

SBND Flash reconstruction

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Light reconstruction chain

OpWaveformSource: from raw::OpDetWaveform (larsoft)

- Read the raw photon-detector records

OpDecon: from Deconvolution_module.cc (duneopdet)

- Deconvolve each waveform with its *single-PE (SPE) template; repair ADC saturation.*



self-trigger

OpRoi: similar as WireCell's charge ROI finding

- ROI finding for Full-stream channels

OpHitFinder: OpHitFinderDeco / fcl dune_ophit_finder_deco (duneopdet + larana)

- Turn each cleaned waveform into pulses on single channels
channel, hit time, width, area, amplitude, PE, start time, flash id (-1), fast/total

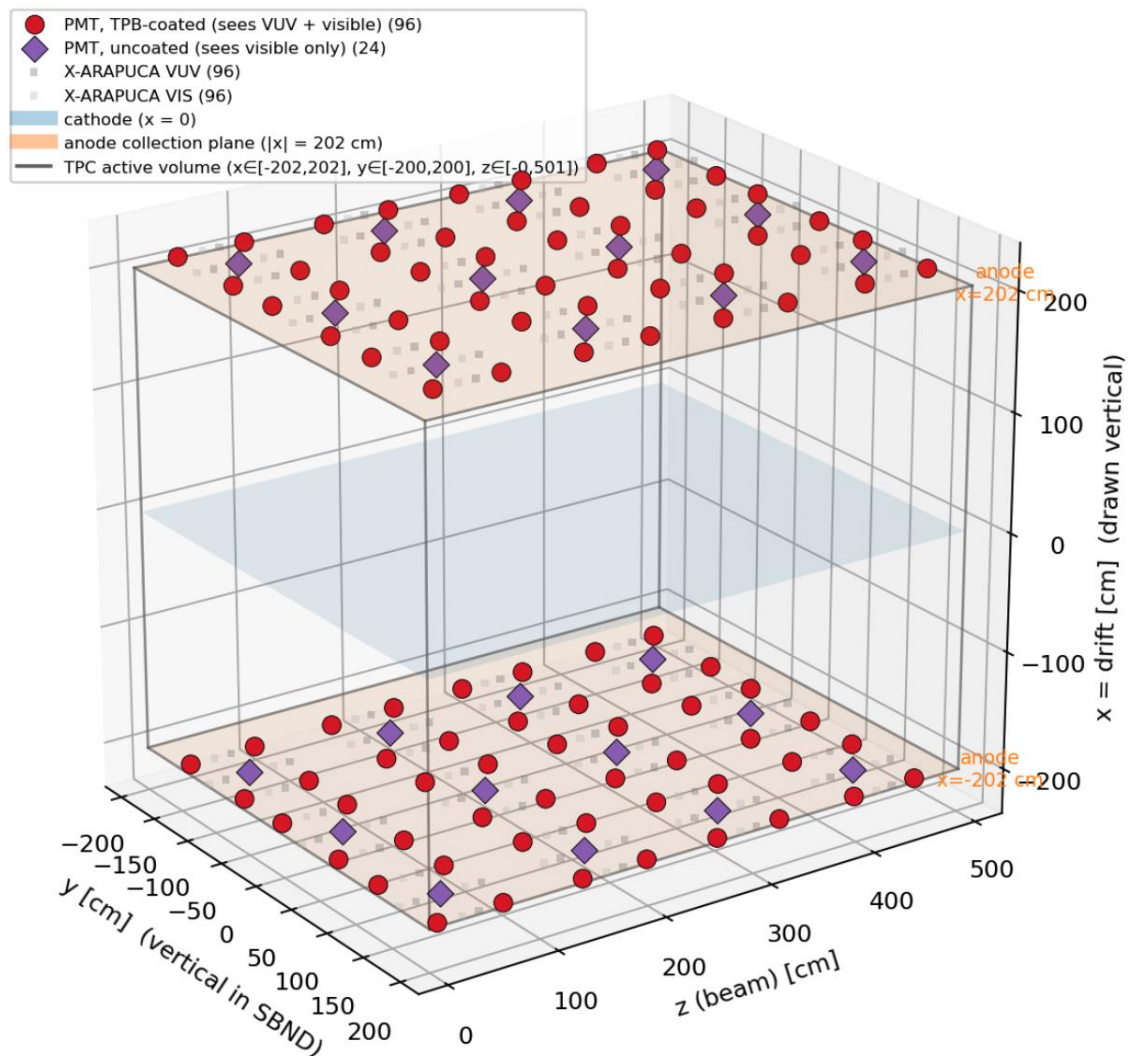
OpFlashFinder: from OpFlashAlg::RunFlashFinder(larana) but improved

- Group time-coincident hits across OpDets into a flash

full stream

SBND light detector

SBND OpDet 3D placement — drift (x) drawn vertical: TPC 1 (x>0) upper, TPC 0 (x<0) lower
cathode x=0 (blue) · anodes |x|≈202 (orange) · PMTs + X-ARAPUCAs behind each anode

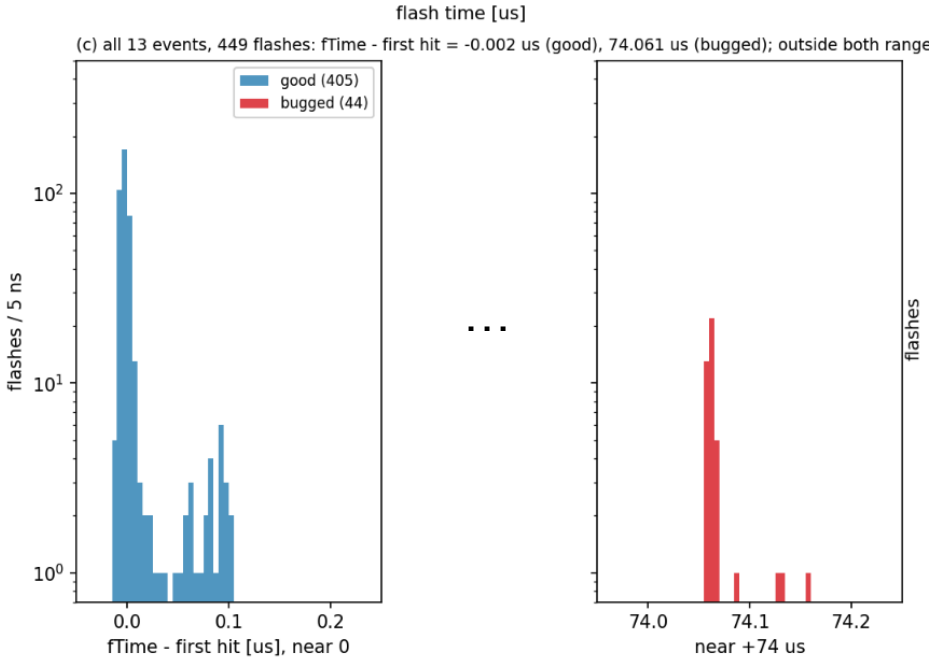


- **light seen by coated vs uncoated PMTs**
- **coated PMT:** its coating turns argon's ultraviolet (VUV) scintillation light into visible light, so it sees **direct VUV light + visible light**.
- **uncoated PMT:** sees **only visible light**. That light mostly comes from the cathode, which is covered with reflective foils that also shift the wavelength.
- ratio X related to coated/uncoated PMT contains the x position information

An issue in current flash

- flash time (**fTime**) = hit-based time – light travel time (0–15 ns)
- Starting and refined time, from the hits.
- Light travel-time correction, from X**
a failed X (–999999) turns the few-ns correction into –74 μs, which swamps the correct hit-based time.
- failed X happens in **small flashes** or **flashes close to the anode**, where the **uncoated PMT** cannot see enough light

X estimate fails for **9.9 %** of MC flashes but only **0.59 %** of data flashes.



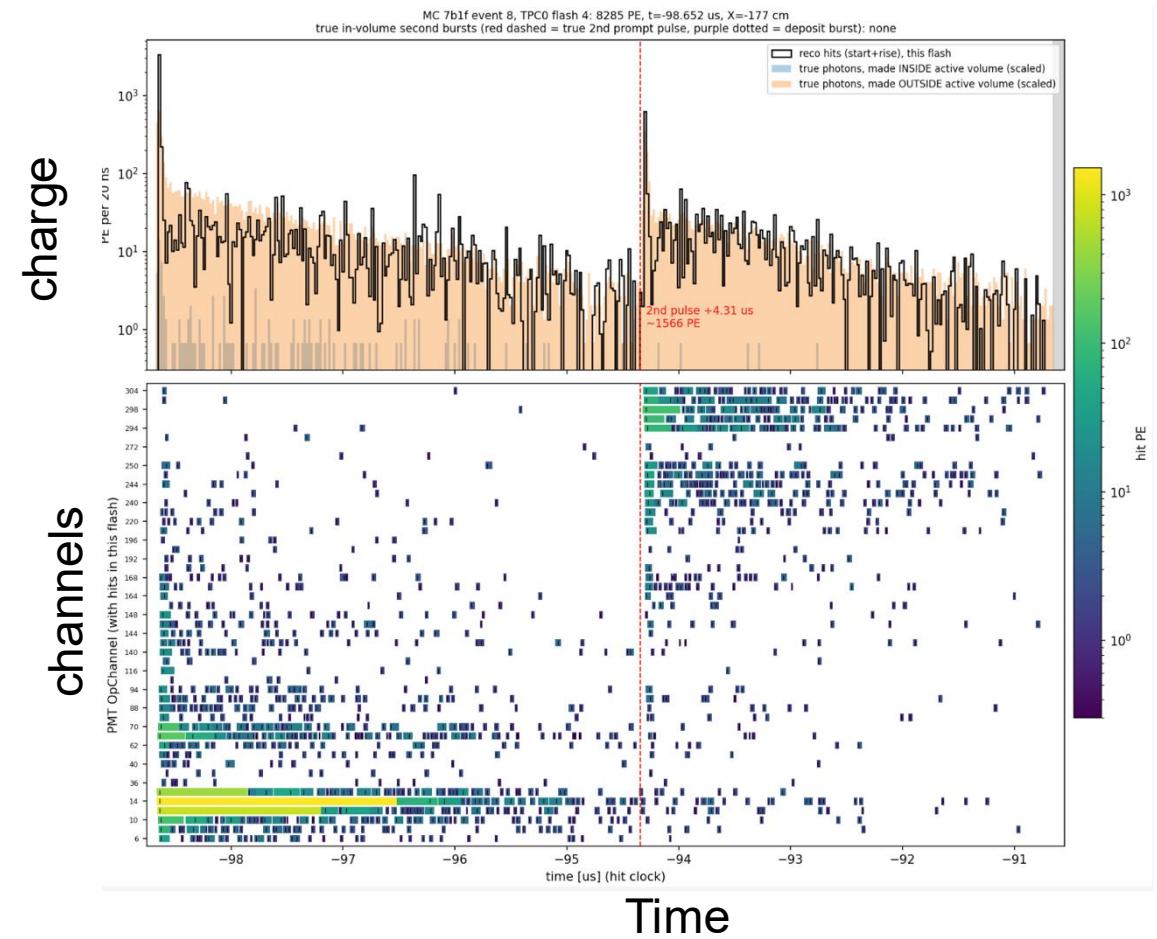
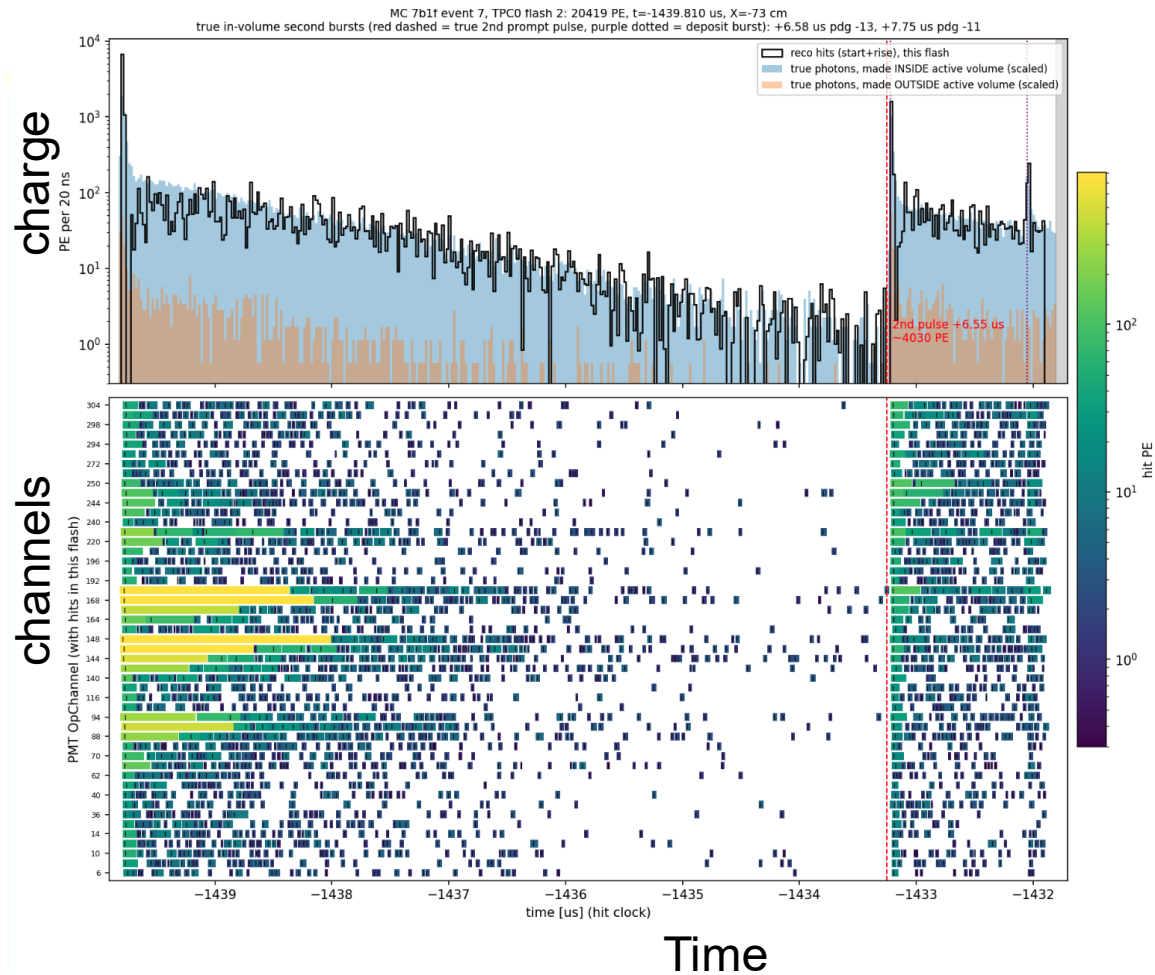
Flash time - first hit time

sample	flashes	failed	rate	TPC0	TPC1
MC, 10 files, 104 events	4,085	403	9.9 % (7.0–12.3 % per file)	9.1 %	10.6 %
data, 2 files, 2,000 events	57,057	336	0.59 % (about 1 per 6 events)	0.47 %	0.71 %

By flash size:

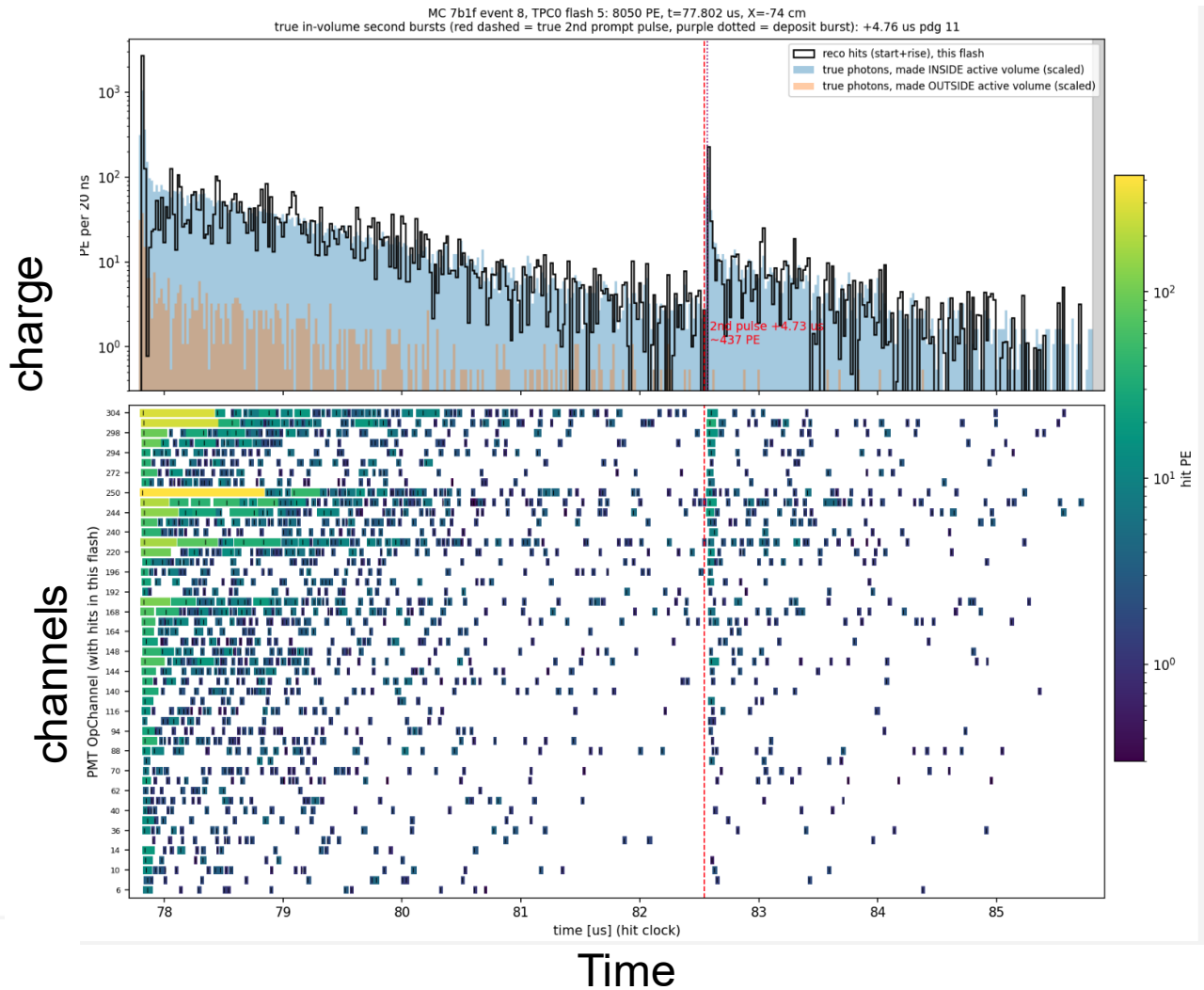
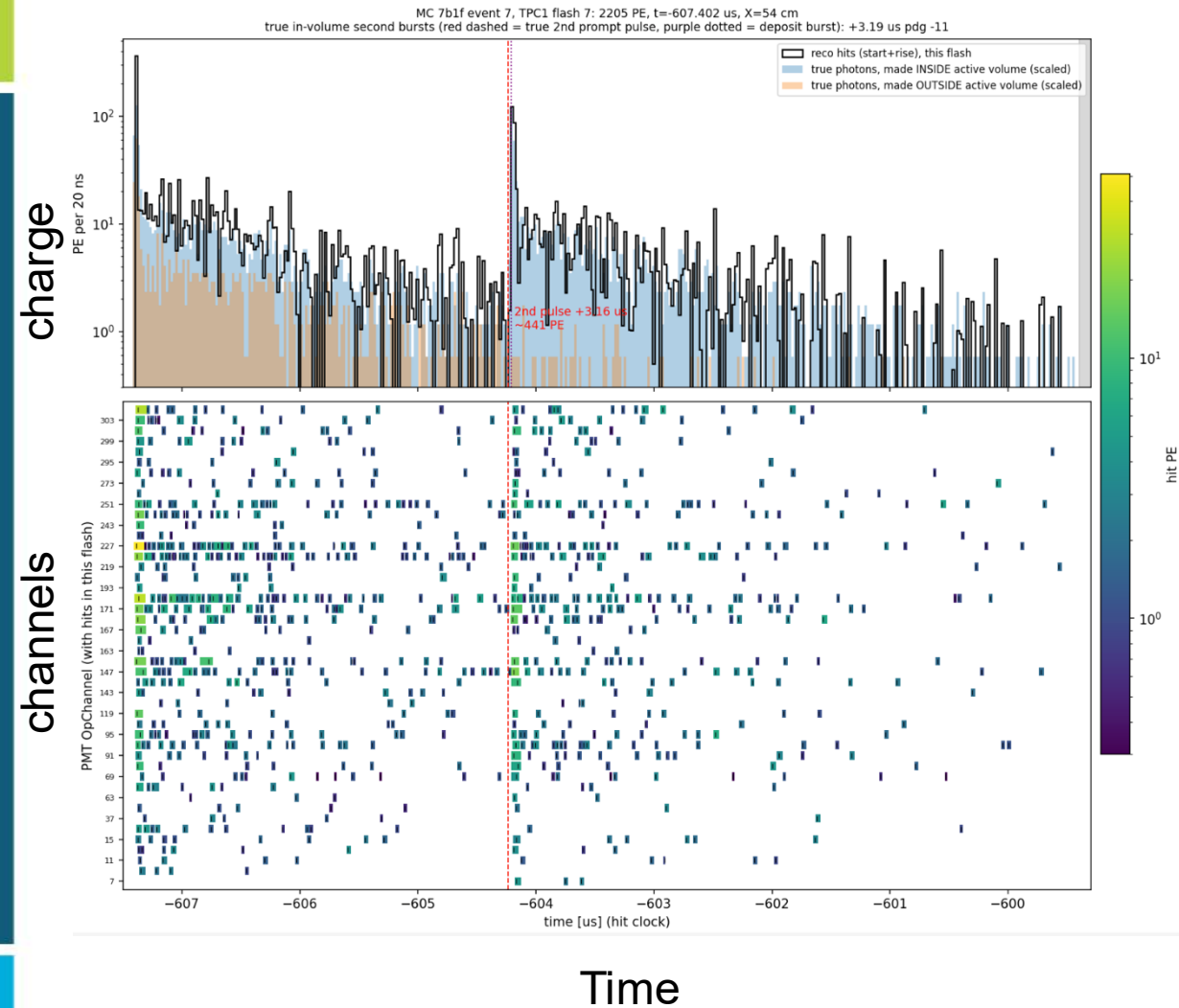
flash PE	20–50	50–100	100–200	200–500	≥ 500
MC	63 %	42 %	26 %	12 %	0.8 %
data	46 %	9 %	0.1 %	0 %	0 %

Merged Flash issue



4.2 % of SBND's flashes (17 of 405) were merged

Merged Flash



Create a SBNDOpFlashFinder

Steps, in order:

1. **Group and claim** in 8 μ s time slices, done as in OpFlashFinder.
2. **Split** a flash where a second sharp burst of light starts.
3. **Join** a leftover piece to the nearest earlier flash if it starts within 1 μ s of that flash's last hit, sits on the same PMTs (at least 90 % of its light), has no sharp burst of its own, and isn't the other half of a split.
4. **Remove late light**: delete a later flash that an earlier flash's glow explains.
5. **Keep flashes on at least 3 PMTs**, and give each SBND's flash time.

Fixed examples

