ICARUS @ CSU: Mooney Group

Michael Mooney

Colorado State University

ICARUS Collaboration Meeting

May 13th, 2018

Group Introduction

- Principal Investigator: Prof. Mike Mooney
  - Joined CSU as Assistant Professor in August 2017
  - Previously a postdoc at BNL (2014 – 2017)
  - Served as Run Coordinator for MicroBooNE during first beam (September 2015 – April 2016), MicroBooNE Oscillations Group convener (August 2016 – August 2017)
- Experiments: MicroBooNE, SBND, DUNE, PixLAr
- Physics Interests: Neutrino Oscillation Physics, Neutrino Interactions on Argon, Detector Systematics
- Technical Interests: LArTPC Calibration, TPC Electronics Commissioning
- Group Members: 3 Graduate Students, 3 Undergraduate Students, 1 Postdoc, 1 Mechanical Engineer, 1 Technician
- ICARUS Contribution: 1 GS (0.5+0.5), 0.3 Postdoc

Group Members

- Graduate Students:
  - **Ivan Caro Terrazas** – 50% MicroBooNE, **50% ICARUS**
    - Signal processing and 3D Michel reconstruction at MicroBooNE
  - Ryan LaZur – 25% MicroBooNE/DUNE, 75% SBND
    - DAQ vertical slice test and cold electronics testing for SBND
  - **Justin Mueller** – 50% MicroBooNE/DUNE, **50% ICARUS**
    - Developing LAr model in NEST (ionization/scintillation model)
- Undergraduate Students:
  - Chris Alleman – ProtoDUNE-SP TPC electronics calibrations
  - Alex Flesher – LArTPC calibrations with ^{39}Ar beta decays
  - Erik Klemm – PixLAr data analysis
- Postdoc: **Hannah Rogers** – 40% DUNE, **60% SBN**
- Mechanical Engineer: Dave Warner
- Technician: Jay Jablonski

Prospective ICARUS Team

Mike Mooney (PI)

Stationed at CSU, frequent travel to Fermilab in fall (no teaching duty this fall)

Hannah Rogers (Postdoc)

Joins June 1st; Stationed at CSU, frequent travel to Fermilab

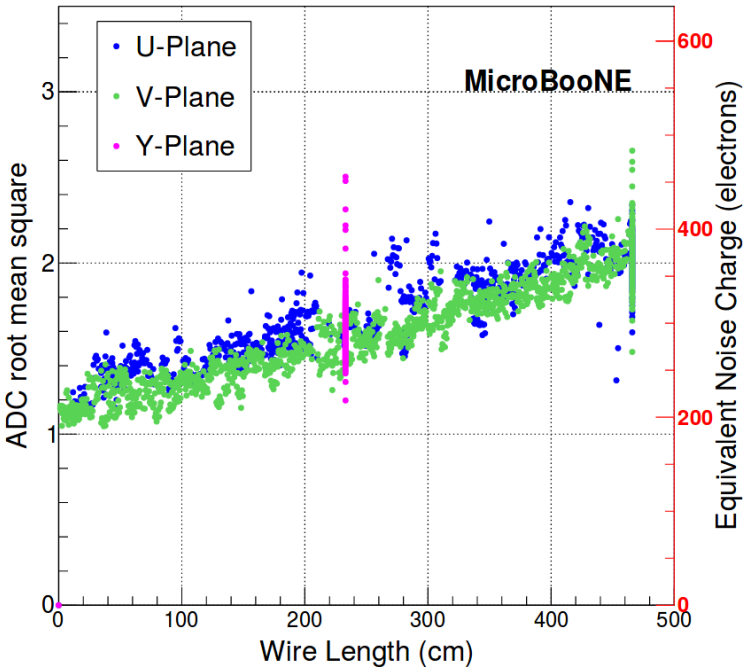
Ivan Caro Terrazas (Grad Student)

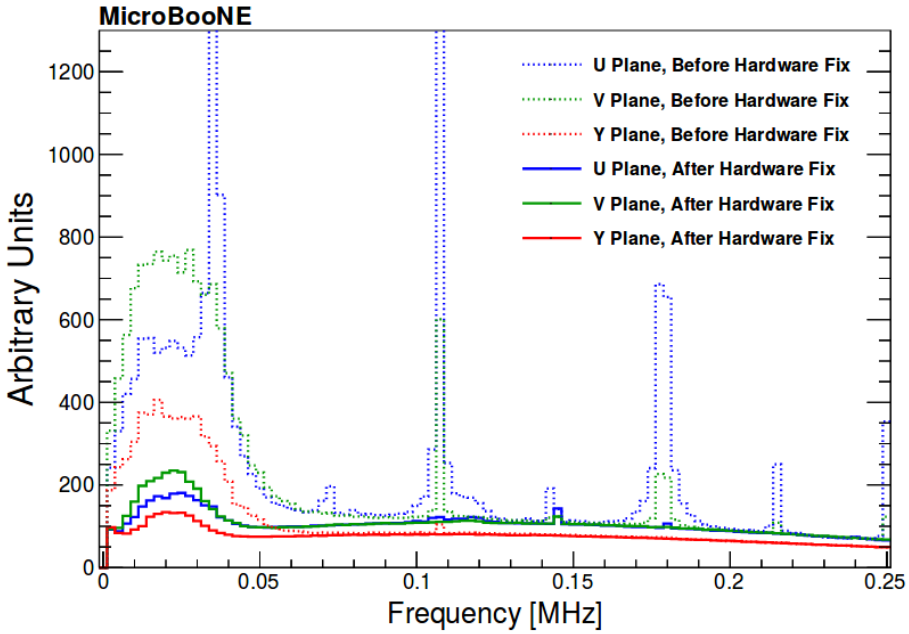
Second-year GS; Moving to Fermilab July 15th

Justin Mueller (Grad Student)

First-year GS; Currently stationed at CSU (for another year of classes)

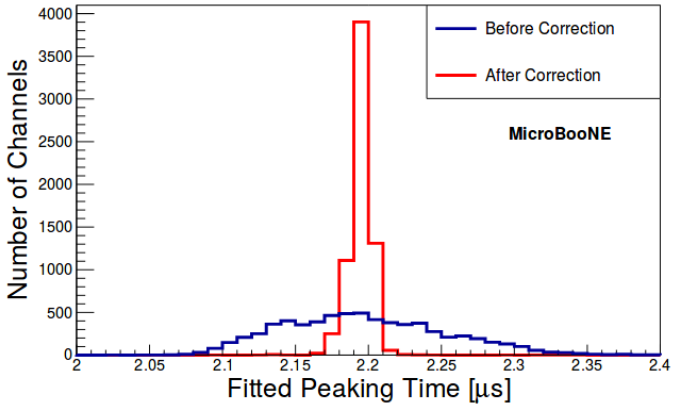
Noise Studies @ MicroBooNE

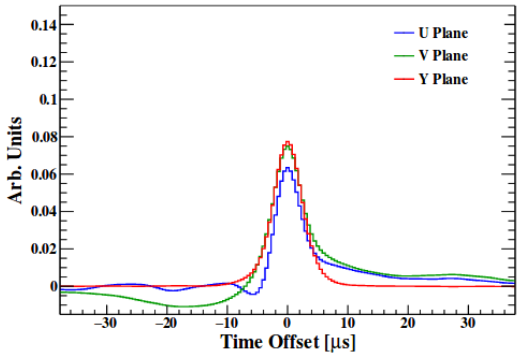




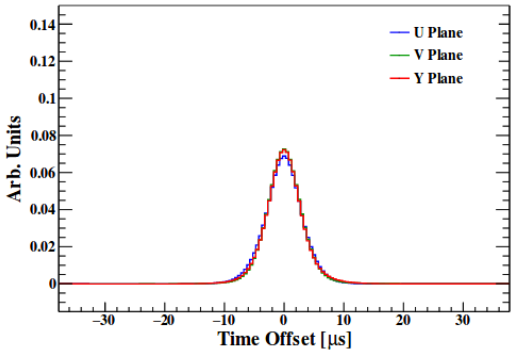
- Experience with investigation/amelioration of noise and TPC electronics issues at MicroBooNE
  - Useful for ICARUS TPC/electronics commissioning
- See MicroBooNE noise paper (JINST): **arXiv:1705.07341**

Signal Processing





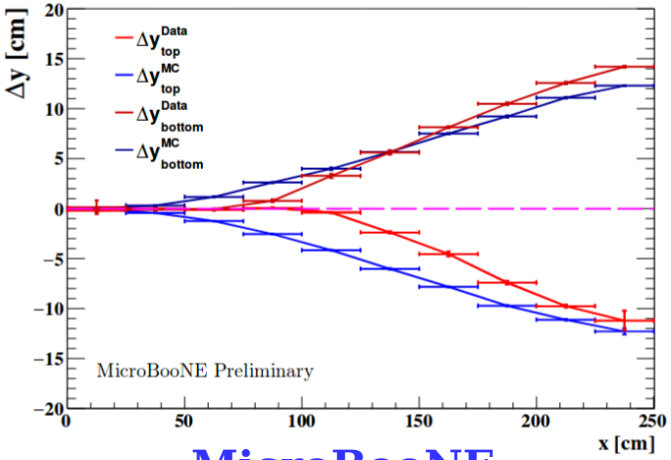
(g) 1D deconvolution, $50° < \theta_{xz} < 70°$.



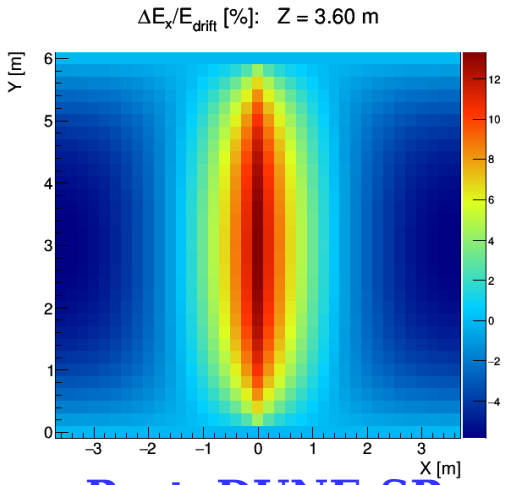
(h) 2D deconvolution, $50° < \theta_{xz} < 70°$.

- Developed new signal processing techniques at MicroBooNE and carried out calibration of TPC electronics
  - Useful for both ICARUS TPC/electronics commissioning and data analysis (e.g. proper handling of induction signals)
- Two upcoming MicroBooNE papers (submitted to JINST):
  - Methodology: **arXiv:1802.08709**
  - Performance and validation with data: **arXiv:1804.02583**

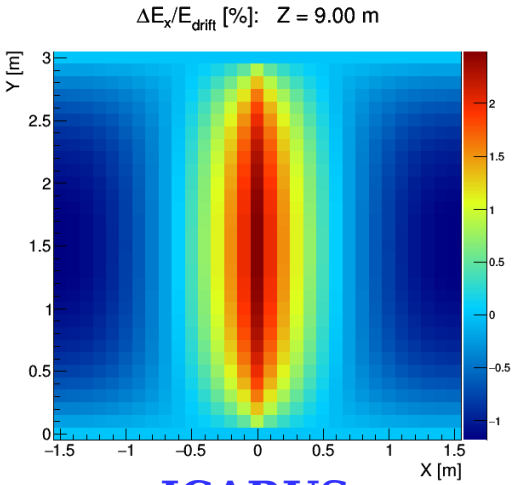
Space Charge Effects



MicroBooNE
Spatial Distortions



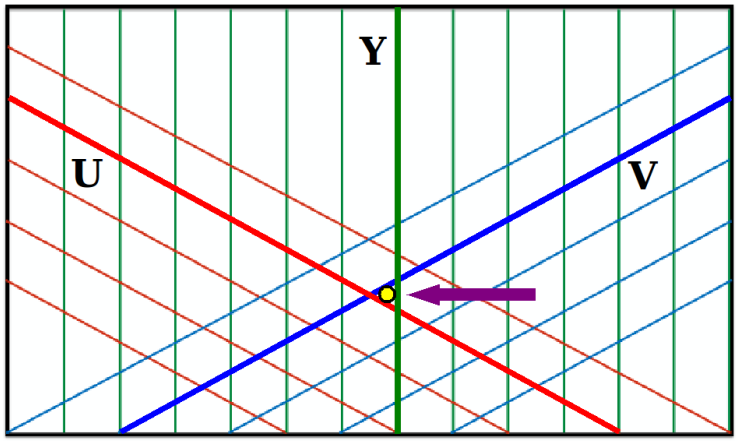
ProtoDUNE-SP
E Field Distortions



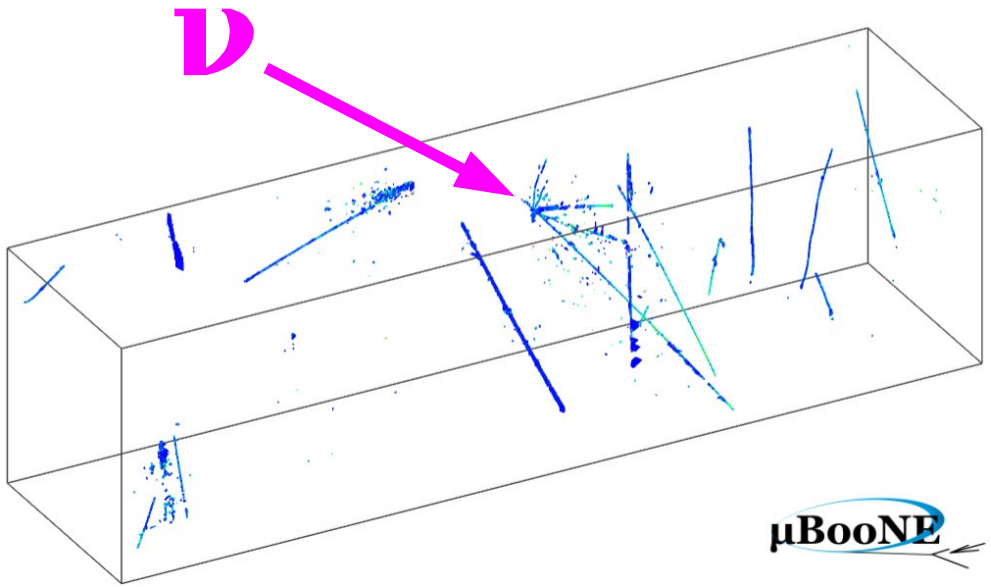
ICARUS
E Field Distortions

- Developed space charge effect (SCE) simulation, used at MicroBooNE and ProtoDUNE, and SCE calibration scheme
  - Useful addition to ICARUS simulation and calibration chain
- Upcoming paper on space charge effects at MicroBooNE
- Current public material on space charge effect studies:
  - First simulation demonstration: **arXiv:1511.01563**
  - MicroBooNE public note: **MICROBOONE-NOTE-1018-PUB**

3D Imaging Techniques



Same Charge Seen on <u>All Three Wires</u>



- Developing 3D imaging and pattern recognition techniques at MicroBooNE for particle reconstruction
  - Student (Ivan) working on Michel reconstruction in 3D
  - Next goal: neutrino interaction reconstruction in 3D
- Can extend these techniques to ICARUS
  - Use to carry out neutrino oscillation and cross section analyses

Thanks!