

# Mitch Soderberg

## Curriculum Vitae

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### Education

- 2006 **Ph.D., Physics**, *University of Michigan*, Ann Arbor, MI.
- 2000 **B.S., Physics**, *Truman State University*, Kirksville, MO.

### Experience

- 2016–present **Associate Professor**, *Syracuse University*, Syracuse, NY.
- 2010–2016 **Assistant Professor**, *Syracuse University*, Syracuse, NY.
- 2010–2016 **Associate Scientist**, *Fermi National Accelerator Laboratory*, Batavia, IL.
- 2006–2010 **Postdoctoral Research Associate**, *Yale University*, New Haven, CT.
- 2000–2001 **High School Physics Teacher**, *St. Louis Priory School*, St. Louis, MO.

### Experiment Collaboration History

- 2014–present **SBND (E-1053)**, Roles: Co-convener of TPC working group; Syracuse group responsible for production of 2 APAs.
- 2012–present **LArIAT (T-1034)**, Roles: Syracuse group led TPC re-furbishment/wiring/installation.
- 2008–present **LBNE/DUNE (E-1071)**, Roles: APA working group Coordinator; APA Consortium Design group Co-convener.
- 2007–present **MicroBooNE (E-974)**, Roles: Co-convener of Physics group; Co-convener of Cross-Sections working group; Editor and primary author of first collaboration publication detailing detector design and construction; Syracuse group played major roles in TPC fabrication/construction/installation.
- 2006–present **ArgoNeuT (T-962)**, Roles: Spokesperson since 2009; Leader of design/construction/installation/operation of the entire experiment, and major involvement in subsequent analysis program that has produced 9 publications.
- 2002–2006 **CDF (E-924)**, Dissertation: “Measurement of the  $W^\pm + b\bar{b}$  Cross-Section in  $695 \text{ pb}^{-1}$  of  $p\bar{p}$  Collisions at CDF II”.

## Research Interests

- **LArTPC Detector Development:** Since the beginning of my postdoctoral years I have been working on developing Liquid Argon Time Projection Chambers (LArTPCs) for use in the study of neutrinos. Progress has been rapid, and there is now a diverse program of running/under-construction LArTPC experiments at Fermilab/CERN, with the ultimate goal of building the 40,000 ton DUNE far detector. I am broadly interested in the design and performance of the TPC detector, and the construction details of these experiments on large scales. I am also interested in improving the instrumentation (e.g. purity monitors, tension measurements, material property studies, etc...) used to construct and operate these detectors.
- **Neutrino Interaction and Oscillation Physics:** The exquisite resolution provided by the LArTPC approach offers new opportunities for exploring the subtleties of neutrino-nucleus interactions. Understanding these subtleties has direct impact on the resolution that the initial neutrino's properties can be determined, which in turn determines our ultimate sensitivity to studying neutrino oscillations. I am interested in measurements of neutrino-nucleus interaction cross-sections, and exploring how these measurements can be used to test and improve accompanying theoretical models implemented in neutrino event generators.
- **Exotic Physics:** With larger detectors comes increased sensitivity to more exotic physics (e.g. supernova neutrinos, nucleon decay, multi-messenger astrophysical events, certain dark matter models). I am interested in exploring these topics with an eye towards measurements on DUNE and perhaps the SBN program.

## Awards

- Spring 2016 "Lunch on the Department" Teaching Award, Small Enrollment Course (PHY216)
- Spring 2014 "Dinner on the Department" Teaching Award, Large Enrollment Course (PHY212)
- Spring 2013 "Dinner on the Department" Teaching Award, Large Enrollment Course (PHY212)
- Spring 2012 "Lunch on the Department" Teaching Award, Small Enrollment Course (PHY361)
- 2001-2003 Regents Fellowship, University of Michigan
- May 2000 Departmental Honors in Physics, Truman State University
- May 2000 Outstanding Senior in Physics, Truman State University

## Funding

- 2017–present NSF – (\$858,000) "Neutrino Physics at Syracuse University", PI
- 2014–present NSF – (\$564,700) "Neutrino Physics with Liquid Argon Detectors: Entering the Micro-BooNE Era", PI
- 2014–present NSF MRI – (\$145,000) "Development of a Time Projection Chamber to Measure Neutrino Interactions in the LAr1 Near Detector", PI
- 2011–2015 NSF – (\$420,000) "Neutrino Physics with Liquid Argon Detectors", PI

## Service

- DOE Intensity Frontier University Comparative Review Panelist: 2015, 2016
- NSF Ad-Hoc Reviewer: 2014, 2015, 2016, 2017
- Co-convenor of the Neutrino Detectors track at the 2011 Technology and Instrumentation in Particle Physics (TIPP) conference, held June 9-14, 2011 in Chicago, IL. Helped recruit and organize ~45 talks, and served as editor of the proceedings for this part of the conference.
- Co-PI of the Syracuse QuarkNet center since its beginning in 2012, which aims to expose local high-school physics teachers and students to modern research in the field of particle physics.
- Director of Graduate Studies for the Syracuse Physics department since Fall 2017
- Referee for papers in *Journal of Instrumentation* (JINST) and *Advances in High Energy Physics*.
- Fermilab Users' Executive Committee: 2007–2009 (Secretary: 2008–2009).

## Public Presentations

- Oct-2017 "Particle Prospecting: Digging for Discovery with Neutrinos", Colgate University Colloquium, Hamilton, NY
- Sept-2017 "Particle Puzzles: Studying Neutrinos and Quarks at SU", Syracuse University Colloquium, Syracuse, NY
- Oct-2015 "Instrumentation and Neutrino Mass", CPAD Instrumentation Frontier Meeting, Arlington, TX
- Sept-2015 "The Big Science of Little Neutrinos", Syracuse University Colloquium, Syracuse, NY
- Feb-2015 "Liquid Argon Capabilities", Workshop on the Intermediate Neutrino Program (WINP2015), Brookhaven National Laboratory
- Oct-2014 "Liquid Argon Detectors", two-part lecture at Neutrino Scattering Physics School, Fermi National Accelerator Laboratory
- July-2014 "Status of the ArgoNeuT and MicroBooNE Experiments", Recontres du Vietnam Flavour Conference, Quy Nhon, Vietnam
- May-2014 "What is the path forward for our precision neutrino oscillation needs?", NuINT 2014, Surrey, United Kingdom
- Feb-2014 "Liquid Argon Time Projection Chambers for Neutrino Physics", Cornell University Seminar, Ithaca, NY
- Nov-2013 "Liquid Argon Detector Developments in the U.S.", NNN13, Kashiwa, Japan
- Nov-2013 "High Voltage in ArgoNeuT", High Voltage in Noble Liquids Workshop, Fermi National Accelerator Laboratory
- Apr-2013 "The Naughty Neutrino", Presentation for Syracuse University Project Advance teachers, New York, New York
- Mar-2013 "Calibrations with Muons in ArgoNeuT", LArTPC R&D Workshop, Fermi National Accelerator Laboratory
- July-2012 "Liquid Argon Detector R&D", NuFACT2012, Williamsburg, VA
- July-2012 "The ArgoNeuT and MicroBooNE Experiments at Fermi National Accelerator Laboratory", ICHEP2012, Melbourne, Australia

- Oct-2011 "Liquid Argon Technology for Neutrinos", 7th International Design Study for Neutrino Factory, Arlington, VA
- June-2011 "Future Neutrino Physics", DOE Institutional Review of Fermilab, Fermi National Accelerator Laboratory
- May-2011 "The ArgoNeuT Project", Fermilab Short Baseline Neutrino Workshop, Fermi National Accelerator Laboratory
- Apr-2011 "Reconstruction and Simulation for LArTPCs", DOE Office of Science Review of Options for Underground Science, Palo Alto, CA
- Mar-2011 "Neutrino Data Analysis with the ArgoNeuT Project", Recontres de Moriond Electroweak 2011, La Thuile, Italy
- Dec-2010 "Liquid Argon Projects in the U.S.", NNN10, Toyama, Japan
- Oct-2010 "Frozen in Time: Neutrino Physics with Liquid Argon Detectors", University of Rochester Seminar, Rochester, NY
- Oct-2010 "ArgoNeuT: University/Lab R&D Experience", Fermilab Workshop on Detector R&D, Fermi National Accelerator Laboratory
- June-2010 "Status of ArgoNeuT and MicroBooNE Experiments", Neutrino 2010, Athens, Greece
- Apr-2010 "Frozen in Time: Neutrino Physics with Liquid Argon Detectors", University of Houston Colloquium, Houston, TX
- Mar-2010 "Frozen in Time: Neutrino Physics with Liquid Argon Detectors", Syracuse University Colloquium, Syracuse, NY
- Feb-2010 "Entering an Era of Precision Neutrino Physics", University of Virginia Colloquium, Charlottesville, VA
- Jan-2010 "Development of Liquid Argon Time Projection Chambers in the U.S.", Indiana University Seminar, Bloomington, IN
- Nov-2009 "Development of Liquid Argon Time Projection Chambers in the U.S.", Rutgers University Seminar, Piscataway, NJ
- Oct-2009 "Development of Liquid Argon Time Projection Chambers in the U.S.", CalTech Seminar, Pasadena, CA
- Sept-2009 "Development of Liquid Argon Time Projection Chambers in the U.S.", University of Michigan Seminar, Ann Arbor, MI
- Sept-2009 "Development of Liquid Argon Time Projection Chambers in the U.S.", SLAC National Accelerator Seminar, Palo Alto, CA
- Sept-2009 "Future Long Baseline Experiments: Options for U.S.", WIN09, Perugia, Italy
- July-2009 "ArgoNeuT: A Liquid Argon Time Projection Chamber Test in the NuMI Beamline", DPF 2009, Detroit, MI
- May-2009 "MicroBooNE: A New Liquid Argon Time Projection Chamber Experiment", NuINT2009, Sitges, Spain
- Feb-2009 "Liquid Argon Time Projection Chambers: U.S. R&D and Physics Program", 45th Karpacz Winter School in Theoretical Physics, Ladek-Zdroj, Poland
- Sept-2008 "Liquid Argon Time Projection Chambers: U.S. R&D and Physics Program", Institut de Physique Nucleaire Seminar, Orsay, France
- Sept-2008 "Liquid Argon Time Projection Chambers: U.S. R&D", NNN08, Paris, France

- Apr-2008 “Liquid Argon Time Projection Chambers: R&D Towards Kiloton Class Detectors”, APS April Meeting, St. Louis, MO
- Nov-2007 “Liquid Argon Time Projection Chambers and Project X”, Project X: 1st Workshop on Physics, Fermi National Accelerator Laboratory

## Selected Publications

- [24] **ArgoNeuT Collaboration**, *Measurement of  $\nu_\mu$  and  $\bar{\nu}_\mu$  neutral current  $\pi^0 \rightarrow \gamma\gamma$  production in the ArgoNeuT detector*, Phys. Rev., D96:012006, 2017.
- [23] **ArgoNeuT Collaboration**, *First Observation of Low Energy Electron Neutrinos in a Liquid Argon Time Projection Chamber*, Phys. Rev., D95:072005, 2017.
- [22] **R. Acciarri et al.**, *Construction and Assembly of the Wire Planes for the MicroBooNE Time Projection Chamber*, JINST 12 (2017) no. 03, T03003.
- [21] **MicroBooNE Collaboration**, *Design and Construction of the MicroBooNE Detector*, JINST 12 (2017) no. 02, P02017.
- [20] **F. Cavanna, O. Palamara, R. Schiavilla, M. Soderberg, R.B. Wiringa**, *Neutrino-nucleus interactions and the short-range structure of nuclei*, nucl-ex/1501.01983 (2015).
- [19] **ArgoNeuT Collaboration**, *First Measurement of Neutrino and Antineutrino Coherent Charged Pion Production on Argon*, PRL 113 (2014) no. 26, 261801.
- [18] **ArgoNeuT Collaboration**, *Detection of back-to-back proton pairs in charged-current neutrino interactions with the ArgoNeuT detector in the NuMI low energy beam line*, Phys. Rev., D90:012008, 2014.
- [17] **ArgoNeuT Collaboration**, *Measurements of Inclusive Muon Neutrino and Antineutrino Charged Current Differential Cross Sections on Argon in the NuMI Antineutrino Beam*, Phys. Rev., D89:112003, 2014.
- [16] **B. Rebel et al**, *High Voltage in Noble Liquids for High Energy Physics*, hep-ex/1403.3613 (2014).
- [15] **LArIAT Collaboration**, *LArIAT: Liquid Argon in a Testbeam*, hep-ex/1405.4261 (2014).
- [14] **SBND Collaboration**, *LAr1-ND (SBND): Testing Neutrino Anomalies with Multiple LArTPC Detectors at Fermilab*, hep-ex/1309.7987 (2013).
- [13] **ArgoNeuT Collaboration**, *A study of electron recombination using highly ionizing particles in the ArgoNeuT Liquid Argon TPC*, JINST (2013) no. 08, P08005.
- [12] **C. Adams et al**, *Scientific Opportunities with the Long-Baseline Neutrino Experiment*, hep-ex/1307.7335 (2013).
- [11] **C. Bromberg et al**, *Liquid Argon Time Projection Chamber Research and Development in the United States*, hep-ex/1307.8166 (2013).
- [10] **ArgoNeuT Collaboration**, *The ArgoNeuT Detector in the NuMI Low-Energy Beam Line at Fermilab*, JINST (2012) no. 07, P10019.
- [9] **ArgoNeuT Collaboration**, *Analysis of a Large Sample of Neutrino-induced Muons with the ArgoNeuT Detector*, JINST (2012) no. 07, P10020.
- [8] **ArgoNeuT Collaboration**, *First Measurements of Inclusive Muon Neutrino Charged Current Differential Cross Sections on Argon*, PRL 108 (2012), 161802.
- [7] **M. Soderberg**, *Liquid Argon Neutrino Detector Development at Fermilab*, Proceedings to Neutrino 2010 Conference, Nuclear Physics B - Proceedings Supplements, Volumes 229-232 (2012).

- [6] **M. Soderberg**, *Liquid-Argon Time Projection Chambers in the U.S.*, Proceedings to 45th Winter School in Theoretical Physics in Ladek-Zdroj, Poland (2009), arXiv:0910.3553.
- [5] **M. Soderberg**, *MicroBooNE: A New Liquid Argon Time Projection Chamber Experiment*, Proceedings to NuINT2009 (2009), arXiv:0910.3497.
- [4] **M. Soderberg**, *ArgoNeuT: A Liquid Argon Time Projection Chamber Test in the NuMI Beamline*, Proceedings to DPF 2009, arXiv:0910.3433.
- [3] **CDF Collaboration**, *Measurement of the  $b$ -jet Cross Section in Events with a  $W$  Boson in  $p$ - $\bar{p}$  Collisions at  $\sqrt{s}=1.96$ TeV*, PRL 104 (2010) 131801.
- [2] **A. Curioni et al**, *A Regenerable Filter for Liquid Argon Purification*, NIM A605:306-311 (2009).
- [1] **A. Curioni, B. Fleming, M. Soderberg**, *The Yale liquid argon time projection chamber*, arXiv:0708.0875.

## Group Members

- Postdoctoral Researchers
  - Pip Hamilton (2016–)
  - Jonathan Asaadi (2012-2015) – Asst. Prof., University of Texas at Arlington
- Graduate Students
  - Ohana Rodrigues (2017–)
  - Avinay Bhat (2015–)
  - Greg Pulliam (2013–)
  - Jessica Esquivel (2011–)
- Undergraduate Students
  - 9 undergraduates employed in last 7 years