



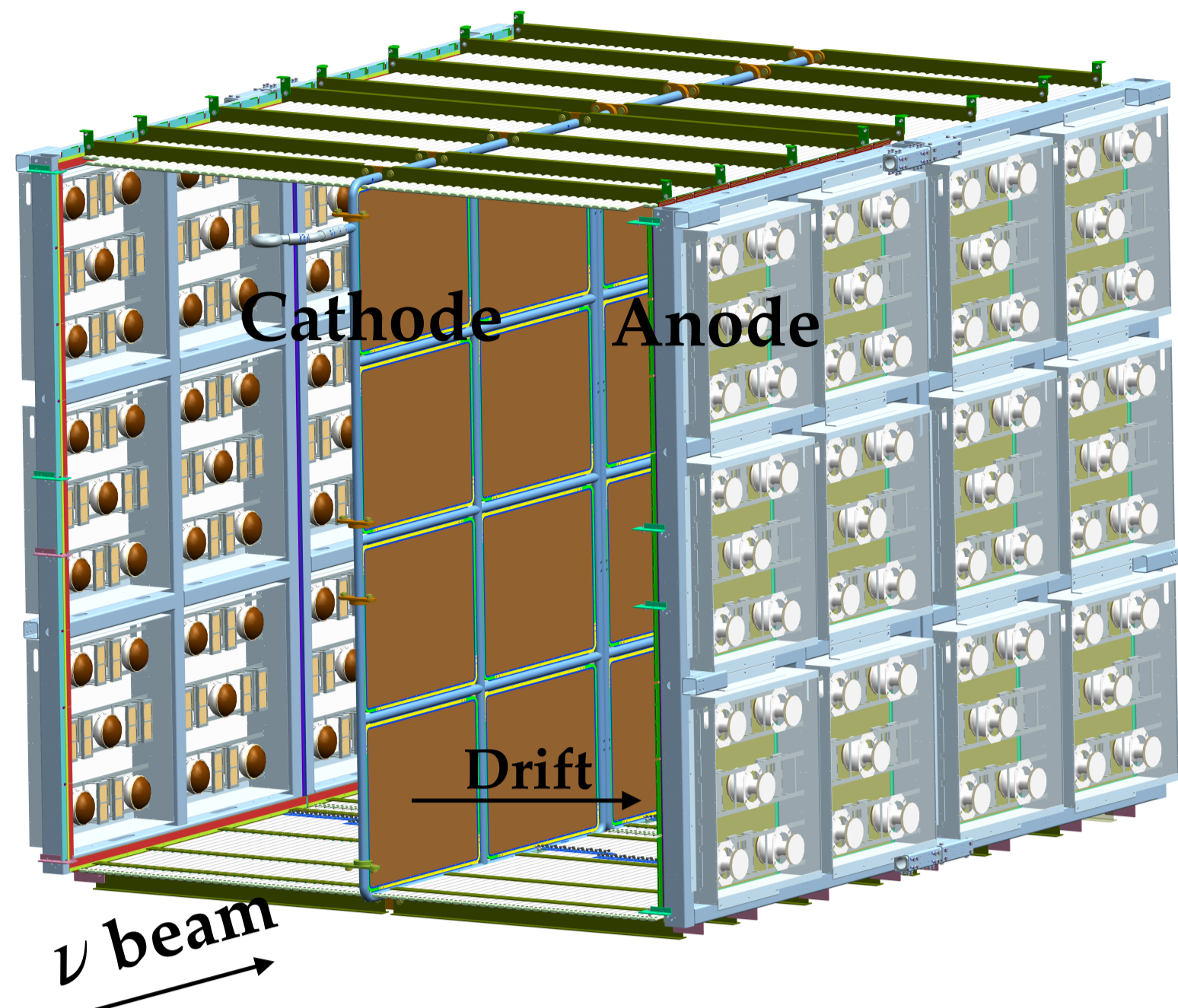
Hyperon searches with the Short-Baseline Near Detector

Francisco Javier Nicolás-Arnaldos (fjnicolas@ugr.es), for the SBND Collaboration



The Short-Baseline Near Detector

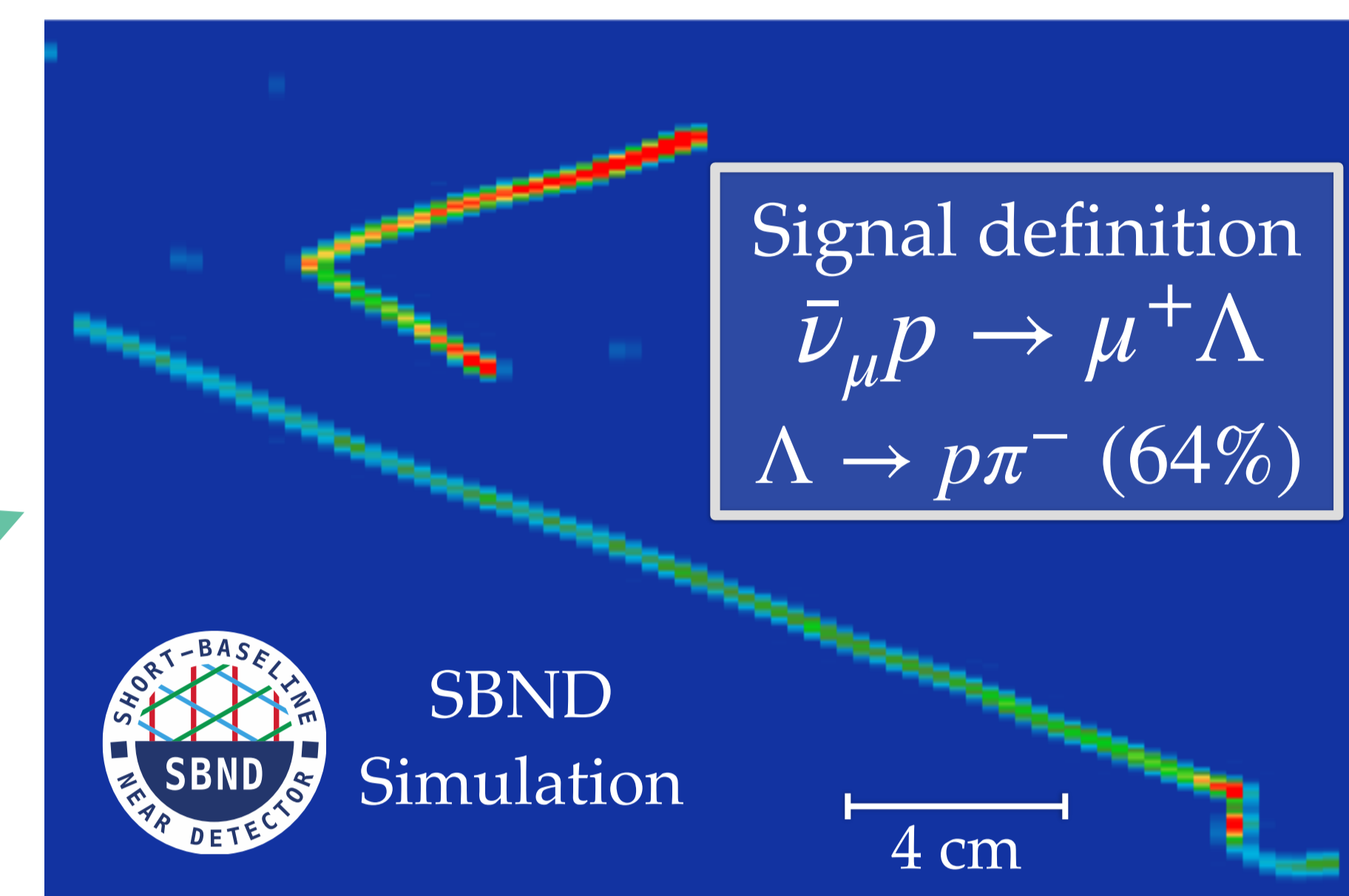
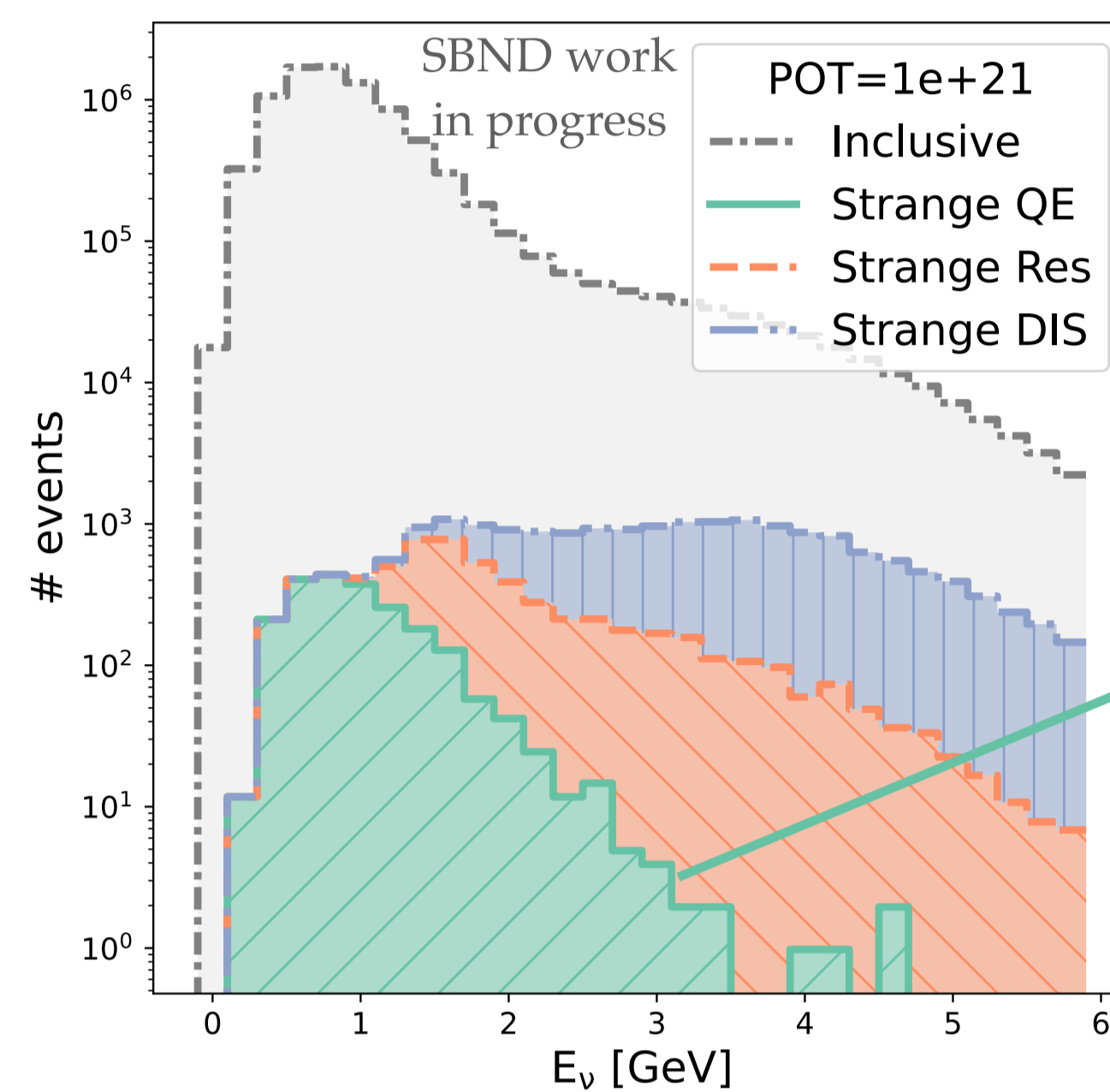
- SBND [1] is a Liquid Argon Time Projection Chamber (LArTPC) designed to capture neutrinos from the **Booster Neutrino Beam** (BNB) at Fermilab



- Its proximity to the beam target (**110 m**) and large mass (**112 tons**) enable the recording of millions of neutrino interactions annually: it will record the largest **ν -Ar interaction** dataset

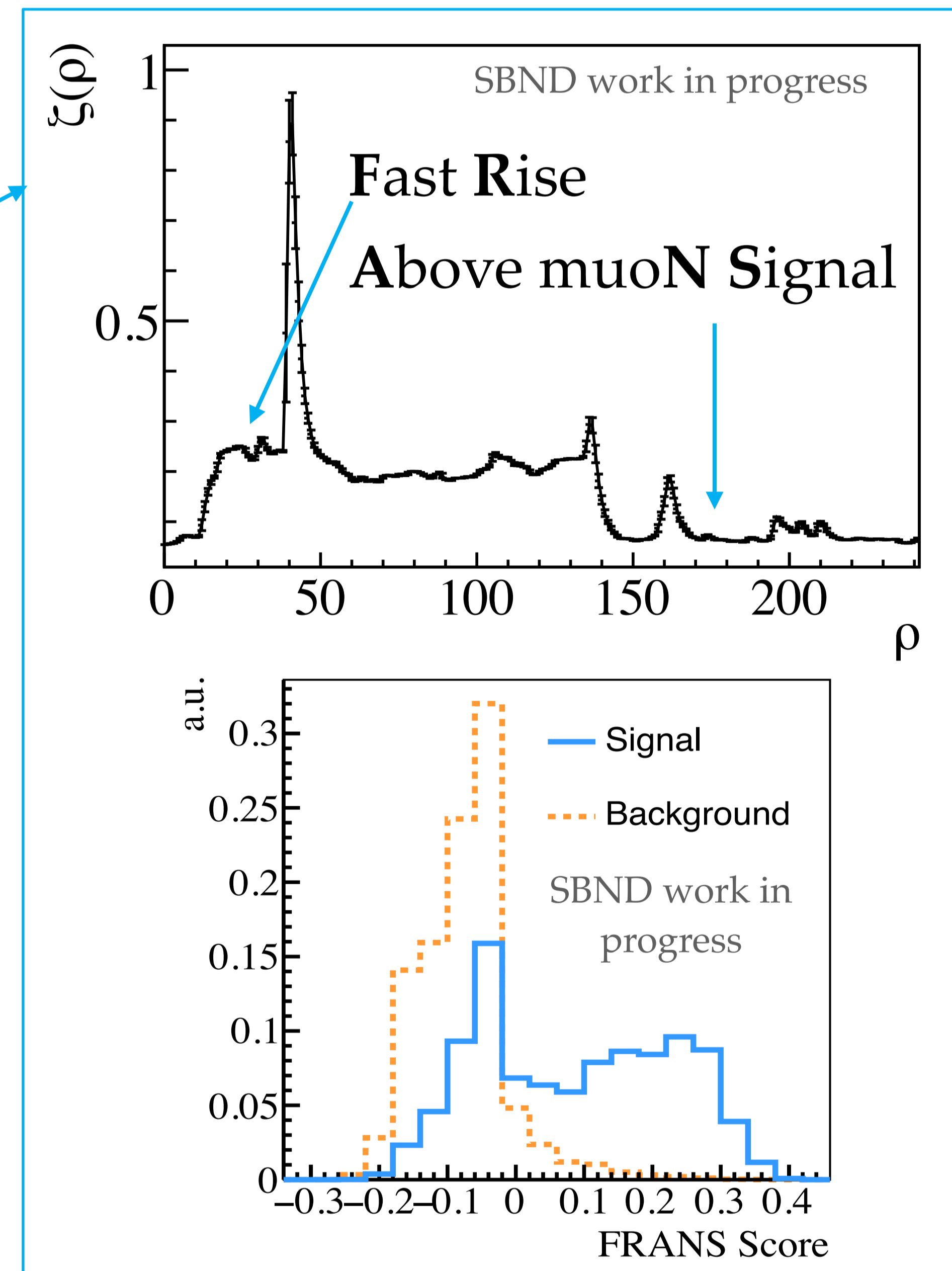
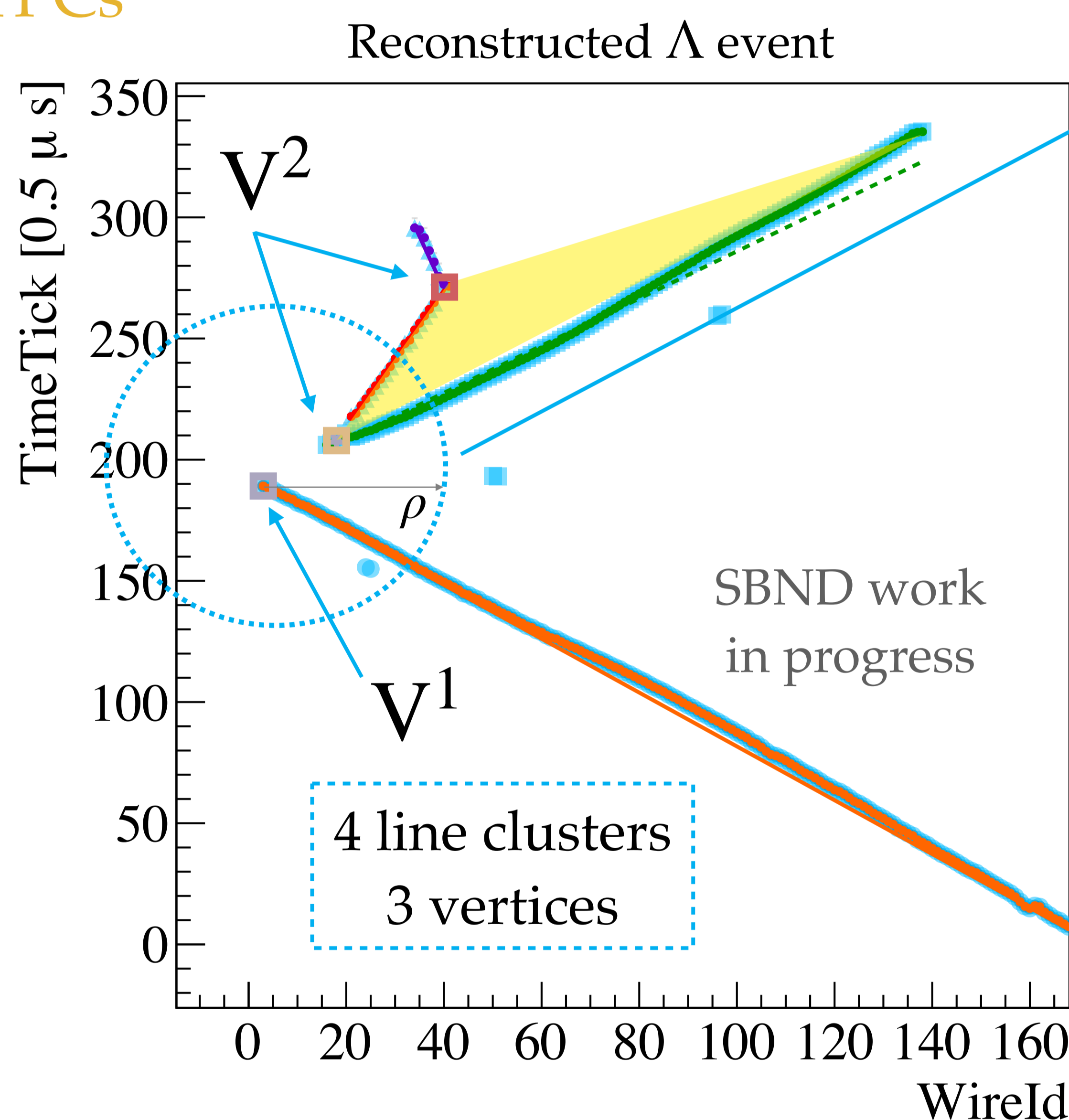
Hyperon production in SBND

- High-resolution imaging + high statistics: facilitates the study of **rare channels** like Cabibbo-suppressed quasielastic (**QE**) **hyperon production**
- ~ 200 /year Λ baryons in the QE channel from the BNB $\bar{\nu}_\mu$ contamination ($\sim 6\%$)
- Only tens of events in the literature to date [2, 3]



Λ baryon identification in LArTPCs

- Topology based selection: primary track (μ^+) followed by a secondary displaced vertex (gap)
- Line-oriented clustering (2D): # **vertices** and associated **multiplicity** ($\equiv V^M$)
- Energy deposition rate** around the primary vertex ($\equiv \zeta(\rho)$)
- Identified “V tracks” candidates reconstructed in 3D: proton/pion discrimination through Bethe-Bloch formula



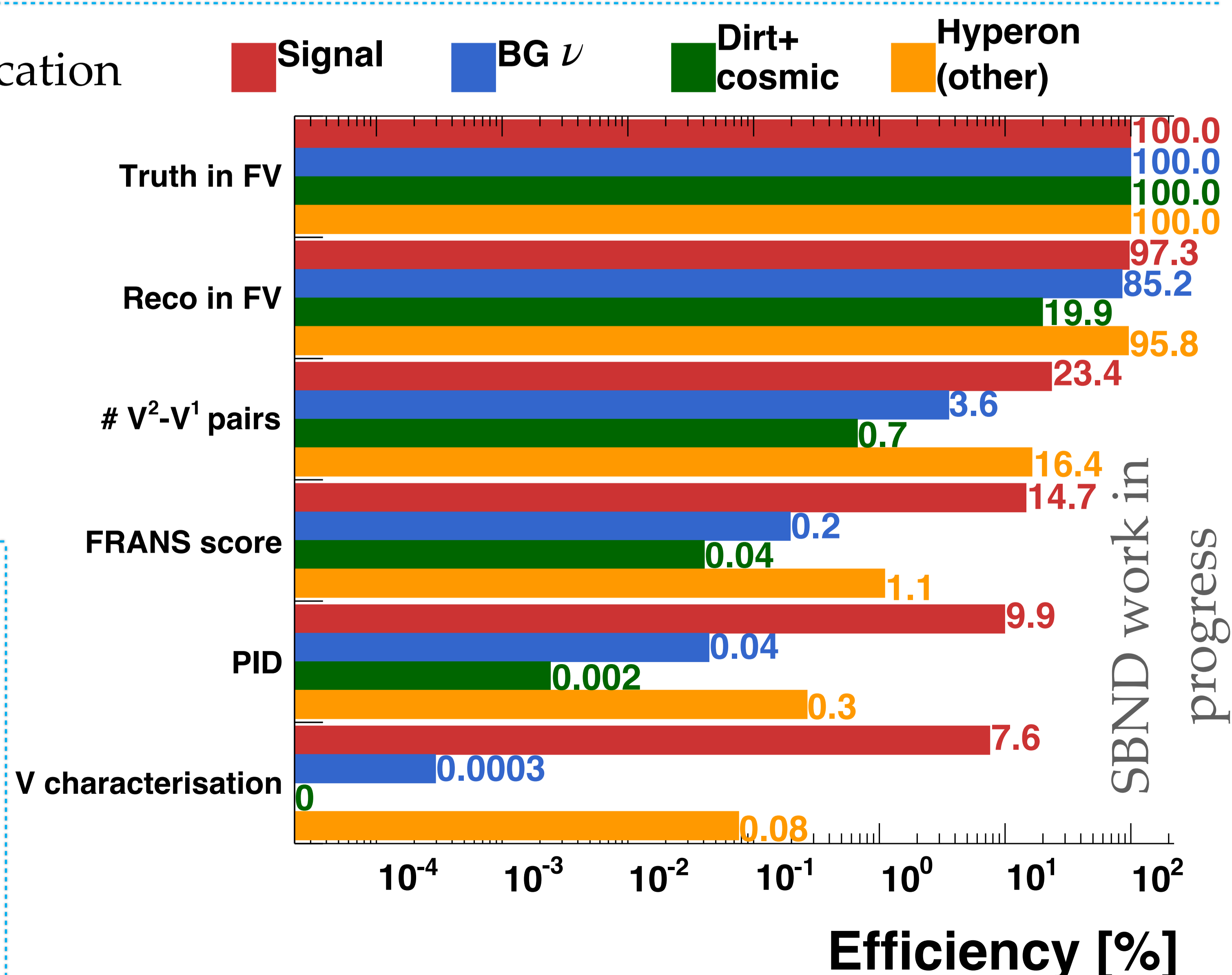
Exercising event selection

- Reconstructed vertex in the fiducial volume (FV)
- 2 vertices with multiplicities 1 and 2
- Fast Rise Above muon Signal** score cut

- V tracks particle identification (PID): low/high dEdx
- V characterisation:
 - V pointing towards the primary vertex
 - No additional activity
 - Beam boost

Summary

- Dedicated event selection for Λ QE channel results in $\sim 7\%$ efficiency with a BG rejection $> 10^5$ with current reconstruction status
- After selection cuts: ~ 10 events/year expected. SBND alone can record similar statistics to the current available



References

- [1] P. A. Machado *et al.*, *The Short-Baseline Neutrino Program at Fermilab*. Annual Review of Nuclear and Particle Science 69, 363–387 (2019)
- [2] Fatima A *et al.*, *Weak Quasielastic Hyperon Production Leading to Pions in the Antineutrino-Nucleus Reactions*. Front. Phys. 7:13.
- [3] P. Abratenko *et al.* (MicroBooNE Collaboration), *First Measurement of Quasielastic Λ Baryon Production in Muon Antineutrino Interactions in the MicroBooNE Detector*, Phys. Rev. Lett. 130, 231802