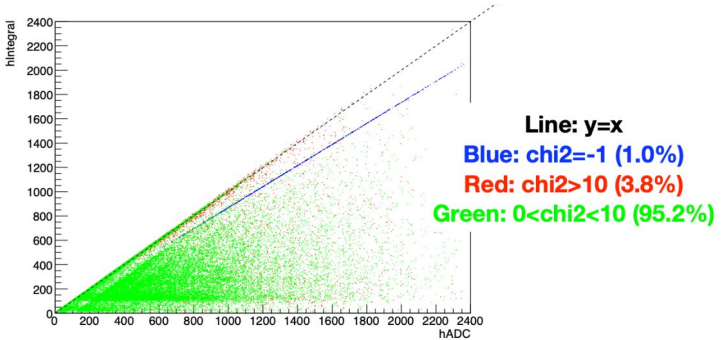
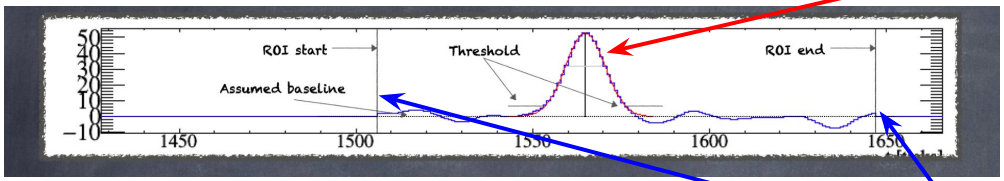
  - Not all hits have good values for Integral
    - Gaussian fit sometimes fails
  - Generally, found that SummedADC as good as Integral in energy reco
    - In principle still works when Gaussian fit fails
  - Also found that SummedADC does not always track Integral



Hits from GausHitFinder

- Hits reconstructed within “region of interest” (ROI)



Tracy Usher, “GausHit Finder Updates”, LCM, June 19, 2018

$$\int_t \text{Fit\_to\_pulse\_shape}(t)dt$$

$$\sum_i^{\text{ROI}} (ADC)_i$$

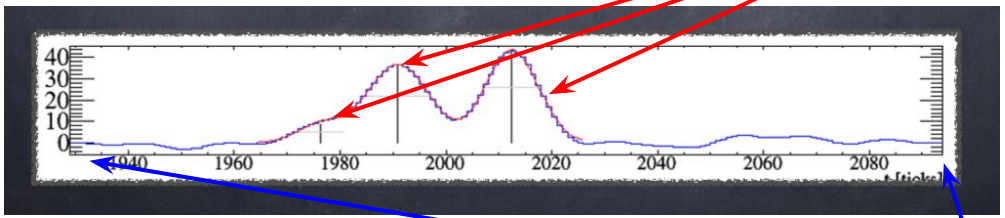
  - Isolated hits: approximately same value of SummedADC and Integral

Hits from GausHitFinder

- Hits reconstructed within “region of interest” (ROI)
  - For overlapping hits:

$$\int_t \text{Fit\_to\_pulse\_shape}(t)dt$$

Each hit has distinct value of Integral



Tracy Usher, “GausHit Finder Updates”, LCM, June 19, 2018

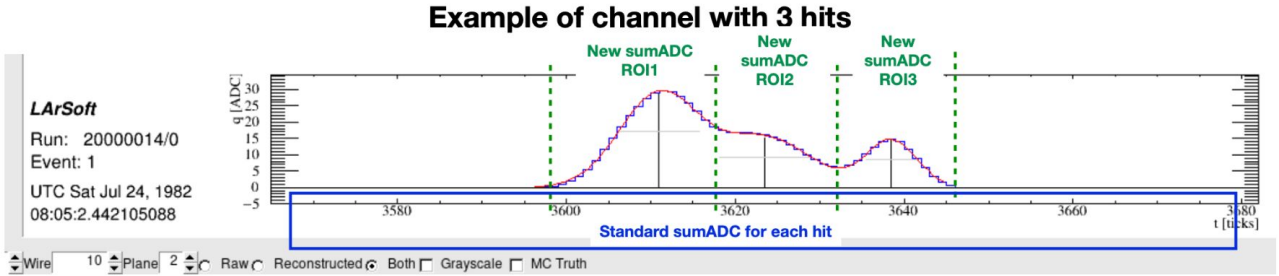
All hits in ROI get same value of SummedADC

$$\sum_i^{\text{ROI}} (ADC)_i$$

  - This is a known “feature” of GausHitFinder
    - Unclear from header comments that this is possible

What to do?

- DUNE proposes a “fix”

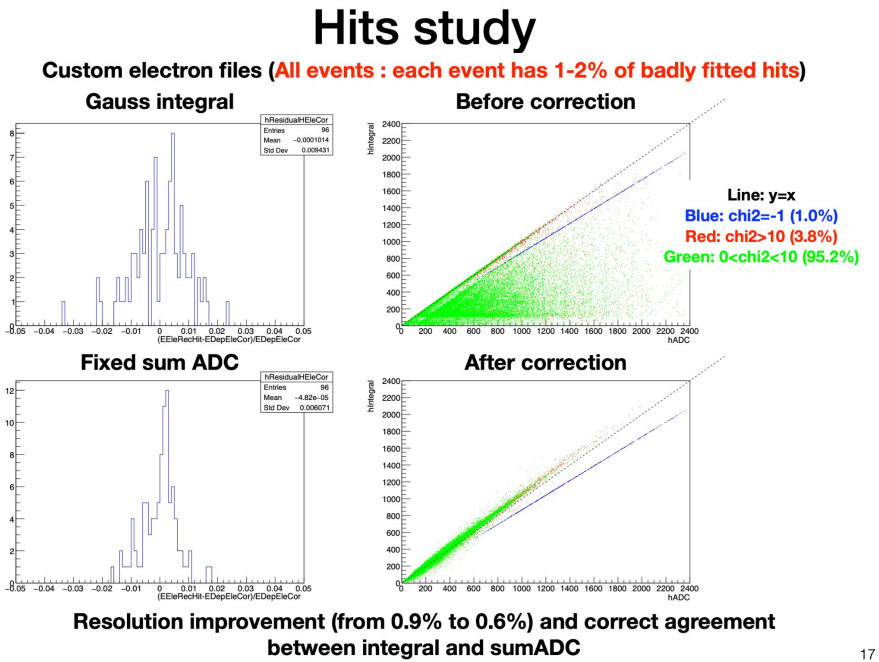


Anselmo Meregaglia, et al.

  - Uses fitted sigmas to define region for ADC sum, sharing between overlaps

What to do?

- After the fix
  - SummedADC tracks Integral
  - Resolution in some cases improves



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Proposed changes to recob::Hit

SummedADC is in use, so cannot just change the behavior

- Proposal
  - Change name of “SummedADC” to “ROISummedADC”
    - Describe as algorithm-dependent value that may sum over full range for overlapping hits (the “ROI”)
  - Add following methods / data members
    - HitSummedADC()
      - Algorithm-dependent value equal to sum of SDC for time ticks assigned to the hit.
      - Intended to be “simple” analog of Integral
    - HitSumStartTick(), hitSummedEndTick()
      - First and last time ticks used to calculate HitSummedADC()
      - In same units as StartTick() and EndTick()

Comments, discussion?

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The end