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# Matthew L. Strait

*Curriculum Vitae — November 16, 2018*

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## EMPLOYMENT

Dec 2015 – Present	Researcher — NOvA/DUNE	University of MN
Oct 2010 – Nov 2015	Postdoc — Double Chooz/SNO+	University of Chicago
Jan 2006 – Sept 2010	Research Assistant — MINOS/NOvA	University of MN
Sept 2004–May 2006/2008	Teaching Assistant/REU Advisor	University of MN

## EDUCATION

Ph.D. Physics	University of Minnesota, Twin Cities Advisor: Dan Cronin-Hennessy	2010
B.A. Physics	Carleton College (magna cum laude) Advisor: Joel Weisberg	2003

## RESEARCH ACTIVITIES

### **NOvA** (2005 – 2010, 2015 – present)

NOvA observes the transitions  $\nu_\mu \rightarrow \nu_e$  and  $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$  in order to measure the CP-violating phase  $\delta$  and the neutrino mass ordering, as well as using the disappearance of  $\nu_\mu$  to measure  $\theta_{23}$  and  $\Delta m_{32}^2$ . My current work focuses on astrophysical analyses, including convening our “Exotics” group. I also work on neutron studies, detector simulation, and systematic errors in  $\nu_\mu$  disappearance. I have served as run coordinator.

### **DUNE** (2017 – present)

DUNE is a proposed long-baseline neutrino experiment that will measure the transitions  $\nu_\mu \rightarrow \nu_e$  and  $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$  to determine  $\delta_{CP}$  and the neutrino mass ordering. I am working on the cosmic ray tracker system for ProtoDUNE-SP, a prototype for DUNE that has been running at CERN since the fall of 2018. The tracker allows for calibration of space charge effects without the need for an internal laser system.

### **SNO+** (2012 – 2015)

SNO+ is a neutrinoless double beta decay experiment which uses  $^{130}\text{Te}$  as its target isotope. While I was at UChicago, our role on SNO+ was development of the online monitoring system, level-2 trigger and supernova data buffer. We designed hardware and software to optimize supernova capabilities; I was deputy convenor of the SNO+ supernova group. Besides involvement in these activities, I headed the “code integrity committee,” which oversaw development of our Monte Carlo, reconstruction, calibration and analysis software.

### **Double Chooz** (2010 – 2015)

Double Chooz measures the neutrino mixing parameter  $\theta_{13}$  by observing the disappearance of reactor  $\bar{\nu}_e$ . I participated in the installation of the UChicago Outer Veto, wrote the event viewer, and contributed to calibration and reconstruction software. I wrote a high-resolution muon reconstruction that aids in suppression of cosmogenic backgrounds and allowed for my analysis of isotope production via muon capture.

### **MINOS** (2006 – 2010)

MINOS performed precision measurement of the neutrino mixing parameters  $\Delta m_{32}^2$  and  $\sin^2 2\theta_{23}$  by observing  $\nu_\mu$  disappearance. My thesis topic was “A Measurement of Oscillation Parameters using Antifiducial Charged Current Events in MINOS,” in which I analyzed the sample of beam events that occur in the exterior of the detector and in the surrounding rock.

## COLLABORATION SERVICE AND LEADERSHIP

- NOvA: Exotics (astrophysics and beyond-the-Standard-Model) group convenor  
Run coordinator  
Internal paper reviewer  
Major detector simulation improvements, leading to large reduction in systematic error  
Fiber aging studies and stringing machine R&D
- DUNE: Cosmic ray tracker DAQ and construction
- SNO+: Code Integrity Committee (ongoing software oversight), chair  
Supernova working group, deputy convenor  
Event viewer selection committee, chair; event viewer maintainer  
Online monitoring/data flow working group  
On-site construction shifts
- Double Chooz: High-precision muon reconstruction  
Outer Veto: installation and calibration; wrote event viewer  
Major efficiency improvements to reconstruction
- MINOS: Reconstruction batch processing working group  
Contributions to detector Monte Carlo  
Study of  $\bar{\nu}_\mu$  disappearance using rock events

## PRIMARY PUBLICATIONS

- M. Strait et al., NOvA muon energy scale systematic, Fermilab technical publication FERMILAB-FN-1061-ND (forthcoming), Nov 2018. **All writing, Monte Carlo updates, Monte Carlo sample generation, judgments, large majority of studies, some physical detector measurements.**
- M. A. Acero et al. (NOvA Collaboration), *New constraints on oscillation parameters from  $\nu_e$  appearance and  $\nu_\mu$  disappearance in the NOvA experiment*, Phys. Rev. D **98**, 032012 (Aug 2018), [arXiv:1806.00096](https://arxiv.org/abs/1806.00096). **Uses my new, accurate, Monte Carlo geometry. Large reduction of previously dominant systematic error on muon energy scale. Maintained detector uptime in role of run coordinator.**
- Y. Abe et al. (Double Chooz Collaboration), *Muon capture on light isotopes measured with the Double Chooz detector*, Phys. Rev. C **93**, 054608 (2016), [arXiv:1512.07562](https://arxiv.org/abs/1512.07562). **Corresponding author; All data analysis; Paper writing.**
- P. Adamson et al. (NOvA Collaboration), *First measurement of electron neutrino appearance in NOvA*, Phys. Rev. Lett. **116**, 151806 (2016), [arXiv:1601.05022](https://arxiv.org/abs/1601.05022), P. Adamson et al. (NOvA Collaboration), *First measurement of muon-neutrino disappearance in NOvA*, Phys. Rev. D **93**, 051104 (2016), [arXiv:1601.05037](https://arxiv.org/abs/1601.05037). **First NOvA papers, authorship represents my graduate work on R&D.**
- S. Andringa et al. (SNO+ Collaboration), *Current status and future prospects of the SNO+ experiment*, Adv. High Energy Phys. **2016**, 6194250 (2016), [arXiv:1508.05759](https://arxiv.org/abs/1508.05759). **Input on supernova and nucleon decay.**
- Y. Abe et al. (Double Chooz Collaboration), *Precision muon reconstruction in Double Chooz*, Nucl. Instrum. Methods **A764**, 330–339 (2014), [arXiv:1405.6227](https://arxiv.org/abs/1405.6227) **Corresponding author; Describes my reconstruction work; Paper writing.**
- Y. Abe et al. (Double Chooz Collaboration), *Improved measurements of the neutrino mixing angle  $\theta_{13}$  with the Double Chooz detector*, JHEP **10**, 086 (2014), [arXiv:1406.7763](https://arxiv.org/abs/1406.7763), [Erratum: JHEP02,074(2015)]. **My reconstruction algorithm was used to reduce  $^9\text{Li}$  background by half.**

- J. R. Alonso et al., *Advanced Scintillator Detector Concept (ASDC): A Concept Paper on the Physics Potential of Water-Based Liquid Scintillator*, (2014), [arXiv:1409.5864](#). **Significant input on supernovae.**
- Y. Abe et al. (Double Chooz Collaboration), *Reactor electron antineutrino disappearance in the Double Chooz experiment*, Phys. Rev. **D86**, 052008 (2012), [arXiv:1207.6632](#). **First Double Chooz analysis to use the UChicago Outer Veto.**
- P. Adamson et al. (MINOS Collaboration), *Measurement of the neutrino mass splitting and flavor mixing by MINOS*, Phys. Rev. Lett. **106**, 181801 (2011), [arXiv:1103.0340](#). **Thesis work: partially contained events.**
- P. Adamson et al. (MINOS Collaboration), *Search for the disappearance of muon antineutrinos in the NuMI neutrino beam*, Phys. Rev. **D84**, 071103 (2011), [arXiv:1108.1509](#). **Cross-check of surprising result using partially contained events.**
- M. Strait, D. Cronin-Hennessy and K. Arms, *Interaction rate of polystyrene fiber optics with pseudocumene-based liquid scintillator*, Nucl. Instrum. Methods **A615**, 33–36 (2010), [doi:10.1016/j.nima.2010.01.002](#). **Design of procedures; Bench work; Paper writing.**

#### OTHER COLLABORATION PUBLICATIONS

- P. Adamson et al. (NOvA Collaboration), *Search for active-sterile neutrino mixing using neutral-current interactions in NOvA*, Phys. Rev. D **96**, 072006 (2017), [arXiv:1706.04592](#)
- P. Adamson et al. (NOvA Collaboration), *Measurement of the neutrino mixing angle  $\theta_{23}$  in NOvA*, Phys. Rev. Lett. **118**, 151802 (2017), [arXiv:1701.05891](#)
- P. Adamson et al. (NOvA Collaboration), *Constraints on oscillation parameters from  $\nu_e$  appearance and  $\nu_\mu$  disappearance in NOvA*, Phys. Rev. Lett. **118**(23), 231801 (2017), [arXiv:1703.03328](#)
- Y. Abe et al. (Double Chooz Collaboration), *Characterization of the spontaneous light emission of the PMTs used in the Double Chooz experiment*, JINST **11**(08), P08001 (2016), [arXiv:1604.06895](#)
- Y. Abe et al. (Double Chooz Collaboration), *Measurement of  $\theta_{13}$  in Double Chooz using neutron captures on hydrogen with novel background rejection techniques*, JHEP **1**, 163 (2016), [arXiv:1510.08937](#)
- Y. Abe et al. (Double Chooz Collaboration), *Ortho-positronium observation in the Double Chooz experiment*, JHEP **10**, 32 (2014), [arXiv:1407.6913](#)
- Y. Abe et al. (Double Chooz Collaboration), *Background-independent measurement of  $\theta_{13}$  in Double Chooz*, Physics Letters B **735**, 51–56 (2014), [arXiv:1401.5981](#)
- Y. Abe et al. (Double Chooz Collaboration), *First measurement of  $\theta_{13}$  from delayed neutron capture on hydrogen in the Double Chooz experiment*, Phys. Lett. **B723**, 66–70 (2013), [arXiv:1301.2948](#)
- Y. Abe et al. (Double Chooz Collaboration), *Direct measurement of backgrounds using reactor-off data in Double Chooz*, Phys. Rev. **D87**, 011102 (2013), [arXiv:1210.3748](#)
- Y. Abe et al. (Double Chooz Collaboration), *First test of Lorentz violation with a reactor-based antineutrino experiment*, Phys. Rev. **D86**, 112009 (2012), [arXiv:1209.5810](#)
- P. Adamson et al. (MINOS Collaboration), *Measurements of atmospheric neutrinos and antineutrinos in the MINOS far detector*, Phys. Rev. **D86**, 052007 (2012), [arXiv:1208.2915](#)
- Y. Abe et al. (Double Chooz Collaboration), *Reactor electron antineutrino disappearance in the Double Chooz experiment*, Phys. Rev. **D86**, 052008 (2012), [arXiv:1207.6632](#)
- P. Adamson et al. (MINOS Collaboration), *An improved measurement of muon antineutrino disappearance in MINOS*, Phys. Rev. Lett. **108**, 191801 (2012), [arXiv:1202.2772](#)
- P. Adamson et al. (MINOS Collaboration), *Search for Lorentz invariance and CPT violation with muon antineutrinos in the MINOS near detector*, Phys. Rev. **D85**, 031101 (2012), [arXiv:1201.2631](#)

- Y. Abe et al. (Double Chooz Collaboration), *Indication for the disappearance of reactor electron antineutrinos in the Double Chooz experiment*, Phys. Rev. Lett. **108**, 131801 (2012), [arXiv:1112.6353](#)
- Y. Abe et al. (Double Chooz Collaboration), *Indication for the disappearance of reactor electron antineutrinos in the Double Chooz experiment*, Phys. Rev. Lett. **108**, 131801 (2012), [arXiv:1112.6353](#)
- P. Adamson et al. (MINOS Collaboration), *Active to sterile neutrino mixing limits from neutral-current interactions in MINOS*, Phys. Rev. Lett. **107**, 011802 (2011), [arXiv:1104.3922](#)
- P. Adamson et al. (MINOS Collaboration), *First direct observation of muon antineutrino disappearance*, Phys. Rev. Lett. **107**, 021801 (2011), [arXiv:1104.0344](#)
- P. Adamson et al. (MINOS Collaboration), *Measurement of the underground atmospheric muon charge ratio using the MINOS near detector*, Phys. Rev. **D83**, 032011 (2011), [arXiv:1012.3391](#)
- P. Adamson et al. (MINOS Collaboration), *Observation in the MINOS far detector of the shadowing of cosmic rays by the Sun and Moon*, Astropart. Phys. **34**, 457–466 (2011), [arXiv:1008.1719](#)
- P. Adamson et al. (MINOS Collaboration), *A search for Lorentz invariance and CPT violation with the MINOS far detector*, Phys. Rev. Lett. **105**, 151601 (2010), [arXiv:1007.2791](#)
- P. Adamson et al. (MINOS Collaboration), *New constraints on muon-neutrino to electron-neutrino transitions in MINOS*, Phys. Rev. **D82**, 051102 (2010), [arXiv:1006.0996](#)
- P. Adamson et al. (MINOS Collaboration), *Search for sterile neutrino mixing in the MINOS long baseline experiment*, Phys. Rev. **D81**, 052004 (2010), [arXiv:1001.0336](#)
- P. Adamson et al. (MINOS Collaboration), *Observation of muon intensity variations by season with the MINOS far detector*, Phys. Rev. **D81**, 012001 (2010), [arXiv:0909.4012](#)
- P. Adamson et al. (MINOS Collaboration), *Neutrino and antineutrino inclusive charged-current cross section measurements with the MINOS near detector*, Phys. Rev. **D81**, 072002 (2010), [arXiv:0910.2201](#)
- P. Adamson et al. (MINOS Collaboration), *Search for muon-neutrino to electron-neutrino transitions in MINOS*, Phys. Rev. Lett. **103**, 261802 (2009), [arXiv:0909.4996](#)
- S. Osprey et al. (MINOS Collaboration), *Sudden stratospheric warmings seen in MINOS deep underground muon data*, Geophys. Res. Lett. **36**, L05809 (2009), [doi:10.1029/2008GL036359](#)
- P. Adamson et al. (MINOS Collaboration), *Search for active neutrino disappearance using neutral-current interactions in the MINOS long-baseline experiment*, Phys. Rev. Lett. **101**, 221804 (2008), [arXiv:0807.2424](#)
- P. Adamson et al. (MINOS Collaboration), *Testing Lorentz invariance and CPT conservation with NuMI neutrinos in the MINOS near detector*, Phys. Rev. Lett. **101**, 151601 (2008), [arXiv:0806.4945](#)
- P. Adamson et al. (MINOS Collaboration), *Measurement of neutrino oscillations with the MINOS detectors in the NuMI beam*, Phys. Rev. Lett. **101**, 131802 (2008), [arXiv:0806.2237](#)
- P. Adamson et al. (MINOS Collaboration), *A study of muon neutrino disappearance using the Fermilab Main Injector neutrino beam*, Phys. Rev. **D77**, 072002 (2008), [arXiv:0711.0769](#)

## STUDENTS SUPERVISED

- Kevin Labe — Graduate student at University of Chicago. Supernova trigger and invisible nucleon decay in SNO+; Dissertation: “Tests of Lorentz Invariance at the Sudbury Neutrino Observatory”, 2017.
- Emily Conover — Graduate student at University of Chicago. Dissertation: “Muon-induced backgrounds in the Double Chooz neutrino oscillation experiment”, 2014.

- Keith Crum — Graduate student at University of Chicago. Dissertation: “A Measurement of  $\sin^2\theta_{13}$  with the Double Chooz Experiment”, 2014.
- Tony LaTorre — Graduate student at University of Chicago. Online monitoring, supernova trigger, solar neutrinos with SNO+.
- Vladimir Bychkov — Graduate student at University of Minnesota: Oscillation study of uncontained  $\nu_\mu$  events in NOvA. PhD 2018.
- Andrew Vold — Graduate student at University of Minnesota. Alternative  $\nu_e$  identification in NOvA. PhD 2018.
- Dmitrii Torbunov — Graduate student at University of Minnesota. Energy reconstruction for  $\nu_\mu$  events in NOvA; Nucleon decay in DUNE.
- Jay Cushing — Undergraduate student at University of Chicago. Improvements to SNO+ offline software and databases; Double Chooz assembly.
- Alex Diaz — Undergraduate student at University of Chicago. Monte Carlo studies of supernova directionality with water volume of SNO+; Double Chooz assembly.
- Hadar Lazar — Undergraduate student at University of Chicago. Test stand studies of organic scintillator time structure.

#### AWARDS, POSTERS AND TALKS

- Universities Research Association Visiting Scholar, 2018–2019, “Travel support for NOvA analysis and ProtoDUNE cosmic ray tracker.” \$7000.
- “Latest results from NOvA”, invited plenary talk, NOW – The Neutrino Oscillation Workshop — 2018, Ostuni, Italy.
- Poster: “Astrophysics with NOvA,” Neutrino 2018, Heidelberg. [doi:10.5281/zenodo.1300535](https://doi.org/10.5281/zenodo.1300535).
- Fermilab Neutrino Physics Center Scholar, 2017–2018, “Travel support for NOvA collaboration on astrophysical analyses and for work on the ProtoDUNE cosmic ray tracker.” \$4000.
- Universities Research Association Visiting Scholar, 2017–2018, “Travel support for NOvA Exotics group and ProtoDUNE cosmic ray tracker collaboration.” \$8000.
- “Demystifying Neutrinos with the NOvA Experiment,” Physics Colloquium, University of Minnesota-Duluth, March 2017.
- “NOvA: Status and Recent Results”, invited plenary talk, MIAMI 2016, Fort Lauderdale, FL.
- Universities Research Association Visiting Scholar, 2016–2017, “Travel support for NOvA collaboration on electron neutrino selection, run coordination, meetings and workshops.” \$9000.
- Poster: “Nuclear Muon Capture Measurements on Light Isotopes in Double Chooz,” Neutrino 2016, London, UK. Proceedings: [doi:10.1088/1742-6596/888/1/012167](https://doi.org/10.1088/1742-6596/888/1/012167).
- “Status of SNO+,” invited plenary talk, Lake Louise Winter Institute 2015.
- Poster: “Supernova Detection in SNO+,” Neutrino 2014, Boston, MA.
- Poster: “Muon Reconstruction in Double Chooz,” NuPhys 2013, London, UK. Proceedings: [doi:10.1088/1742-6596/598/1/012031](https://doi.org/10.1088/1742-6596/598/1/012031)
- “Status and First Results from Double Chooz,” High Energy Physics Seminar, University of Pittsburgh, February 2012.
- “Neutrino Oscillations and the MINOS Experiment,” Physics Colloquium, St. Olaf College, March 2010.
- “Anti-fiducial Muons in MINOS,” High Energy Physics Seminar, University of Minnesota, April 2010.
- “New Results from MINOS,” invited plenary talk, PHENO 2010, Madison, WI.