Lifetime and XSec Tests: Part 2

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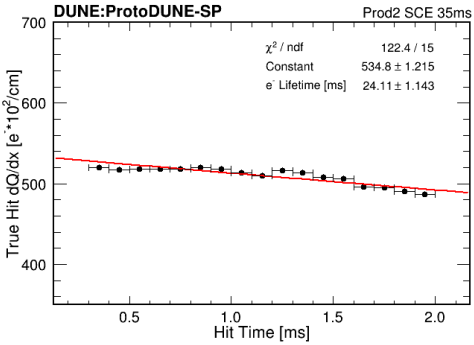
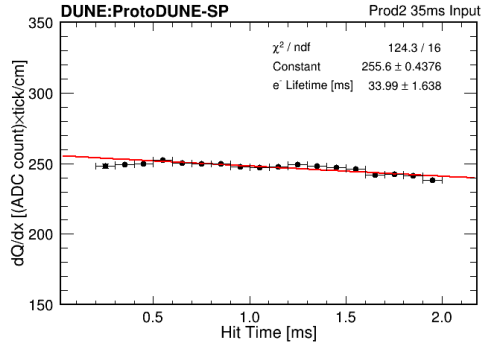
Truth Lifetime Tests

- Used the backtracker to take all the true electrons from a TPC hit and measure the dQ/dx from the electrons on the wire alone.
- Make corrections for the SCE as needed on the true electrons on the wire using the same correction between true electrons on the wire and hit integral. (Yes, I know these are different)
- Compare the lifetime from true electrons on the wire to the simulation.

There are plenty of single generator tests that show the lifetimes match for a single generator without an angle:
`https://indico.fnal.gov/event/43228/contributions/185638/attachments/128161/154915/Prod_3_Electron_Lifetime_Tests.pdf`

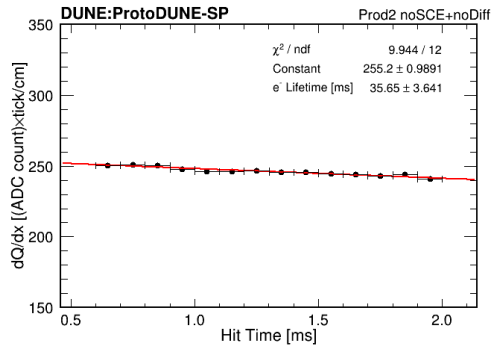
Background: Prod. 2 35 ms with SCE





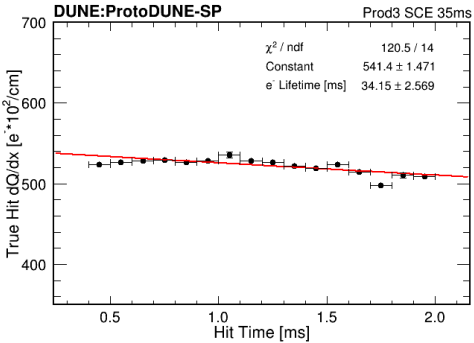
Prod 2 35 ms truth (left) and with hit reco (right)

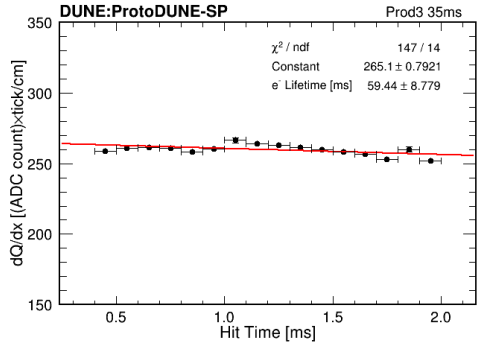
Background: Prod. 2 35 ms with noSCE+noDiff



Legacy 35 ms with noSCE+noDiff

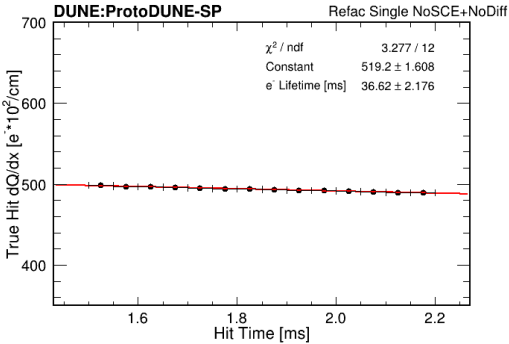
Background: Refactored Simulation 35 ms with SCE

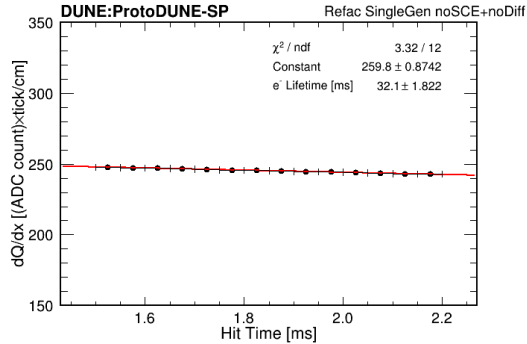




Refactored with CryoFix with SCE 35 ms truth (left) and with hit reco (right)

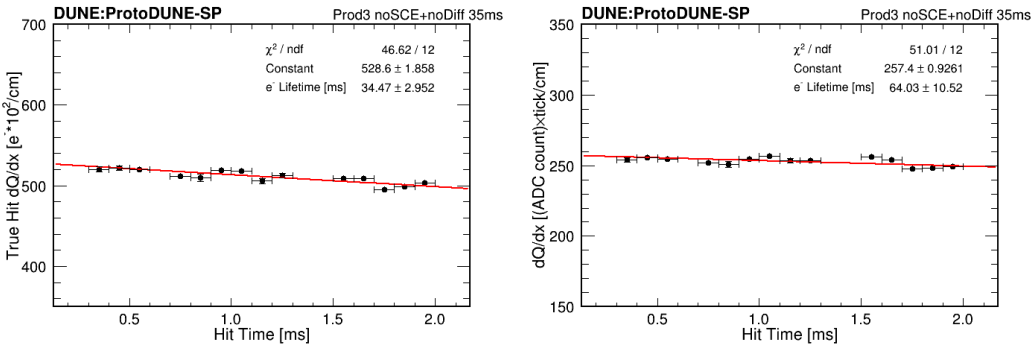
Background: Refactored Simulation 35 ms with noSCE+noDiff Single Gen





Refactored with SingleGen with SCE 35 ms truth (left) and with hit reco (right)

Background: Refactored Simulation 35 ms NoDiff+NoSCE

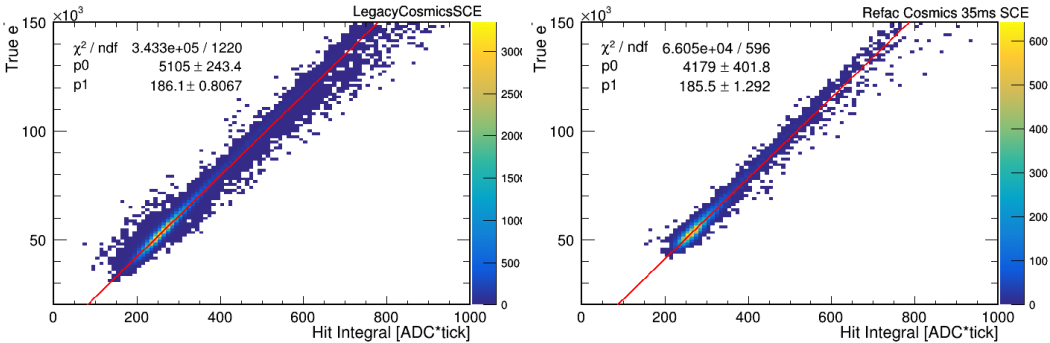


Refactored 35 ms truth (left) and with hit reco (right)

Truth Hit and Reco Hit

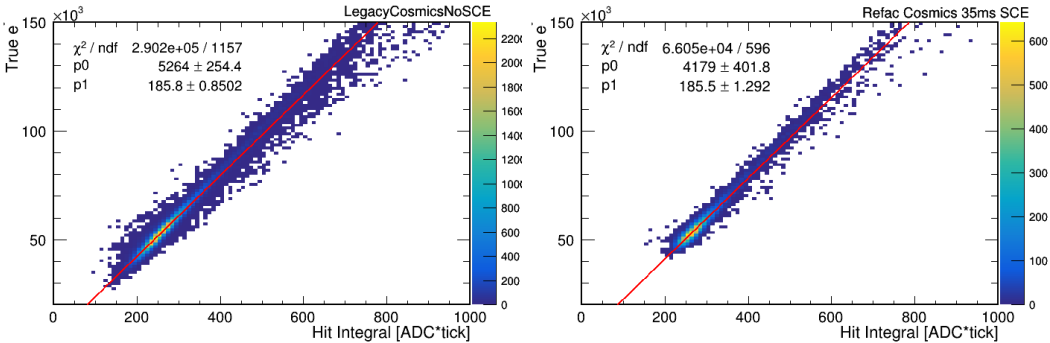
- Based on David Adams' suggestion I simply plotted a 2D distribution of the true electrons on a wire and the reconstructed hit.
- There are a lot of combinatorics, so I apologize for the lack of information or the inundation of data.
- All of these tracks are matched with the CRT reconstruction.
- I added a linear fit just to compare the constant and slope between different distributions.
- These distributions are likely poorly zoomed in and binned, but I had to make some sacrifices to fit everything.

Truth and Reco 2D Distributions



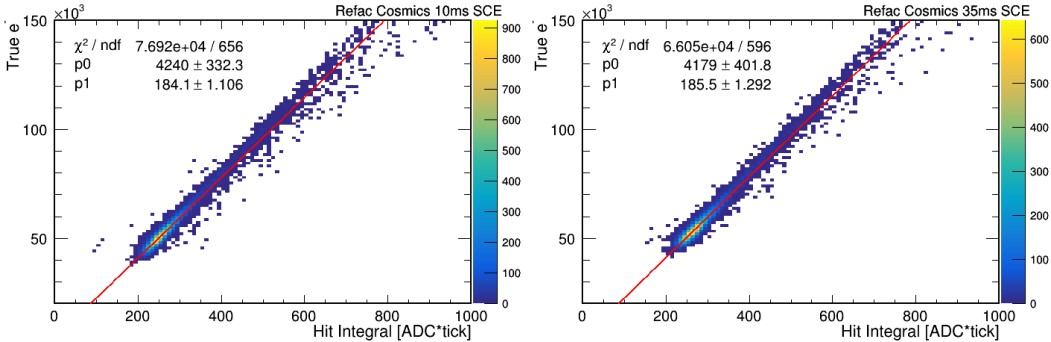
Legacy cosmics (left) and refac. cosmics (right)

Truth and Reco 2D Distributions



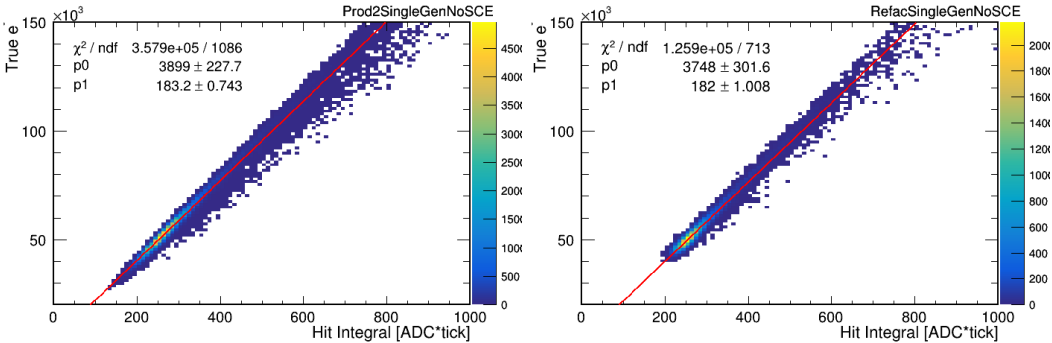
Legacy cosmics with noSCE (left) and refac. cosmics (right)

Truth and Reco 2D Distributions



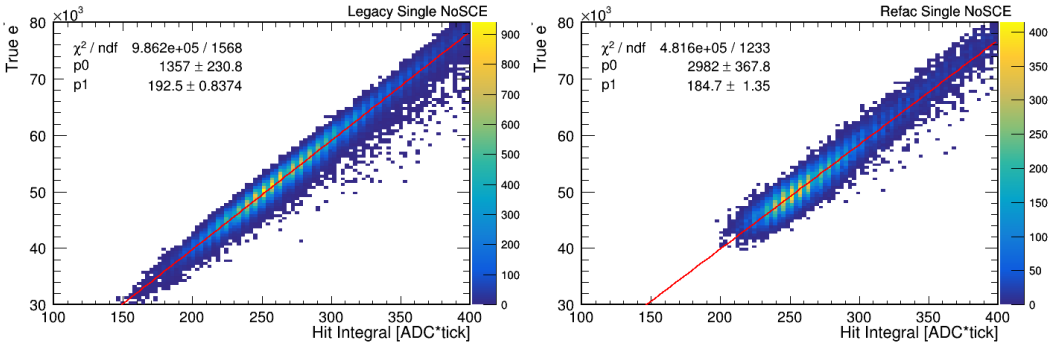
Refac. cosmics with 10 ms drift lifetime (left) and refac. cosmics with 35 ms drift lifetime (right)

Truth and Reco 2D Distributions



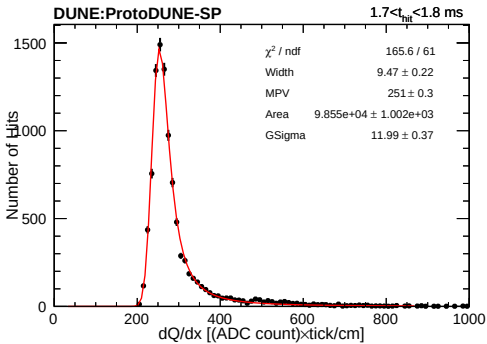
Single gen legacy with no SCE (left) and refactored single gen with no SCE (right).

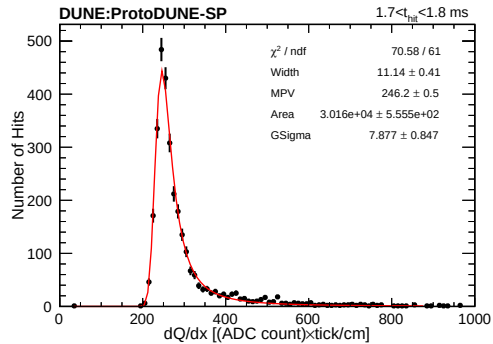
Truth and Reco 2D Distributions



Single gen legacy with no SCE (left) and refactored single gen with no SCE (right).

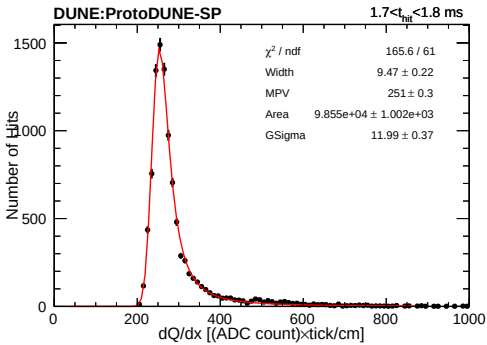
Langaus Distributions

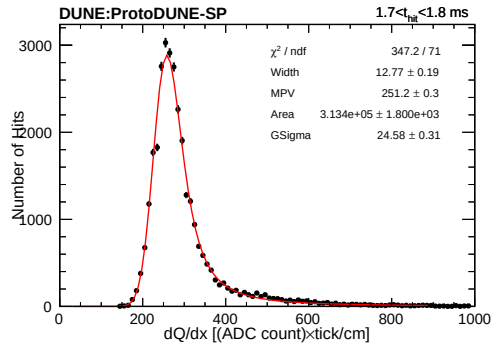




Refactored (left) and data (right)

Langaus Distributions





Refactored (left) and legacy (right)

Tests of the MCTruth Cross Section

Heng-Ye made a module that calculates the truth cross section of a track as follows:

- Slice the track up into slices of summed energy deposits with segmentation equal to the collection plane wire pitch.
- Sum up all the energy deposits within a slice and use that dE/dx to find the KE for that slice.
- Use the process list to bin the slice into either an incident or interacting slice.

Heng-Ye's code uses the daughters to find a final position when the process list and truth track does not show an obvious one.

Tests for the Truth Cross Section

- Used single particle generator using legacy and refactored to ensure the refactored simulation matched the legacy.
- Compared the cross section to the G4 truth provided by Hans' G4HadStudies package.
- Saw an excess of both elastic and inelastic scatters in the slices.

NOTE: For all plots, blue=elastic, red=inelastic, black=total

Responses to Questions from Last Meeting

Could daughters be the reason why there is an excess?

- Heng-Ye's code uses the daughters to find a final position when the process list and truth track does not show an obvious one.

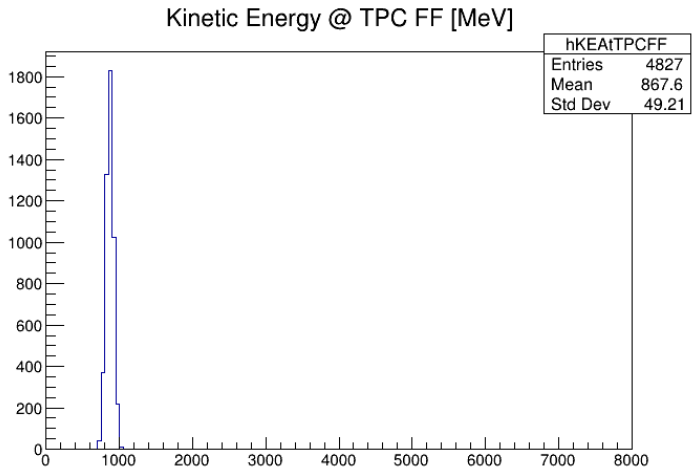
What about the energies?

- Plot shows that it peaks around 800 MeV. See next slide.

Why is there an excess bin at 1 GeV in legacy but not refactored?

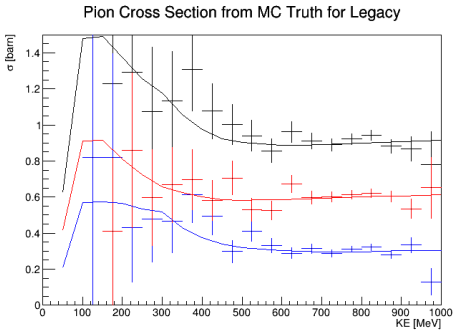
- That bin had a value larger than the range in the plot. It is there and is largely "divergent."

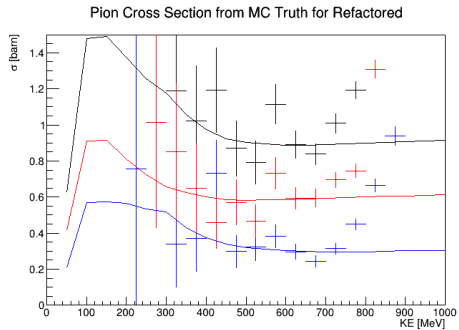
KE for 1 GeV Test



KE at z=0 cm for pions shot at z=-1 cm.

Old 1 GeV Pion Truth Cross Section Test

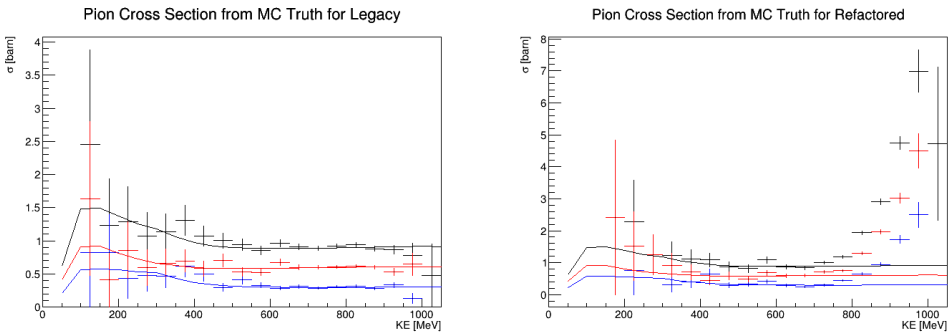




Pion 1 GeV truth cross section for legacy (left) and refactored (right) (blue=elastic, red=inelastic, black=total)

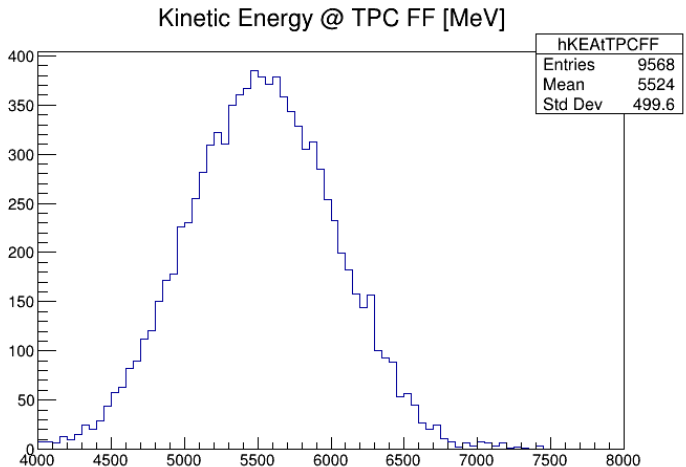
1 GeV Pion Truth Cross Section Test

This is the new plot with the cross-check taken out and zoomed out. Still see issues.



Pion 1 GeV truth cross section for legacy (left) and refactored (right) (blue=elastic, red=inelastic, black=total)

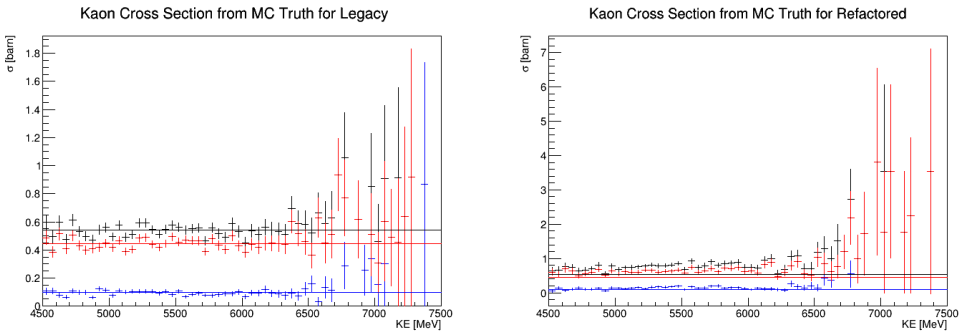
KE for 6 GeV Test



KE at z=0 cm for kaons shot at z=-1 cm.

6 GeV Kaon Truth Cross Section Test

Again, issues still exist between the two simulations.



Kaon 6 GeV truth cross section for legacy (left) and refactored (right) (blue=elastic, red=inelastic, black=total)

Moving Forward

- Definite differences in hits between refactored and legacy, but refactored looks more similar than data. I do not know enough to say anything technical.
- Double-checked the truth cross sections and they still appear different even after addressing previous questions.