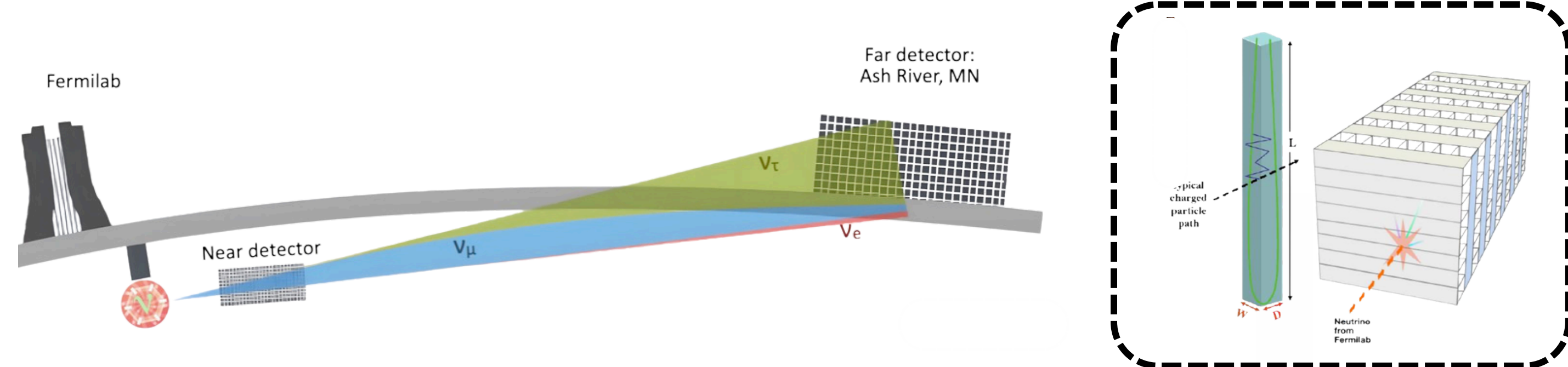


NEUTRON MULTIPLICITY

from neutrino interactions IN NOvA

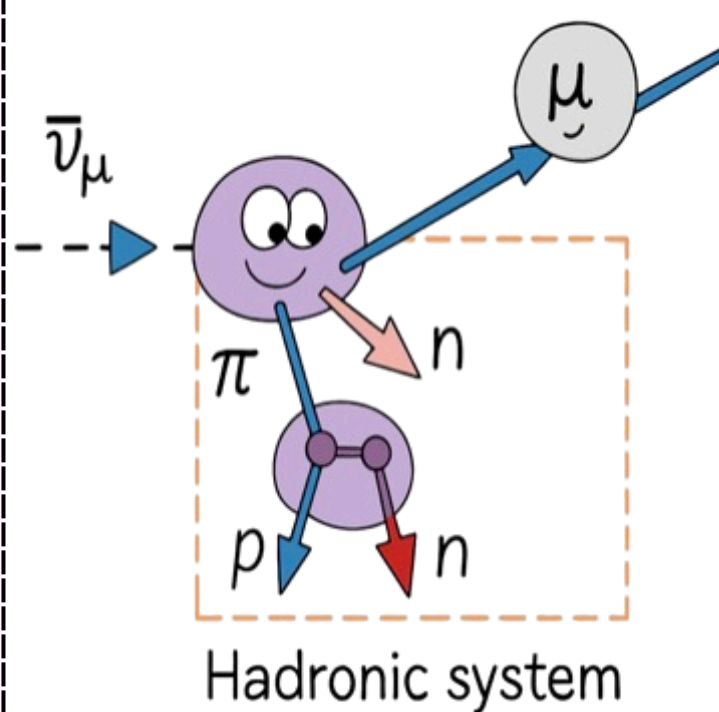
G. Kufatty (FSU), A. Himmel (FNAL), M. Sanchez (FSU)
On Behalf of the NOvA Collaboration



- Tracking calorimeters made up of polyvinyl chloride cells.
- Filled with liquid scintillator and optical wavelength shifting fibers which carries light to the readout electronics.

Calorimeters measure only charged particle depositions. Therefore, neutral particles escape detection unless they scatter secondary charged particles.

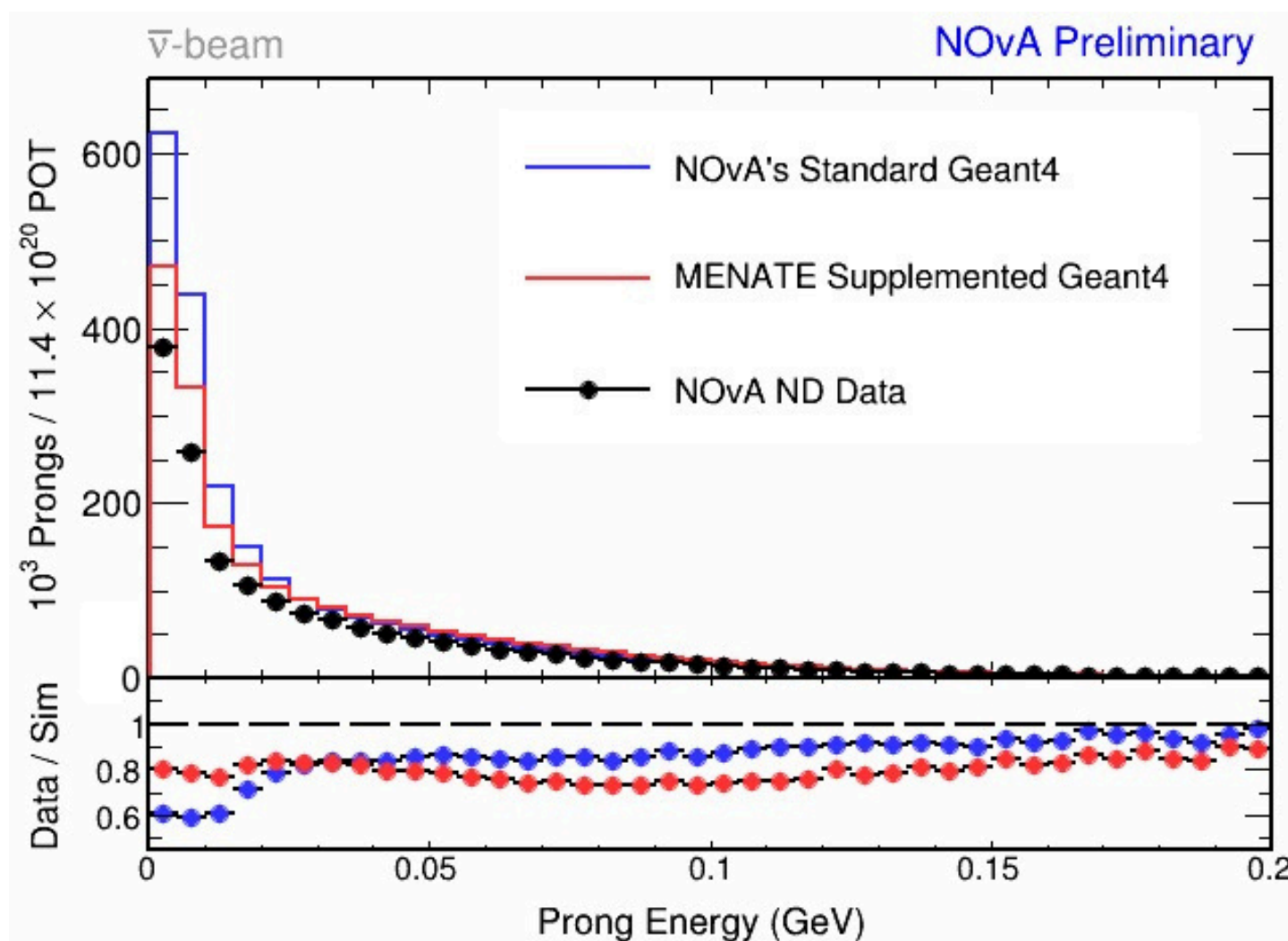
Missing energy from neutrons is one of the leading systematic uncertainties in calorimeter-based neutrino experiments.



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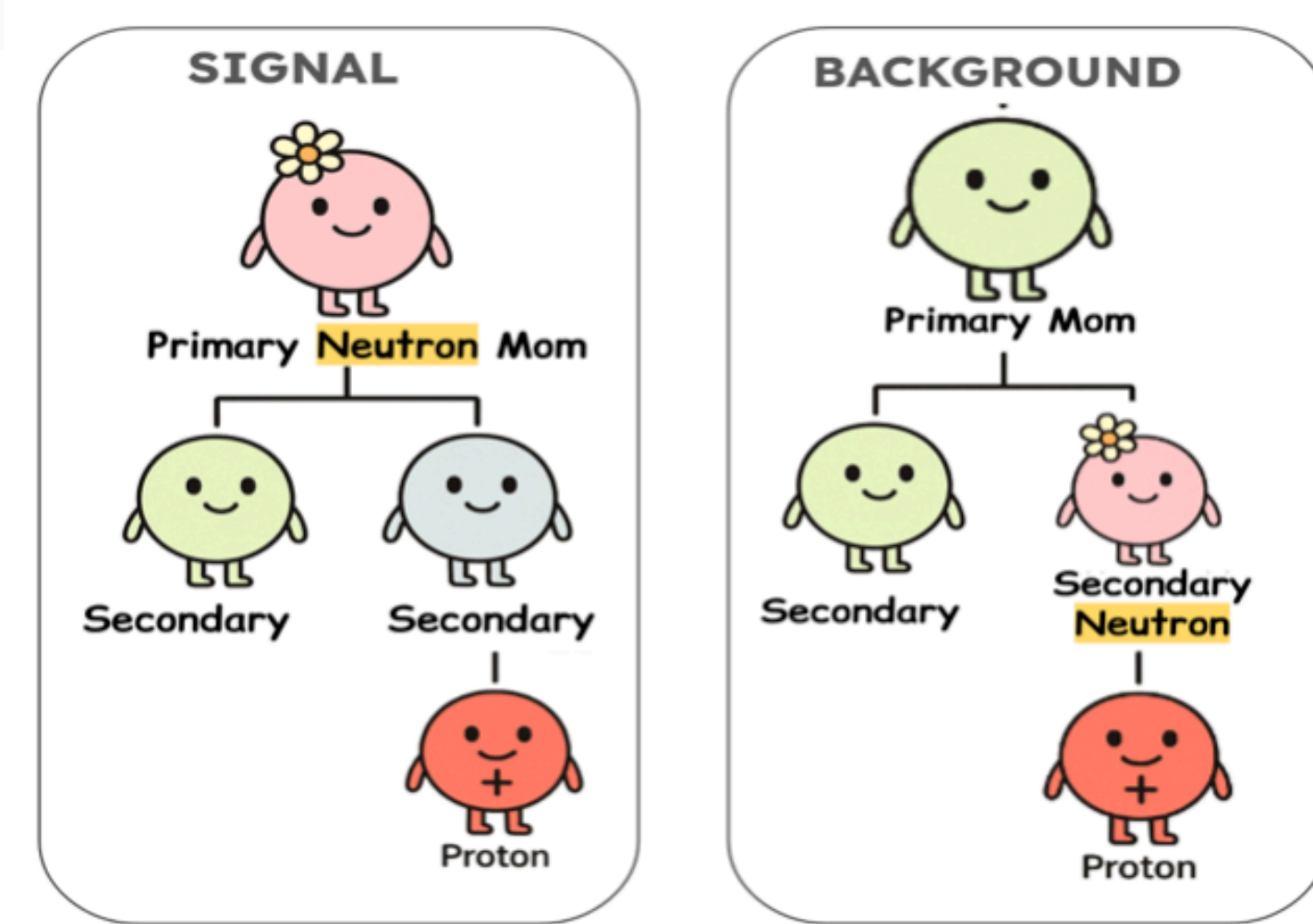
NEUTRONS IN NOvA

- Despite NOvA's neutron model improvements, a 20% residual discrepancy remains.
- About half of neutrons do not produce neutron activity in the current NOvA simulation.



Our signal are neutrons produced directly from the neutrino interaction.

Our background is composed mostly by gammas from pion decay and protons.



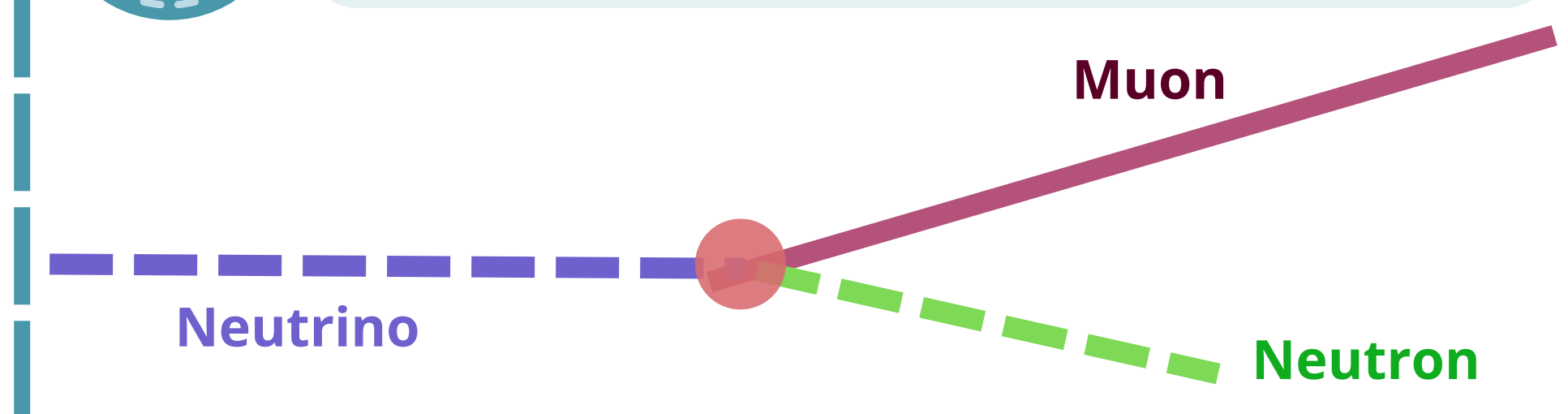
Acknowledgement

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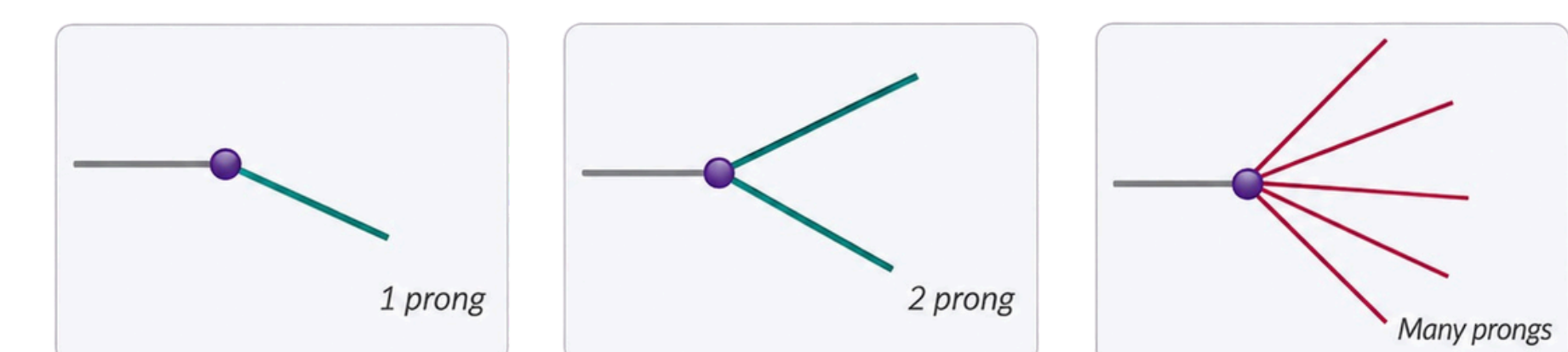
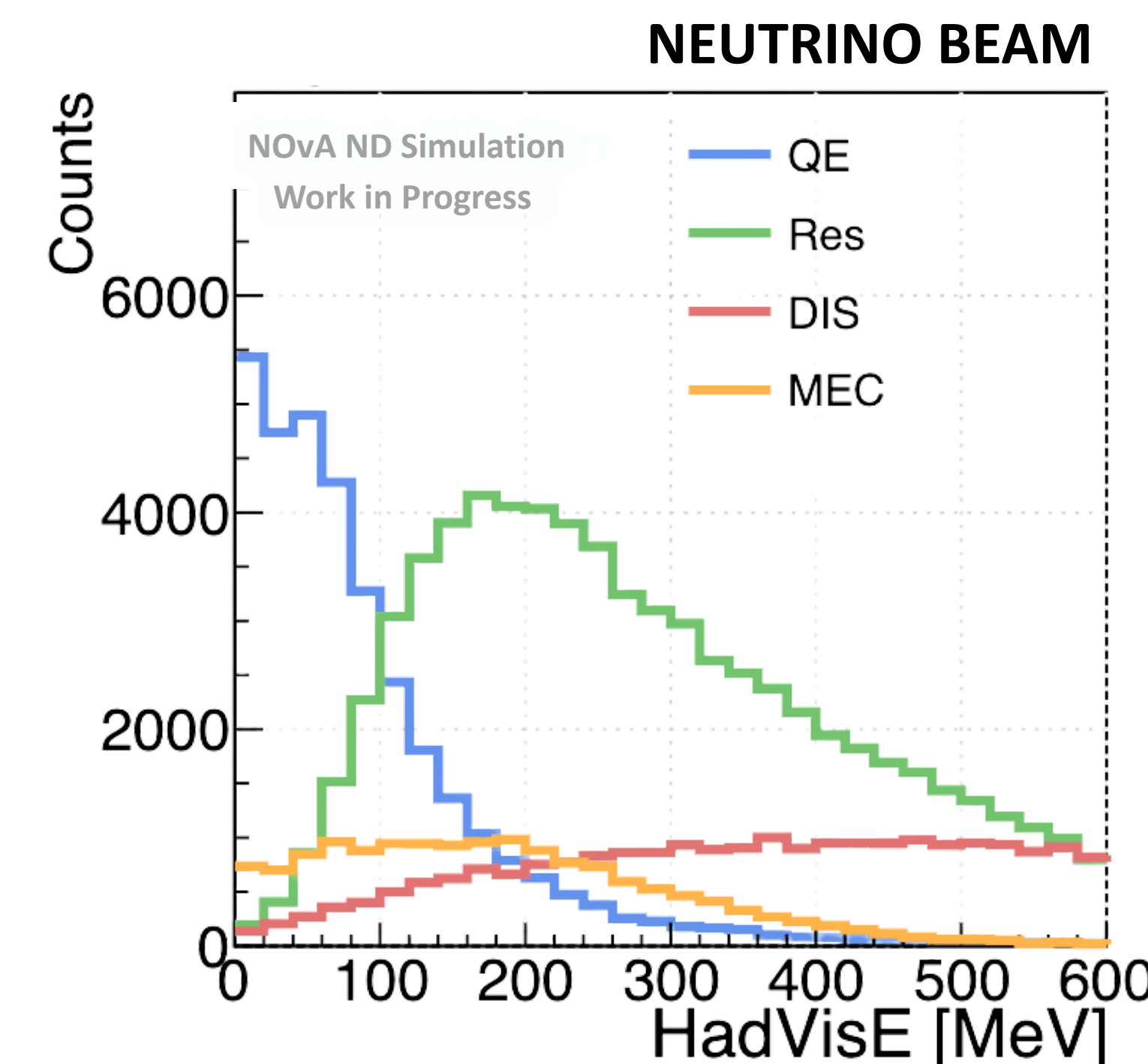
How do we reconstruct VISIBLE NEUTRONS



1 Quasielastic-Like Interactions



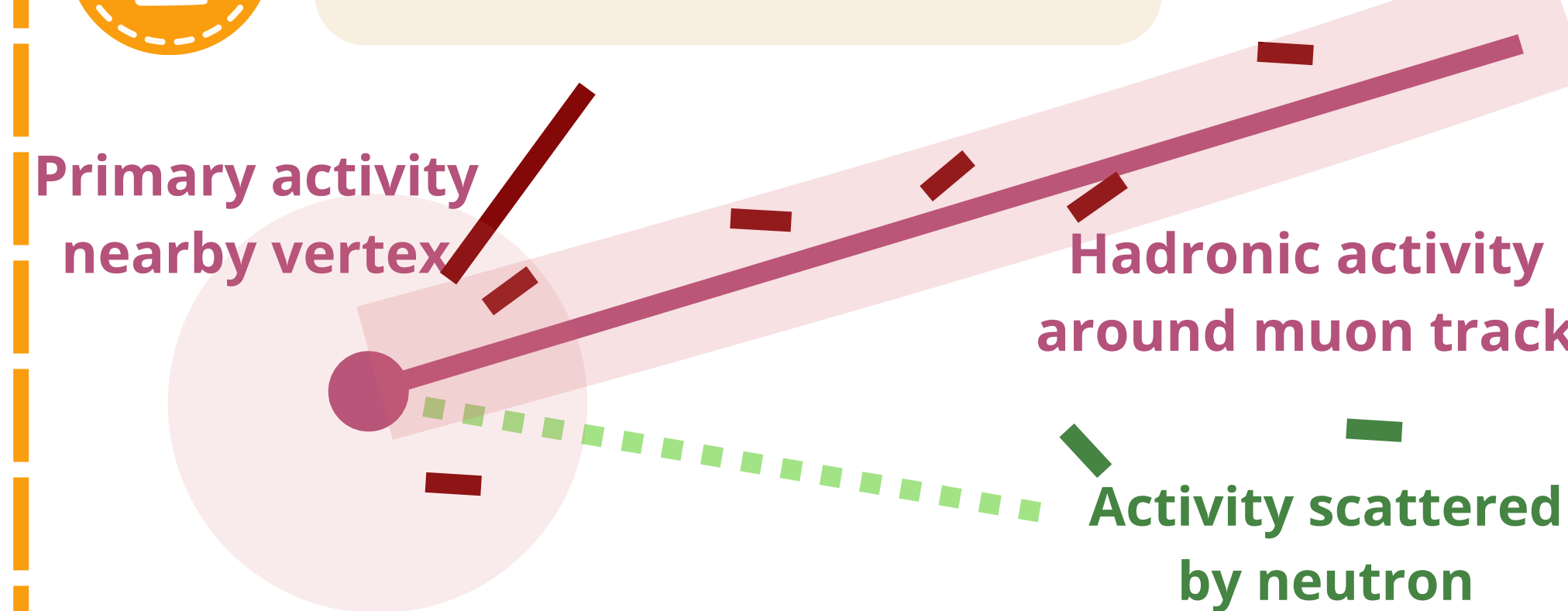
Quasielastic (QE) interactions are a clean channel to look for neutron-induced signals. Other interaction modes, as resonance (RES) or meson exchange (MEC), can look "QE-like" after final state interactions.



Simplest topology Muon + low energy track High hadronic activity

Limiting hadronic visible energy to up to 100 MeV reduces event complexity and enriches the fraction of neutrons from primary neutrino interactions.

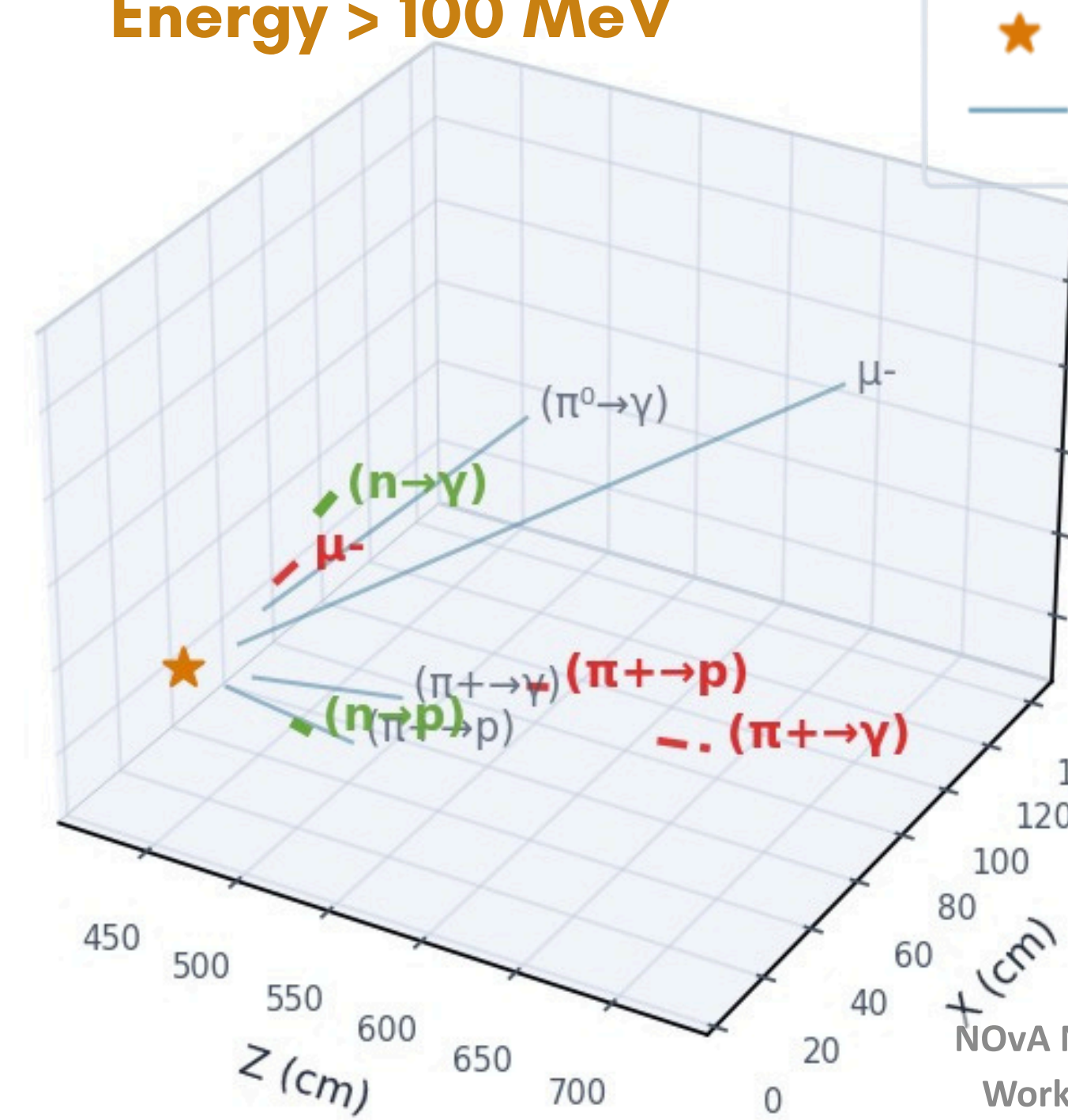
2 Neutron-Like Activity



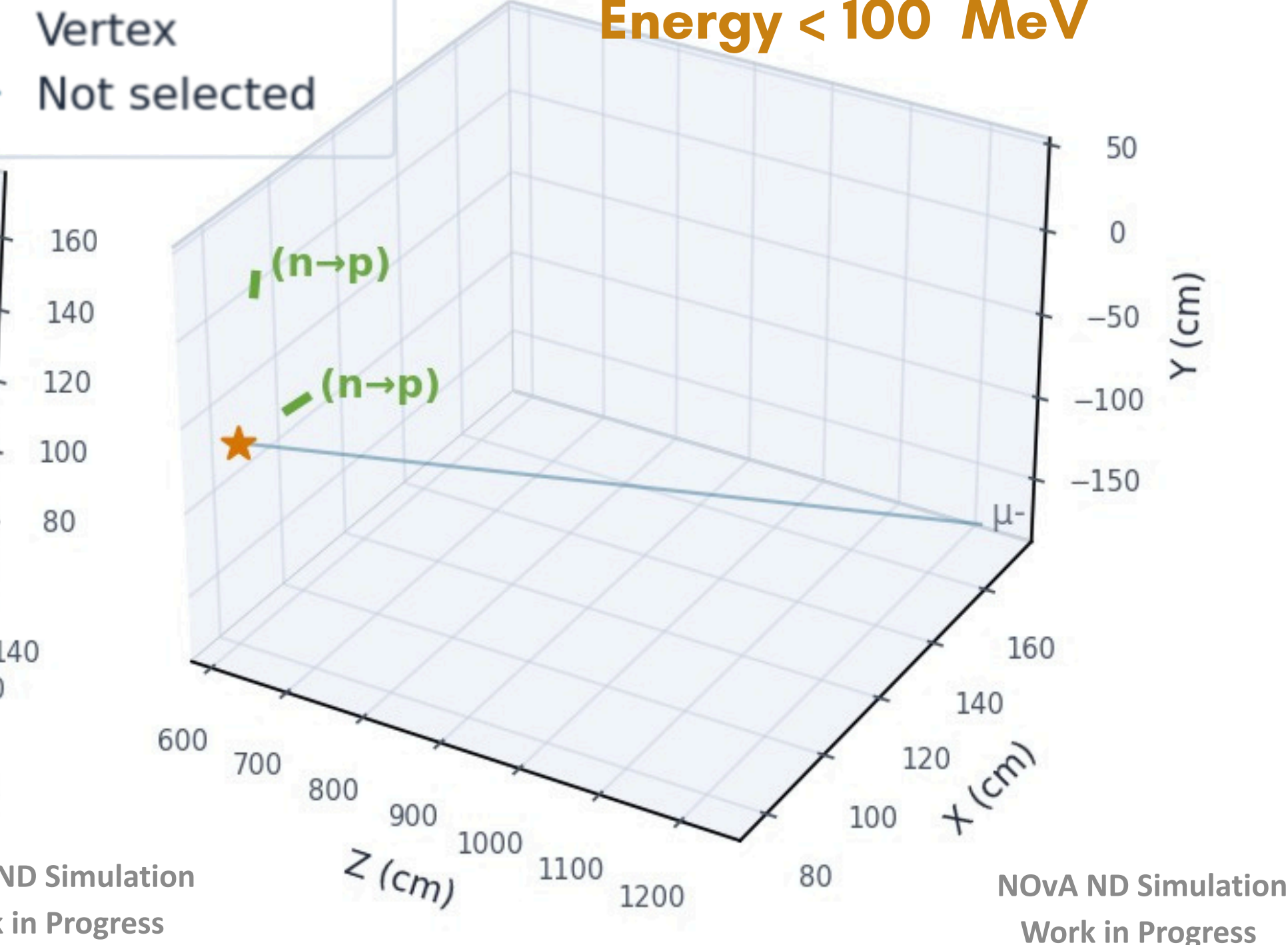
Neutrons typically appear in the detector as isolated point like activity

- Low number of hits in detector.
- Displaced from interaction vertex.
- Exclusion region around muon track.

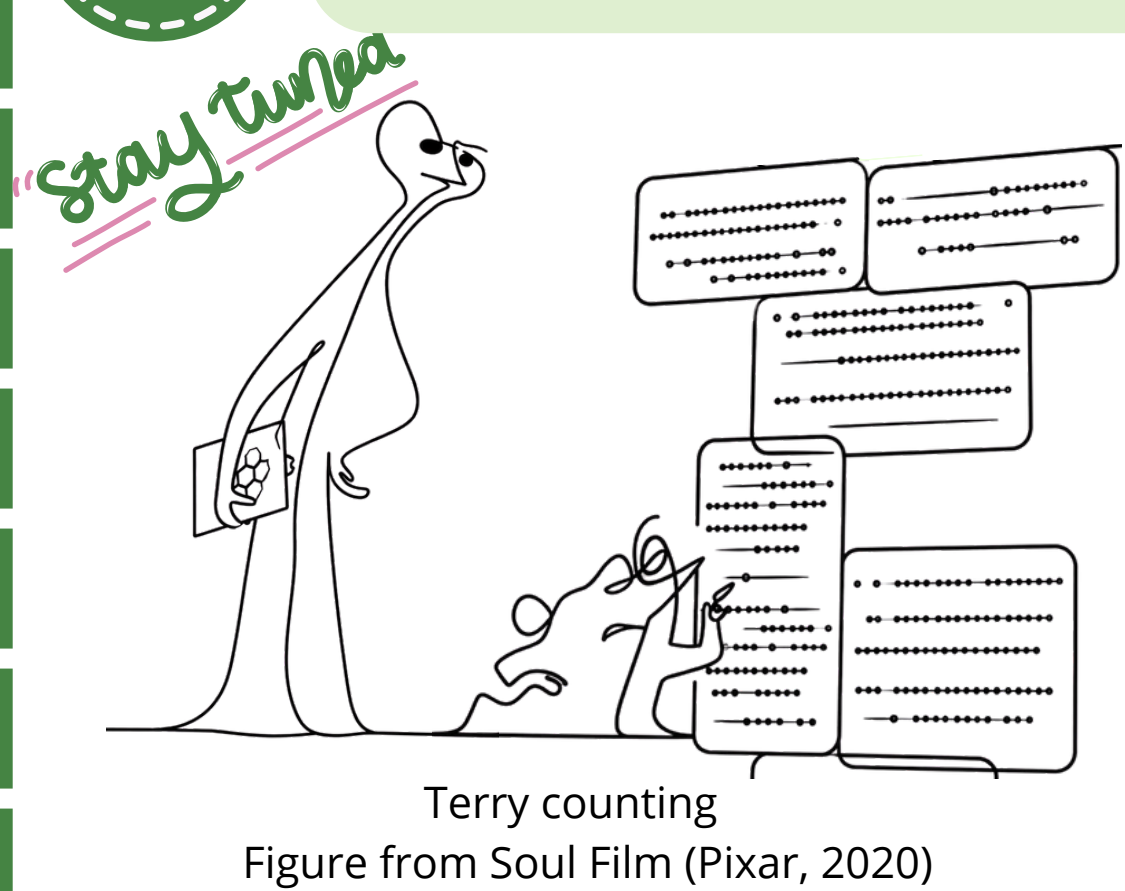
Hadronic Visible Energy > 100 MeV



Hadronic Visible Energy < 100 MeV

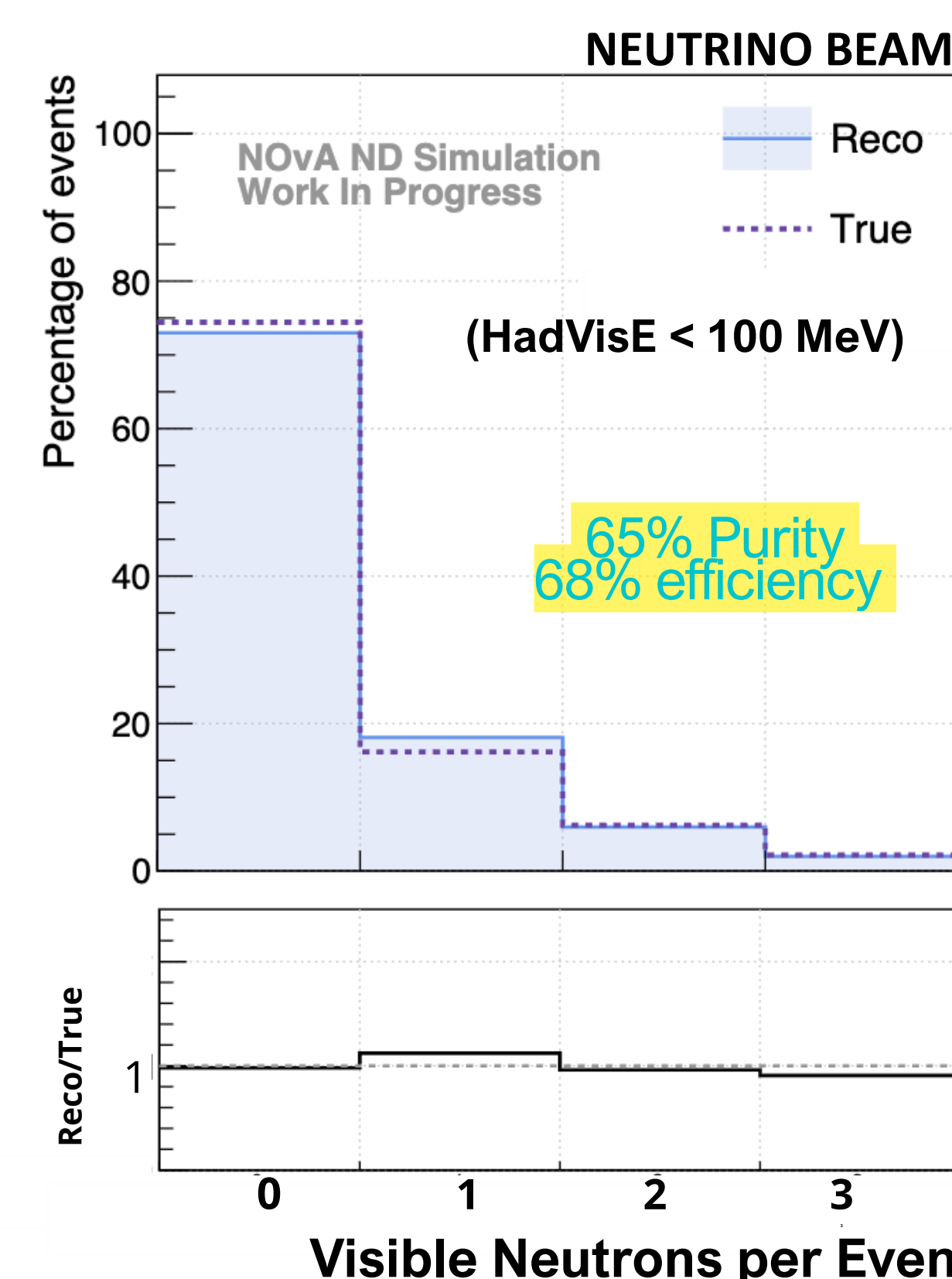


3 Reconstructed Neutron Multiplicity



A neutron measurement will help to assess the reported data-MC discrepancy in neutron activity.

The selection background systematics will be constrained with a data-driven correction, while the neutron systematics will be calibrated using a pulsed neutron source.



COMPOSITION OF THE SELECTED SAMPLE - NEUTRINO BEAM

