ICARUS @ SLAC

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Group Introduction

- SLAC Beam Neutrino Group formed in 2012
- Members of:
  - DUNE
  - MicroBooNE
  - ICARUS (since 2015)
- Current ICARUS members:
  - Staff: Mark Convery,Tracy Usher
  - Assoc. Staff: Yun-Tse Tsai
- Planned additions:
  - Faculty: Hiro Tanaka
  - Assoc. Staff: Kazu Terao, Gianluca Petrillo
  - Grad Student: Laura Domine
  - Post-Docs: 2 to be hired in 2019

Group Interests

- Physics interests in:
  - Oscillation physics
    - ν_e disappearance
  - ν_e cross section in NUMI beam
  - Astrophysical/Exotic signals in LArTPC
    - Exotics in BNB or NUMI beam
    - Astrophysics searches/sensitivity studies
      - Connection to DUNE
- Technical Strengths:
  - Simulation/Reconstruction Software
  - Data Acquisition Hardware/ Firmware/Software
  - Electronics
  - Machine Learning for LArTPC reconstruction
- ICARUS activities so far focused on:
  - Simulation and reconstruction within LArSoft (Tracy Usher)
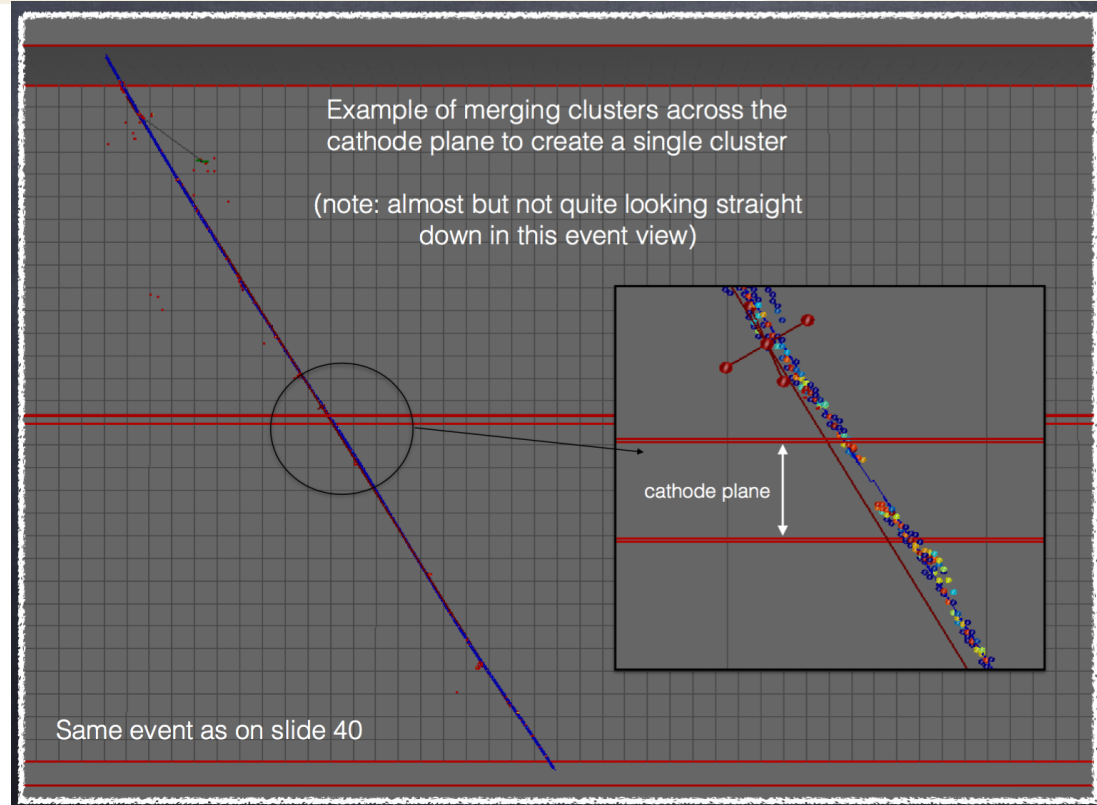 - Data Acquisition (Yun-Tse Tsai)

Heavy Sterile Neutrino search at MicroBooNE
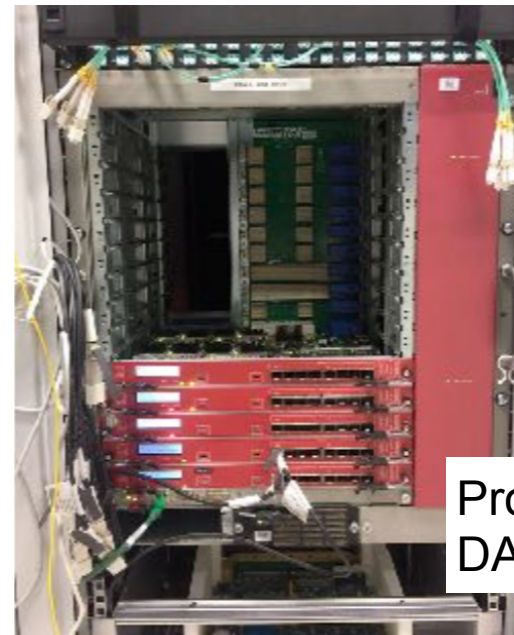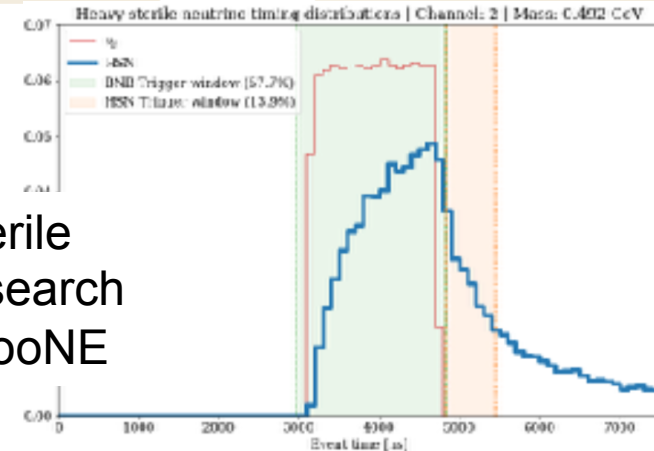
ProtoDUNE-SP DAQ at CERN

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ICARUS Simulation/Reconstruction Software (Usher)

- SLAC effort led by Tracy Usher (Leon Rochester now retired)
  - MicroBooNE reco co-coordinator 2014-2017
  - Analysis Tools co-coordinator 2017-present
- Interested in adapting/re-using algorithms from MicroBooNE merging with existing ICARUS code
- Addressing ICARUS-specific issues:
  - Multiple drift volumes
  - Horizontal wires
  - Utilizing superior PMT coverage/digitization for cosmic rejection
  - Signal-processing in TPC and PMT
- Domine, Petrillo and Terao to join this effort

Example of merging clusters across the cathode plane to create a single cluster

(note: almost but not quite looking straight down in this event view)

cathode plane

Same event as on slide 40

Data Acquisition and Triggering (Tsai)

- Yun-Tse Tsai
  - MicroBooNE DAQ co-Commissioner
  - MicroBooNE DAQ lead 2015-18
- Interested in
  - DAQ and TPC readout
  - DAQ commissioning
  - High-level (software) triggering
  - Application of DAQ to detector commissioning and testing
- Convery and others to join this effort
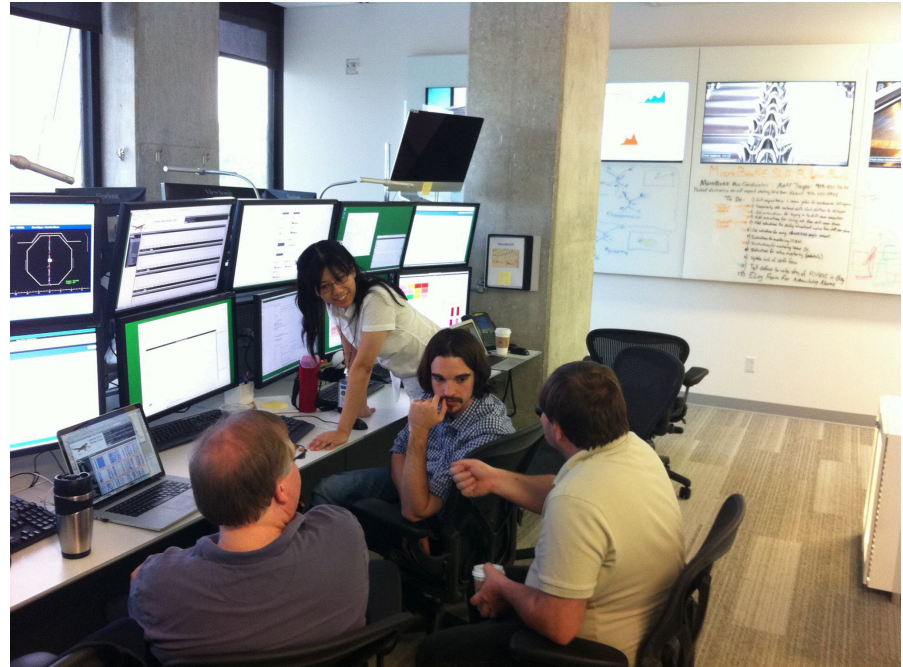
Machine Learning to Aid LArTPC Reconstruction (Terao, Domine)

- 2D and 3D data analysis chain R&D using **Deep Neural Networks** (deeplearnphysics.org)
  - Initiated in MicroBooNe (JINST 12 P03011 2017), now effort across the U.S. intensity frontier
  - Vertex identification, particle clustering, shower/track pixel discrimination
  - 2D and 3D applications + GPU acceleration
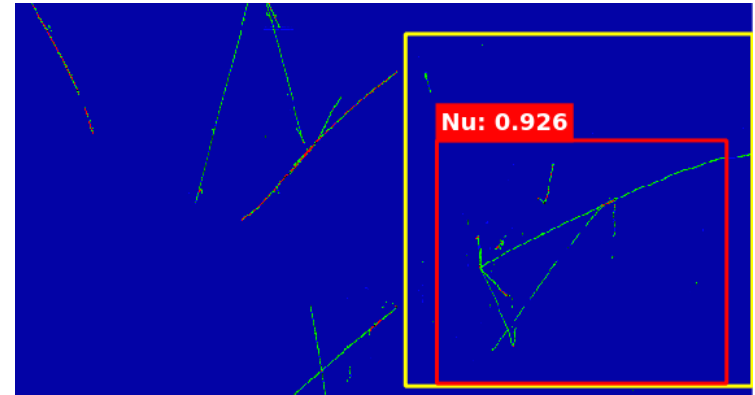
Yellow: "correct" bounding box
**Red**: by the network

Nu: 0.926

μBooNE

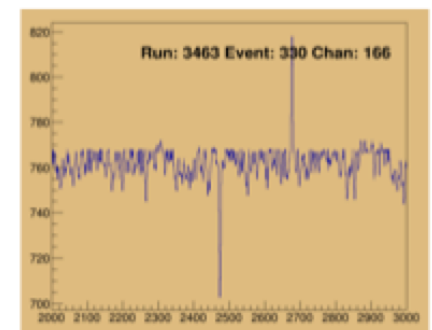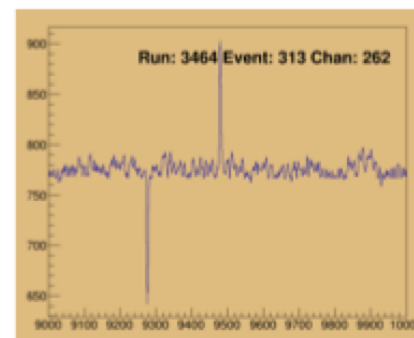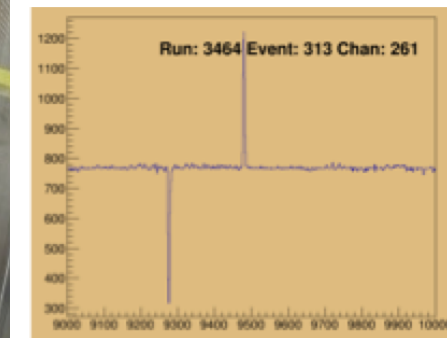μBooNE
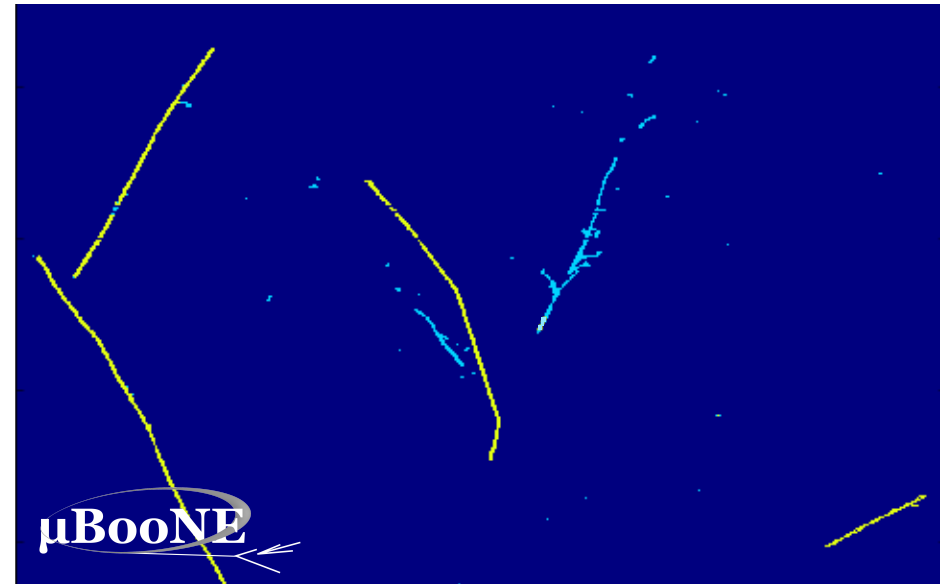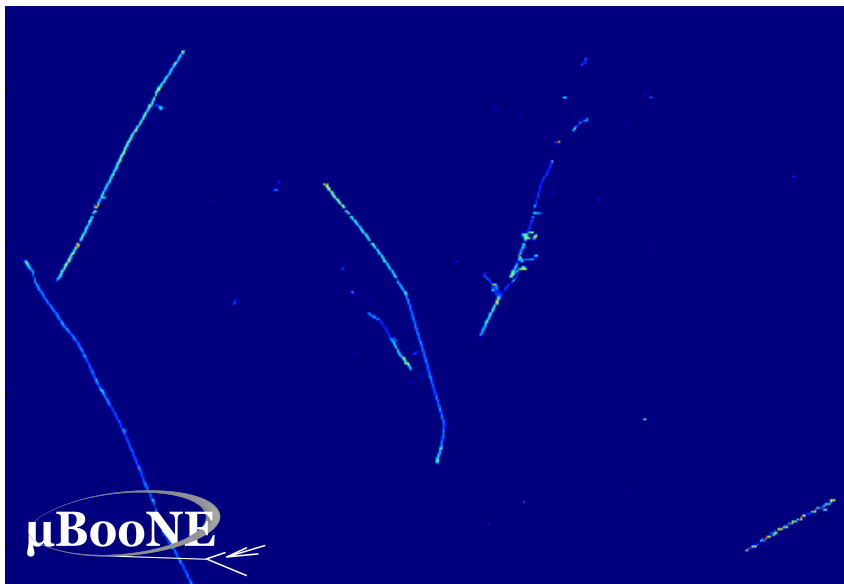
Potential Commissioning Roles

- It would make sense to leverage SLAC strengths in DAQ and electronics to help with commissioning
    - TPC wire continuity
    - Front End card testing
    - Perhaps could develop a DAQ "vertical slice" to read one flange of wires (similar to MicroBooNE MRT)
- Need to interface with INFN groups to see if this makes sense

MicroBooNE Mobile Test Stand
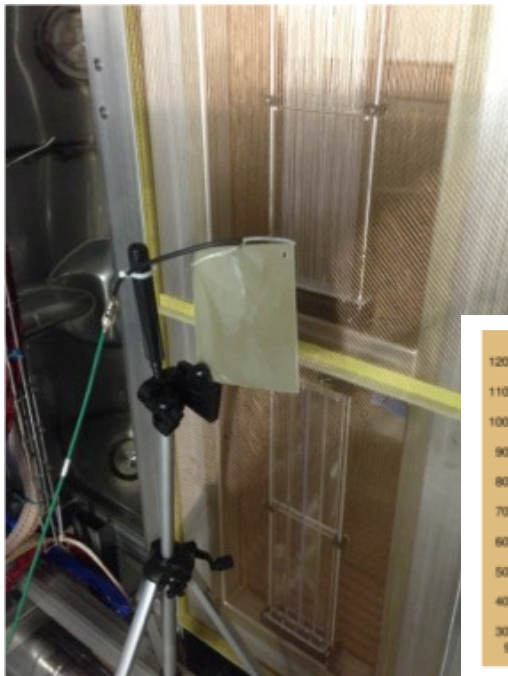
35-ton external Capacitive pulser

Conclusions

- SLAC group has grown and is excited to help commission and extract Physics results from ICARUS

- Logical roles grow out of existing experience in

  - LArTPC Simulation and Reconstruction from MicroBooNE

  - Data Acquisition and Electronics from MicroBooNE and DUNE