

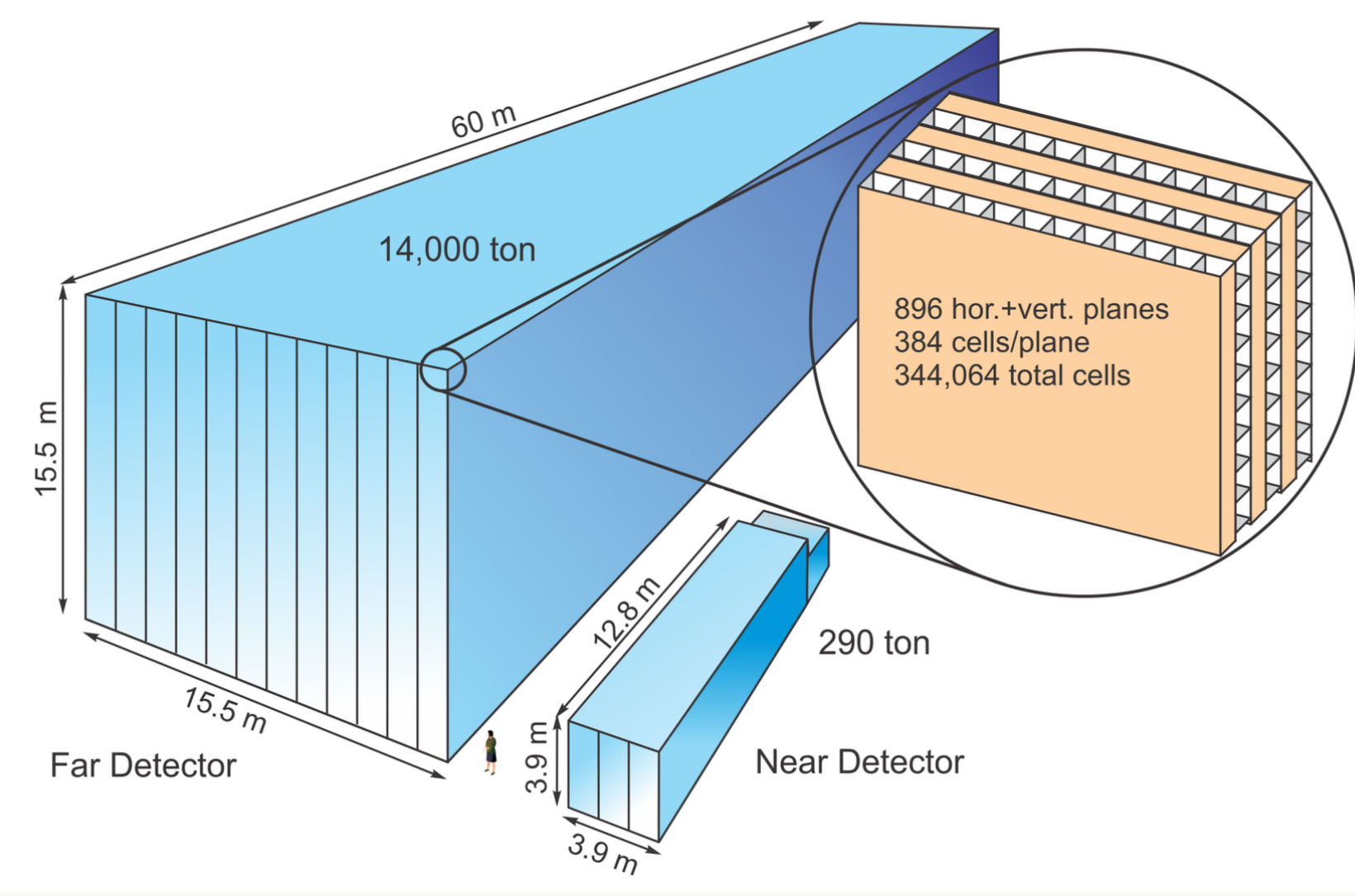
Event Selections in the NOvA 2024 Analysis

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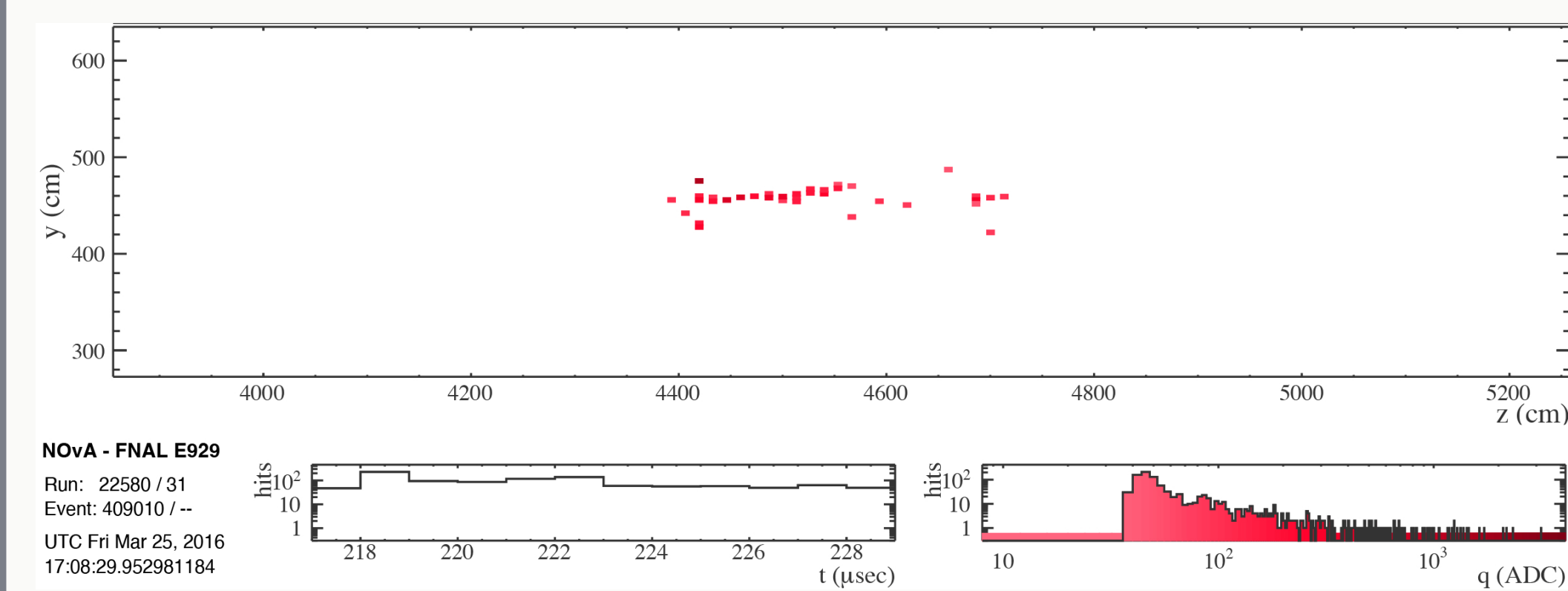
1 NOvA Experiment



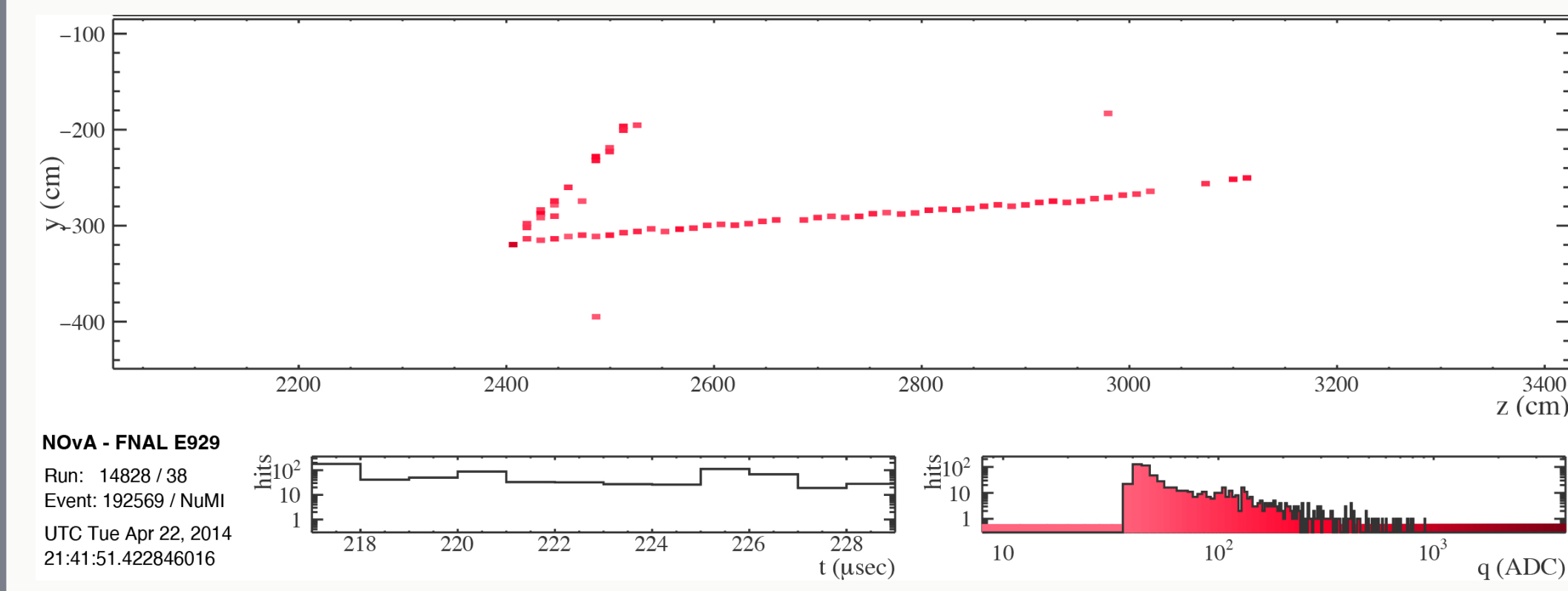
NOvA ND/FD schematic

- NOvA uses the NuMI beam with a baseline of 810 km and an off-axis spectrum peaked around 2 GeV.
- NOvA uses functionally identical Near Detector (ND) and Far Detector (FD) segmented liquid-scintillator detectors.
- Alternating vertical and horizontal detector planes enable 3D reconstruction of neutrino interactions.
- Event selections identify candidate ν_e and ν_μ samples while reducing beam and cosmic backgrounds.

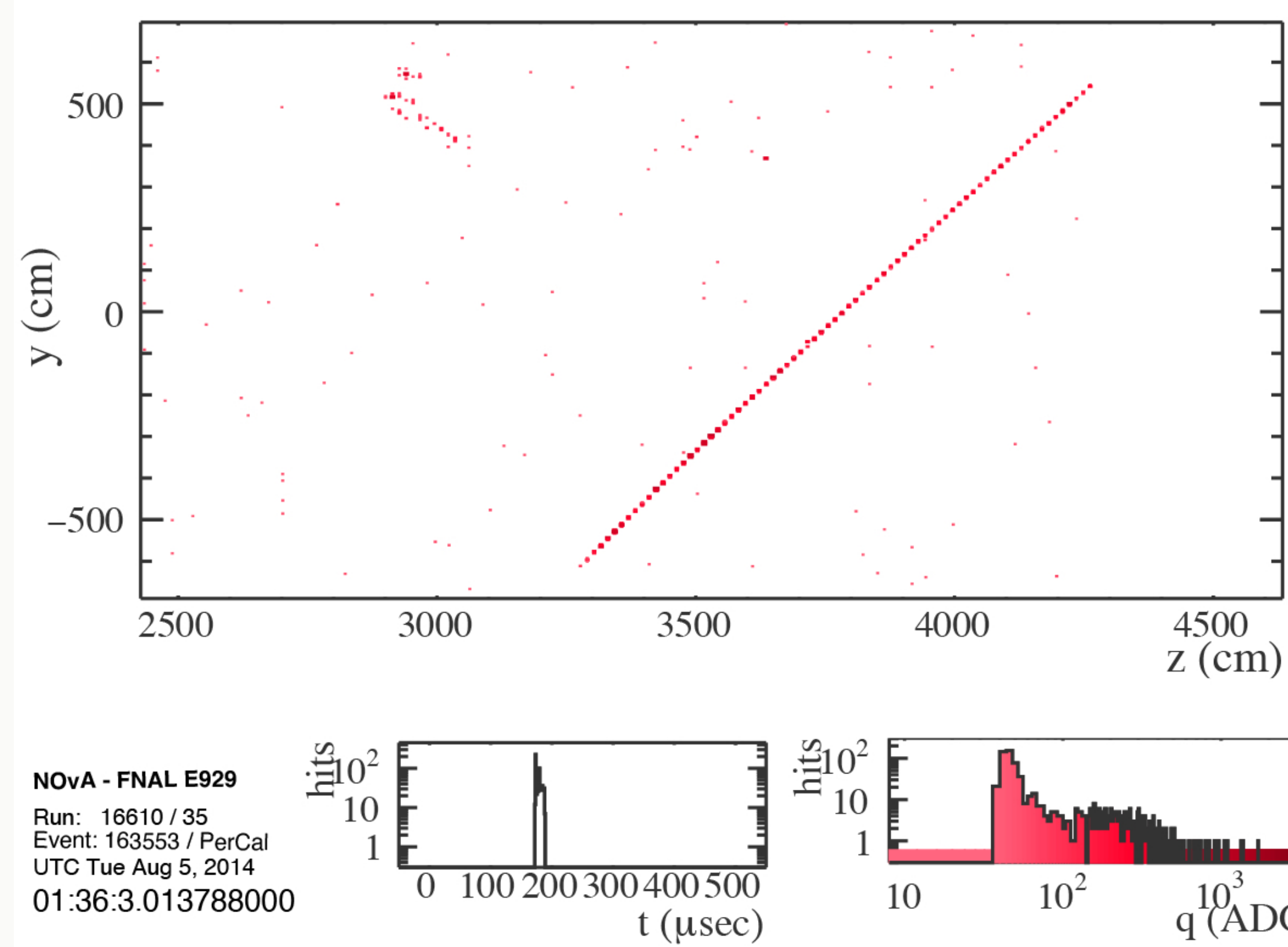
2 Event Displays



Selected ν_e candidate with a compact, wide electromagnetic-shower.



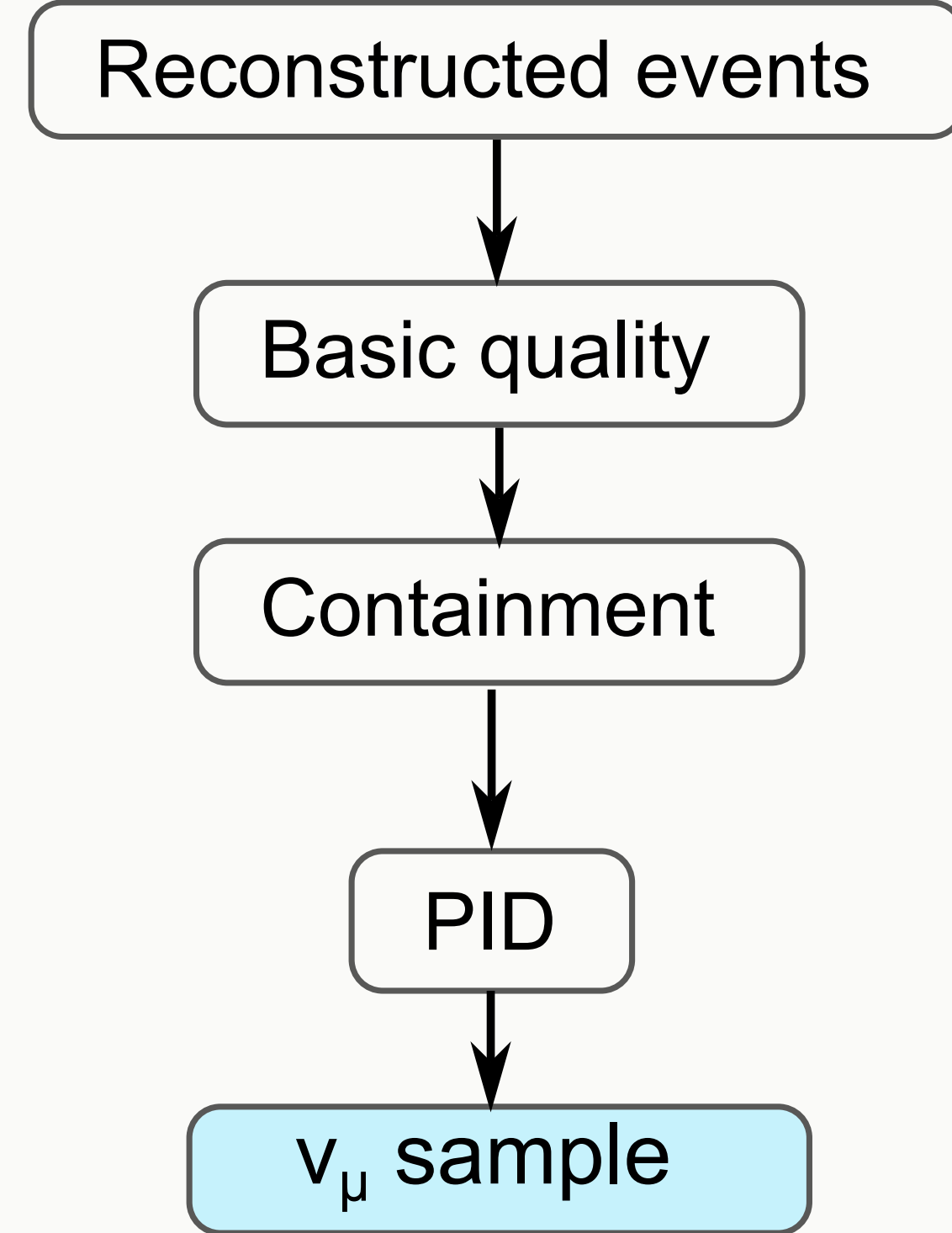
Selected ν_μ candidate. Good ν_μ candidates contain a long, straight muon-like track contained in the detector.



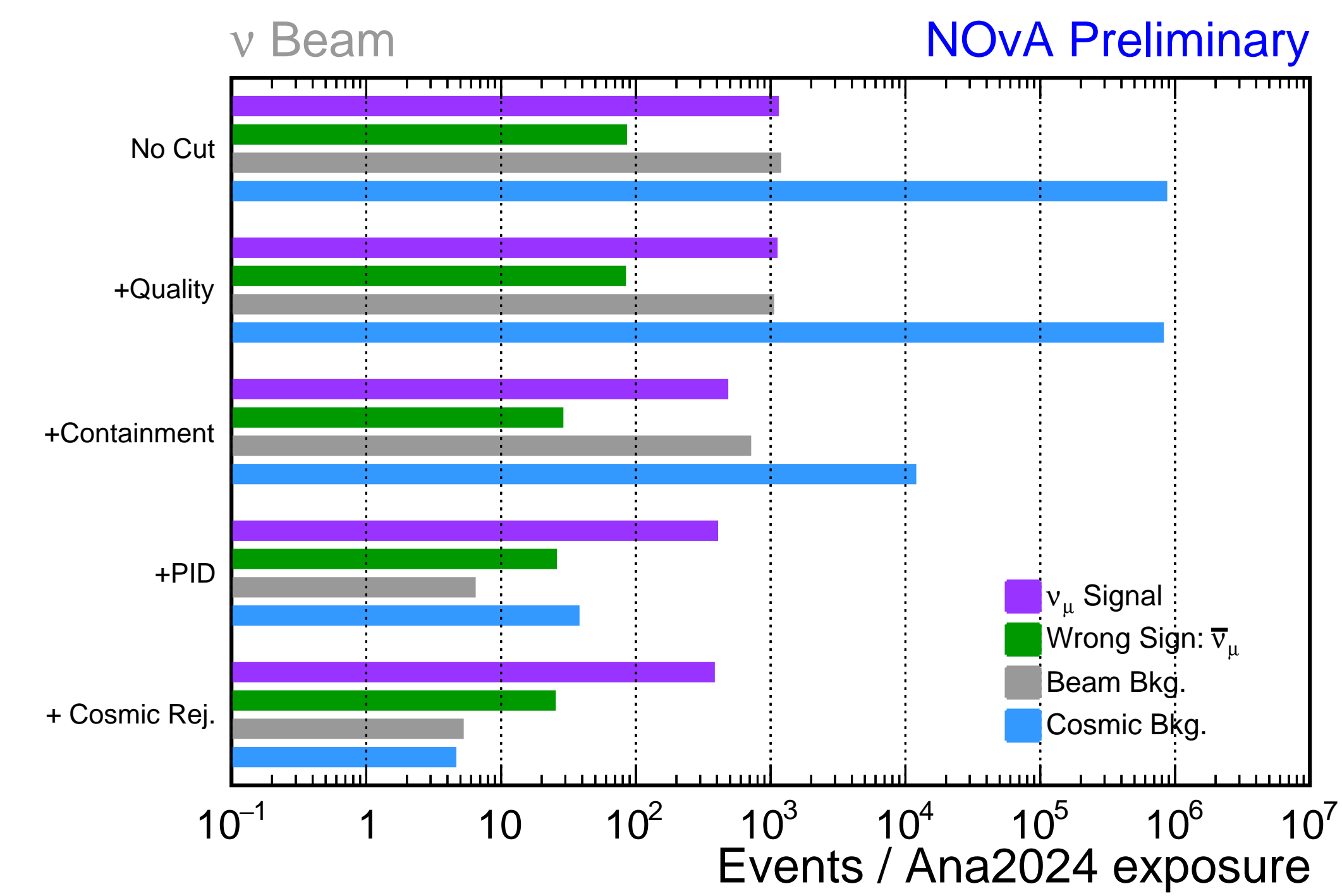
Two signal-like cosmic-background events observed in the FD. The right event shows a long-track topology similar to a ν_μ candidate, while the upper-left event shows shower-like activity with features of a ν_e candidate. Our selection must differentiate these events from beam events.

The ν_μ selection follows a similar strategy for the Near and Far detectors.

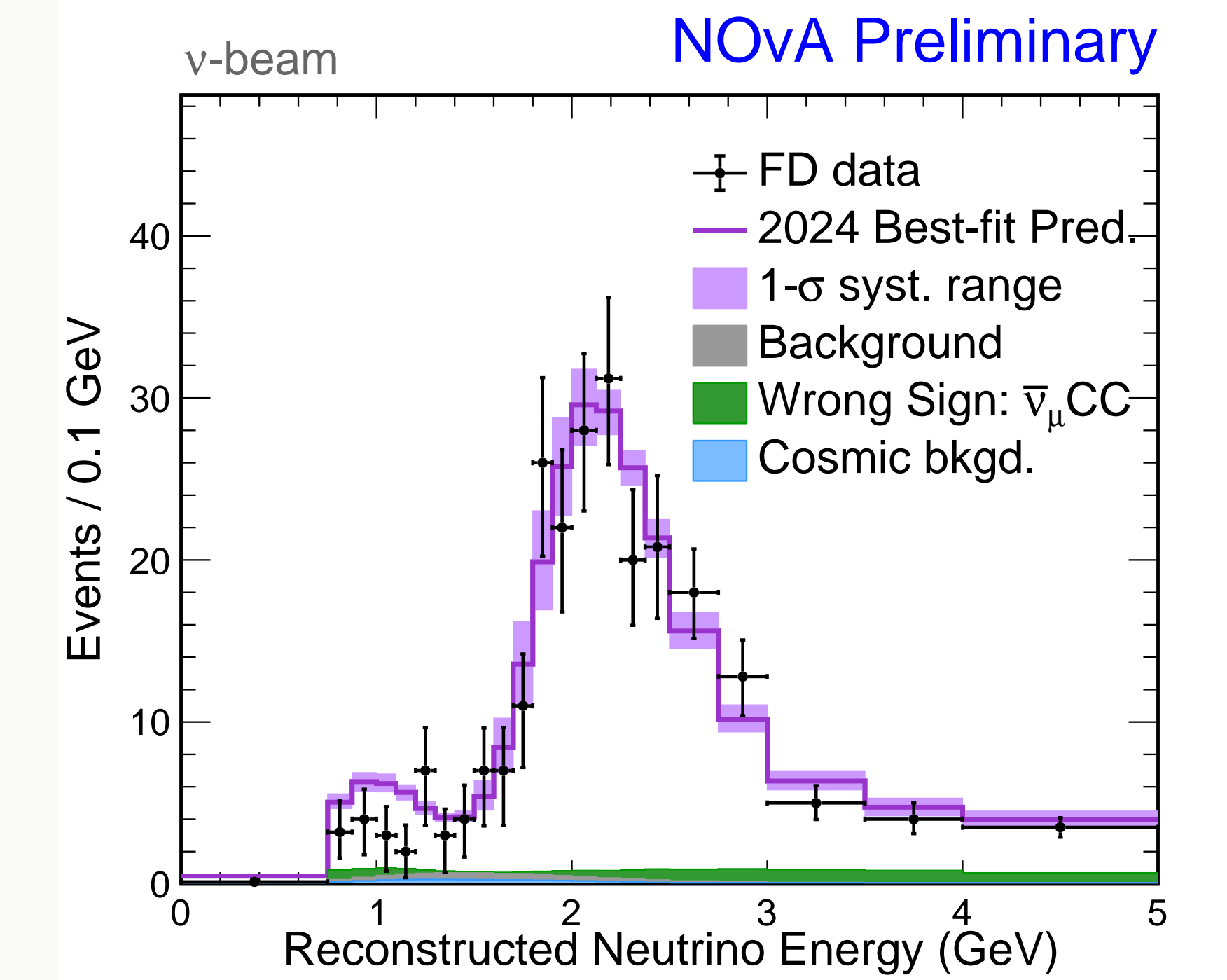
- NuMI beam time window selection
- Preselection to remove un-reconstructable events and those with energy above 5 GeV
- Containment criteria to ensure the full ν_μ energy is contained in the detector
- PID criteria to remove NC, ν_e and cosmic backgrounds



3 ν_μ Selection



Simulated event counts at each stage of the ν_μ selection. The final efficiency is 34% with a purity of 91%

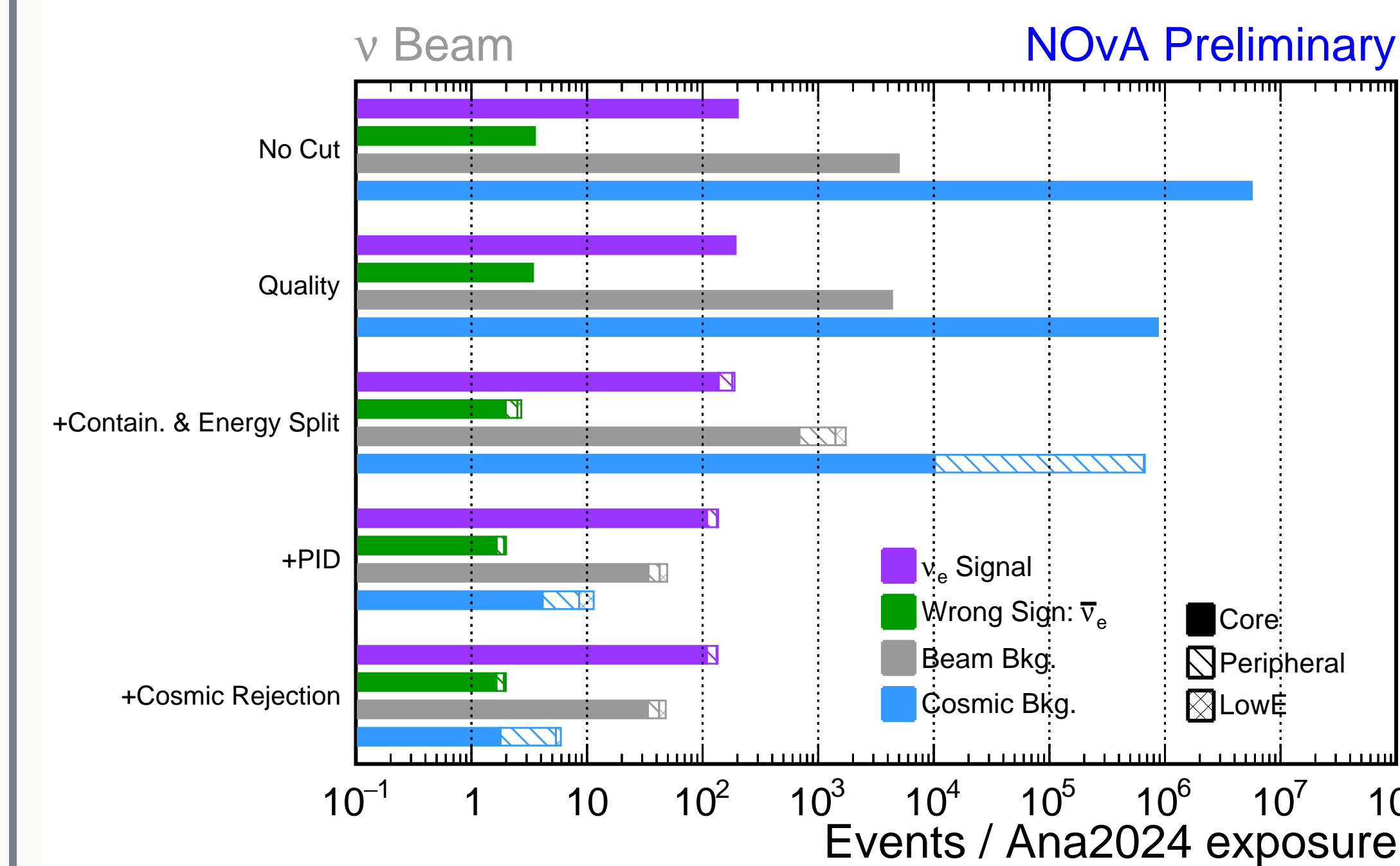
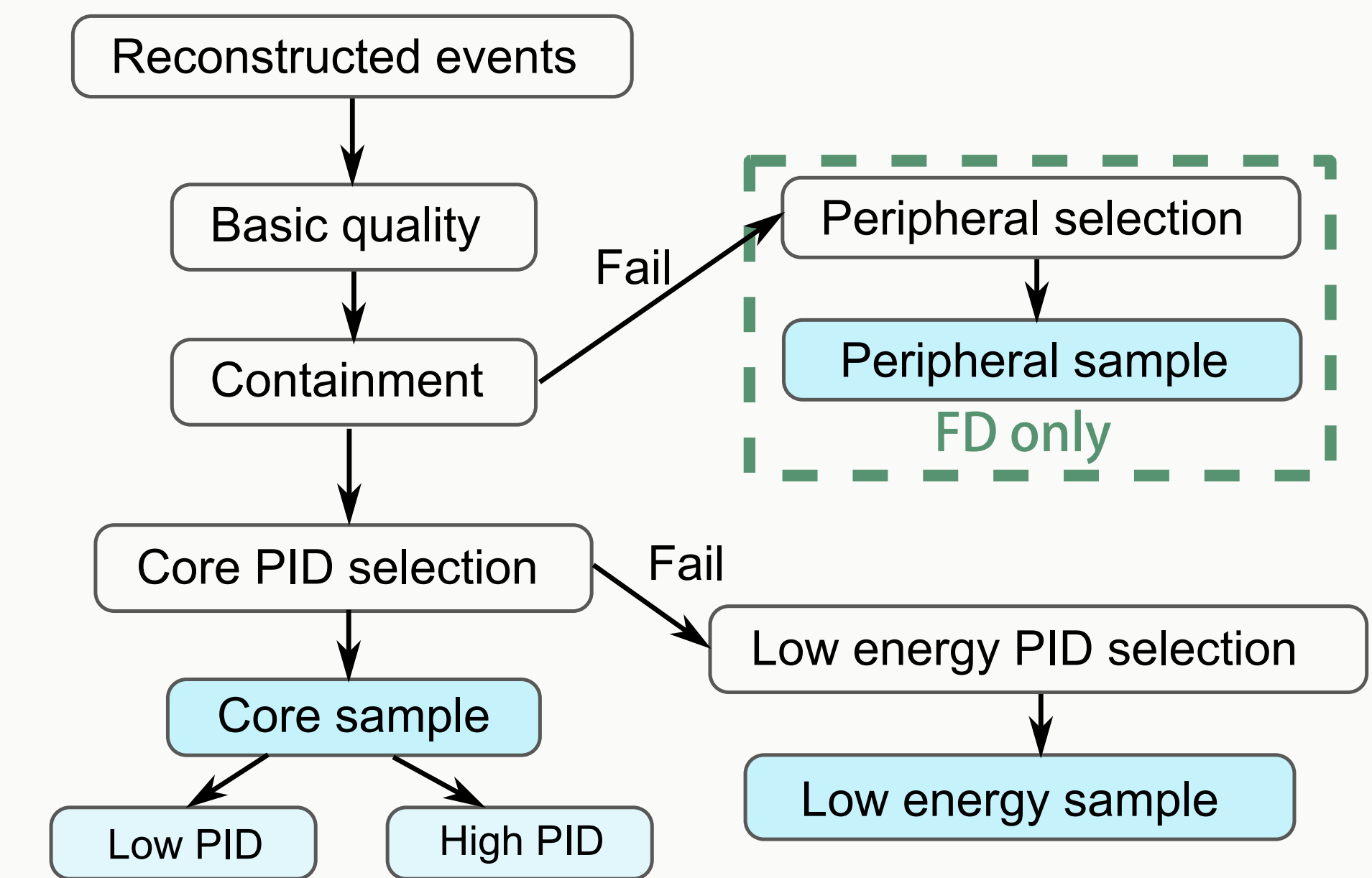


FD ν_μ data simulation comparison with 1σ systematic bands and background components

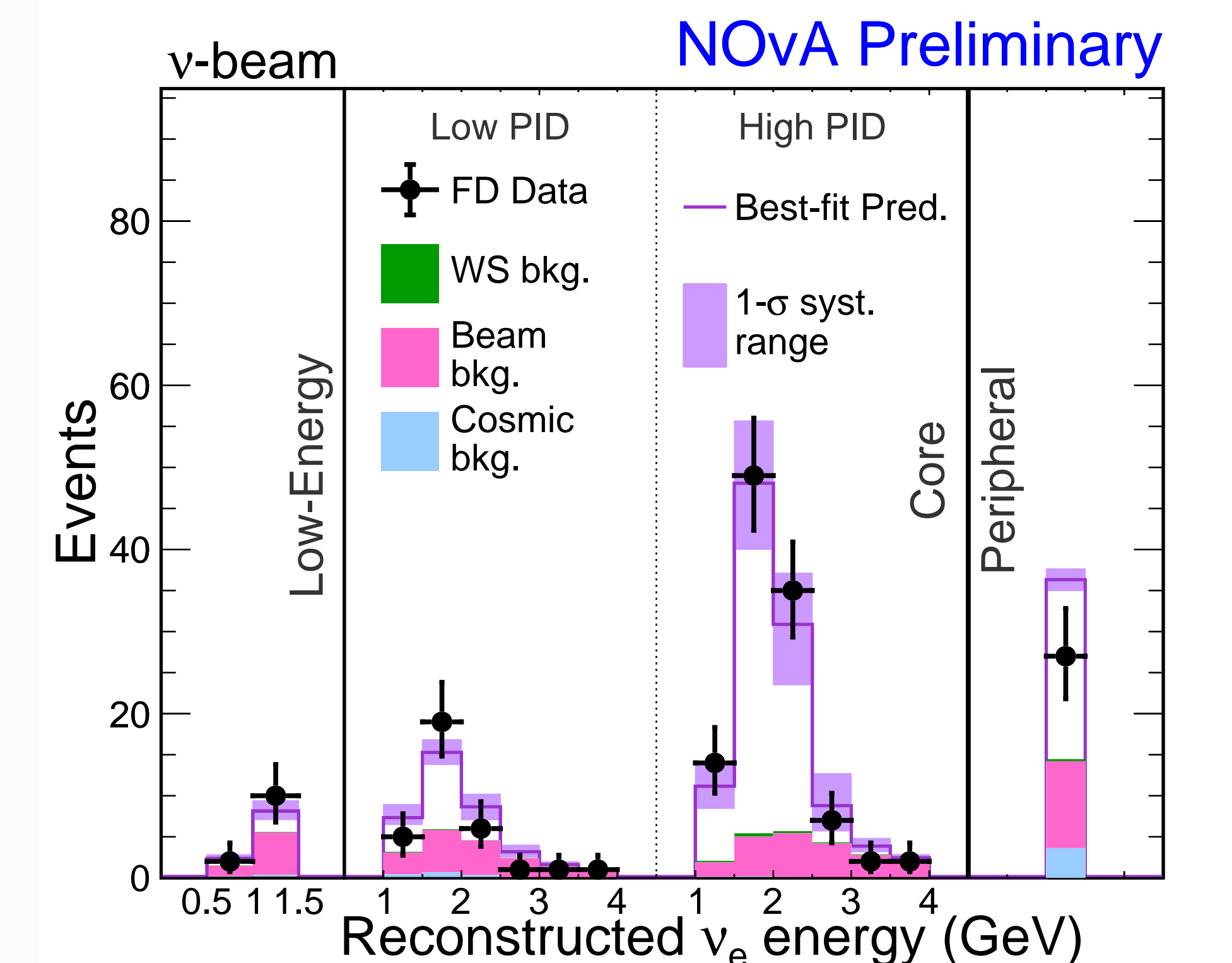
4 ν_e Selection

The ν_e selection divides candidates into samples targeting different event topologies and energy regions:

- Core: well-reconstructed ν_e candidates, split into low- and high-PID subsamples.
- Peripheral: partially-contained ν_e candidates selected in the FD, used as an event-counting sample.
- LowE: low reconstructed-energy candidates introduced in NOvA's 2024 analysis to improve mass-ordering sensitivity.



Simulated event counts at each stage of the ν_e selection. The final efficiency is 67% with a purity of 71%.



FD ν_e data simulation comparison with 1σ systematic bands and background components

Explore NOvA events



Can you classify the event?

References

- S. Abubakar et al. "Precision Measurement of Neutrino Oscillation Parameters with 10 Years of Data from the NOvA Experiment". In: *Phys. Rev. Lett.* 136 (1 Jan. 2026), p. 011802. DOI: 10.1103/x53y-2b86. URL: <https://link.aps.org/doi/10.1103/x53y-2b86>.
- D. S. Ayres et al. *The NOvA Technical Design Report*. Tech. rep. Oct. 2007. DOI: 10.2172/935497. URL: <https://www.osti.gov/biblio/935497>.