Stefano Castro Tognini

Curriculum Vitæ

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stognini

Professional experience

2023 — **Research Scientist**, *Oak Ridge National Laboratory*
Scalable Engineering Applications
Computational Sciences and Engineering Division

2019 – 2023 — **Postdoctoral Research Associate**, *Oak Ridge National Laboratory*
HPC Methods for Nuclear Applications
Nuclear Energy and Fuel Cycle Division

Education

2012 – 2018 — **Ph.D. in Physics**, *Federal University of Goias*
High Energy Physics, focused on cosmic ray data analysis on the NOνA Experiment
Funding: CAPES, CNPq, ANL
DOE OSTI www.osti.gov/biblio/1468447

2010 – 2012 — **M.Sc. in Physics**, *Federal University of Goias*
High Energy Physics, focused on cosmic ray Monte Carlo simulation
Funding: CAPES, Fermilab

2005 – 2009 — **B.Sc. in Physics**, *Federal University of Goias*

Collaborations

2020 — **Celeritas Project**, *ORNL, Fermilab, ANL, and LBNL*
A GPU Monte Carlo particle transport code for HEP experiments celeritas-project
- Core member of the Celeritas team. Mostly focused on physics implementation and validation.

2020 — **URL Muon Detector Project**, *ORNL, PNNL, and Purdue University*
A compact muon detector apparatus developed to test and validate new non-destructive techniques for geological disposal safety assessments (GDSA).
- Core team member involved with all stages of the project: Detector design, simulation, commissioning, deployment, and analysis.

2013 – 2019 — **NOνA Experiment**, *Managed by Fermilab*
NuMI Off-axis ν_e Appearance Experiment novaexperiment.fnal.gov
- **Ph.D. Dissertation [**Phys. Rev. D **99**, 122004 (2019)**]**
- **The NOνA Remote Operation Center at Federal University of Goias**
  - Commissioned, certified, and maintained the NOνA ROC at UFG between 2016 and 2018.
- **Integration of CORSIKA in the NOνA *art* Framework**
  - Developed an integration layer software for between CORSIKA and Fermilab's *art* Framework. This code has since been used by MicroBooNE and ProtoDUNE experiments as well.
- **APD quality assessment task force**
  - NOνA detector channels consist of wavelength-shifting fibers submersed in liquid scintillator and connected to Avalanche Photo Diodes (APDs). The work consisted in testing the quality of these APDs before being installed in the NOνA Near Detector.
  - Trained new people to keep the APD testings running at the end of the Near Detector commissioning period.
- **On call emergency contact for Near Detector related issues (8 months)**

2011 **MINOS/MINOS+ Experiment**, *Managed by Fermilab*

Main Injector Neutrino Oscillation Search Experiment www-numi.fnal.gov

(Data taking period ended on June 29, 2016. Data analyses are still ongoing.)

- **MINOS/MINOS+ Remote Operation Centers**
  - Developed software packages, wrote documentation, and provided technical support for commissioning, certifying, and maintaining all MINOS/MINOS+ ROCs.
  - Helped writing a certification process for ROCs. Certification processes for all Fermilab neutrino experiments evolved from on it.
  - Built and maintained the MINOS ROC at UFG, which was the first certified ROC of any Fermilab neutrino experiment.
  - Deployed and maintained the main MINOS+ Control Room at Fermilab until data-taking ended.
- **Data analyses**
  - Observation of seasonal variation of atmospheric multiple-muon events in the MINOS Near and Far Detectors doi 10.1103/PhysRevD.91.112006
  - Measurement of the multiple-muon charge ratio in the MINOS Far Detector doi 10.1103/PhysRevD.93.052017

Invited talks & seminars

2023 **Celeritas: A GPU Monte Carlo detector simulation code for HEP**. *Amherst Center for Fundamental Interactions Seminar*. University of Massachusetts Amherst.
https://www.umass.edu/physics/events/2023-04-11-celeritas-gpu-monte-carlo-detector-simulation-code-hep

2022 **From muons to supercomputers**. Fermilab Students and Postdocs Association Early Career Seminar.
https://spa.fnal.gov/early-career-seminar-series/

Celeritas: Bringing exascale computing to HEP detector simulation. *Colloquium*. Department of Physics and Astronomy, University of Mississippi.
https://relativity.phy.olemiss.edu/Colloquia/#tognini

2019 **Particle Physics**. *XI Physics School*. Institute of Physics, Federal University of Goias.
Presented as a part of a series of lectures at undergraduate level. (In Portuguese)
https://if.ufg.br/e/23682-xi-escola-de-fisica-do-if-ufg

2018 **Observation of cosmic ray multiple-muon seasonal variations in the NOνA Near Detector**. *High Energy Physics Seminar*. Department of Physics, Syracuse University.
http://physics.syr.edu/event-items/2018/2018-04-11-stefano-tognini-hep-seminar.html

2012 **The problem with the speed of neutrinos**. *Perturbation Theories*—a series of seminars organized and presented by the graduate students of the Physics Institute at UFG. (In Portuguese)
http://teoriasperturbativas.wikidot.com/blog:4

Conferences, Meetings & Workshops

Chairing sessions

2022 **Neutrinos: MiniBooNE / MicroBooNE / Neutrino beams**. New Perspectives. Fermilab.
https://indico.fnal.gov/event/53945

2021 **Dark Matter: LDMX / PROSPECT / BUFFALO**. New Perspectives. Fermilab.
https://indico.fnal.gov/event/49432

Meetings & Workshops

2023 **Celeritas, focused talk: initial results**. SciDAC-5 PI Meeting. Rockville (MD).
https://web.cvent.com/event/cea4f932-d2f7-457e-8d29-b5c1d91ee037

Celeritas Physics Validation. (Poster) SciDAC-5 PI Meeting. Rockville (MD).
https://web.cvent.com/event/cea4f932-d2f7-457e-8d29-b5c1d91ee037

2022 S. C. Tognini and S. R. Johnson. ***Celeritas*: HEP detector simulation on GPUs**. (Poster) Snowmass Community Summer Study Workshop. Seattle (WA).
https://indico.fnal.gov/event/22303/contributions/243736/

***Celeritas* experiment integration**. HSF Detector Simulation on GPU Community Meeting.
https://indico.cern.ch/event/1123314/

T. M. Evans and S. C. Tognini. **HEP-CCE: *Celeritas***. HEP-CCE All Hands Meeting.
https://indico.fnal.gov/event/53750/

Selected conference presentations

2023 **An overview of Celeritas: a novel GPU Monte Carlo detector simulation code**. *G10: Computational Methods and their Implementation in Physics*. APS April Meeting. Minneapolis (MN).
https://meetings.aps.org/Meeting/APR23/Session/G10.8

2017 A. Habig, S. C. Tognini, *et al.* (On behalf of the NOνA Collaboration) **Seasonal Variation of Multiple-Muon Events in MINOS and NOνA**. (Poster) 35th International Cosmic Ray Conference (ICRC), Bexco, Busan, Korea.
https://pos.sissa.it/301/

2014 S. C. Tognini and R. A. Gomes. **Simulation of cosmic ray shower using CORSIKA and CRY in the NOνA Far Detector**. (Poster) XXXV National Meeting of Particles and Fields, Passa Quatro (MG), Brazil.

S. C. Tognini and R. A. Gomes. **Neutrino oscillation physics at the NOνA experiment**. (Poster) XXXV National Meeting of Particles and Fields, Passa Quatro (MG), Brazil.

2012 **Simulation of atmospheric temperature effects on cosmic ray muon flux**. (Poster) NuInt12: Eight International Workshop on Neutrino-Nucleus Interactions in the Few-GeV Region, Rio de Janeiro (RJ), Brazil.

2011 **Remote MINOS Shift Station at IF-UFG**. (Poster) I Physics Meeting, Foz do Iguacu (PA), Brazil.

2010 **Monte Carlo simulation of the cosmic ray muons at the MINOS Far Detector**. (Poster) XXXI National Meeting of Particles and Fields, Passa Quatro (MG), Brazil.

2009 **Status and results in neutral hyperon physics at KTeV (Fermilab) and NA48/1 (CERN)**. (Poster) XXX National Meeting of Particles and Fields, Passa Quatro (MG), Brazil.

Leadership roles

Oak Ridge National Laboratory

2020

Code lead of the URL Muon detector project simulation framework

- Code lead developing the digital twin of the experiment. This entails developing and integrating multiple Monte Carlo and analysis codes.

Federal University of Goias

2014
2018

Liaison of the NOνA remote Operation Center at UFG

2014
2016

Liaison of all MINOS Operation Centers worldwide

- Liaison of all certified MINOS Operation Centers at: Fermilab, Federal University of Goias, University of Warsaw, University of Minnesota (and Minnesota Duluth), Tufts University, College of William and Mary, University College London, University of Texas at Austin, and University of Cincinnati.

2013–2014 **Administrative Council of the Physics Graduate Program**, *Institute of Physics*, Federal University of Goias

- Elected representative of the M.Sc. and Ph.D. body of students. Duties included presenting, discussing, and voting on administrative resolutions, such as graduate program guidelines, code of conduct, budget, as well as managing the use of office spaces and approving travel expenses for Ph.D. students.

2011–2016 **Liaison of the MINOS Remote Operation Center at UFG**

Teaching, mentoring, & defense committees

Oak Ridge National Laboratory

2023 **Ph.D. defense committee**, *Ademar Paulo Júnior*, Simulation of atmospheric muon charge ratio using CORSIKA (In Portuguese), Federal University of Goias.

2022–2023 **Co-mentor**

- **Kadin Deisenroth**, from the University of Buffalo, during his SULI internship at PNNL for the summer of 2022 and his tech internship at PNNL until May 2023. His work focused on developing a Geant4 Monte Carlo simulation of the URL Muon Detector project, a collaboration between ORNL, PNNL, and Purdue University.
- **Ethan A. Asano** during his Summer internship. The project consisted in validating *Celeritas* physics models by comparing them against Geant4.

Federal University of Goias

2012–2018 **Advising assistant**

- Helped advise younger students from my HEP research group on multiple projects.

2015 **Co-advisor & senior thesis defense committee**, *Matheus Norberto Jacomé*, Stratospheric temperature effects on cosmic ray muon flux (In Portuguese), State University of Goias.

2011–2013 **Teaching assistant**

Semesters of **2012** and **2013** (as a Ph.D. student)

- Physics I
- Physics III
- Introduction to Elementary Particle Physics

Semesters of **2011** and **2012** (as a M.Sc. student)

- Physics I
- Laboratory of Physics II
- Introduction to Elementary Particle Physics

Scientific outreach

2020 **Being a scientist outside the University**. Invited speaker at PUC Goias. (In Portuguese)
https://www.pucgoias.edu.br/noticias/eventos/a-vida-de-cientista-fora-da-universidade/

2018 **How particle accelerators revolutionized our World**. Invited speaker at Campus Party Brasilia, Brazil. (In Portuguese)
https://campuse.ro/events/Campus-Party-Brasilia-2018-CPBSB2/talk/internet-tratamentos-de-cancer-producao-de-eletronicos-pneus-de-carro-como-aceleradores-de-particulas-revolucionaram-nosso-mundo-cpbsb2/

2016 Interviewed at **Connect to UFG – Innovation and Technology**. *TV UFG*, aired on October 26, 2016. (In Portuguese)
https://www.youtube.com/watch?v=TeTco24vgY4

2015 Volunteer scientist to interact with adults and children at the **Fermilab's Family Open House**. Briefly interviewed at: https://www.dailyherald.com/article/20150208/news/150208893/

2014 Invited scientist to answer questions from community decision leaders and VIPs at the **Future of Fermilab Address and Reception**.

Funding

Research funding

2024 **Early Career Development Program**, *PI*, Oak Ridge National Laboratory
Modeling and simulation of muon-catalyzed fusion.

2023 **Laboratory Directed Research & Development**, *Co-PI*, Oak Ridge National Laboratory
Development of Cosmic Radiation Noise Cancellation Method.

2022 **SciDAC-5**, *DOE ASCR & HEP*
Celeritas: GPU-accelerated particle transport for detector simulation in high energy physics experiments.

2021 **SFWST**, *DOE NE*
URL Muon Detector Project: A compact muon detector for GDSA and serve as a pilot to help plan facility access protocols for future uses of the Underground Research Laboratory (URL).

Scholarships

2012–2016 **CAPES**
Ph.D. scholarship.

2014–2015 **Science Without Borders Fellowship (CAPES & CNPq) & Argonne National Laboratory**
One-year period at ANL and Fermilab working on NOνA and MINOS/MINOS+.

2010–2012 **CAPES**
M.Sc. scholarship.

2011 **Fermi National Accelerator Laboratory**
3 months period at Fermilab working on MINOS/MINOS+.

Skills

Programming & scripting languages

C/C++, Python, SQL, FORTRAN, UNIX Shell scripting, LaTeX

Frameworks, libraries & tools

ROOT, Geant4, CORSIKA, Fermilab art Framework (NOvASoft and LArSoft), GIT, SVN, Doxygen, SAM/samweb, Spack, Jobsub, PBS TORQUE

Spoken languages

Portuguese (native), English (fluent), Italian (fluent), French (conversational)

Publications

Research profiles

orcid.org/0000-0001-9741-6608
inspirehep.net/authors/1074966
scholar.google.com/citations?user=M4To0NcAAAAJ
www.webofscience.com/wos/author/record/B-2288-2019
www.researchgate.net/profile/Stefano-C-Tognini

Journal articles

2021 M. A. Acero, *et al.* (NOνA Collab.) **Seasonal variation of multiple-muon cosmic ray air showers observed in the NOvA detector on the surface**. Phys. Rev. D **104**, 012014.
10.1103/PhysRevD.104.012014

2020 P. Adamson, *et al.* (MINOS+ Collab.) **Precision Constraints for Three-Flavor Neutrino Oscillations from the Full MINOS+ and MINOS Dataset**. Phys. Rev. Lett. **125**, 131802.
10.1103/PhysRevLett.125.131802

P. Adamson, *et al.* (MINOS+ Collab.) **Improved Constraints on Sterile Neutrino Mixing from Disappearance Searches in the MINOS, MINOS+, Daya Bay, and Bugey-3 Experiments**. Phys. Rev. Lett. **125**, 071801.
10.1103/PhysRevLett.125.071801

2019 M. A. Acero, *et al.* (NOνA Collab.) **Observation of seasonal variation of atmospheric multiple-muon events in the NOvA Near Detector**. Phys. Rev. D **99**, 122004.
10.1103/PhysRevD.99.122004

P. Adamson, *et al.* (MINOS+ Collab.) **Search for Sterile Neutrinos in MINOS and MINOS+ Using a Two-Detector Fit**. Phys. Rev. Lett. **122**, 091803.
10.1103/PhysRevLett.122.091803

2018 M. A. Acero, *et al.* (NOνA Collab.) **New constraints on oscillation parameters from ν_e appearance and ν_μ disappearance in the NOvA experiment**. Phys. Rev. D **98**, 032012.
10.1103/PhysRevD.98.032012

2017 P. Adamson, *et al.* (NOνA Collab.) **Search for active-sterile neutrino mixing using neutral-current interactions in NOvA**. Phys. Rev. D **96**, 072006.
10.1103/PhysRevD.96.072006

P. Adamson, *et al.* (MINOS+ Collab.) **Search for flavor-changing nonstandard neutrino interactions using ν_e appearance in MINOS**. Phys. Rev. D **95**, 012005.
10.1103/PhysRevD.95.012005

P. Adamson, *et al.* (NOνA Collab.) **Measurement of the Neutrino Mixing Angle θ_{23} in NOvA**. Phys. Rev. Lett. **118**, 151802.
10.1103/PhysRevLett.118.151802

P. Adamson, *et al.* (NOνA Collab.) **Constraints on Oscillation Parameters from ν_e Appearance and ν_μ Disappearance in NOvA**. Phys. Rev. Lett. **118**, 231801.
10.1103/PhysRevLett.118.231801

2016 P. Adamson, *et al.* (MINOS Collab.) **The NuMI neutrino beam**. Nucl. Instr. Meth. A **806**, 279-306.
10.1016/j.nima.2015.08.063

P. Adamson, *et al.* (NOνA Collab.) **First measurement of muon-neutrino disappearance in NOvA**. Phys. Rev. D **93**, 051104(R).
10.1103/PhysRevD.93.051104

P. Adamson, *et al.* (MINOS Collab.) **Measurement of the multiple-muon charge ratio in the MINOS Far Detector**. Phys. Rev. D **93**, 052017.
10.1103/PhysRevD.93.052017

P. Adamson, *et al.* (NOνA Collab.) **First Measurement of Electron Neutrino Appearance in NOvA**. Phys. Rev. Lett. **116**, 151806.
10.1103/PhysRevLett.116.151806

P. Adamson, *et al.* (Daya Bay Collab., MINOS Collab.) **Limits on Active to Sterile Neutrino Oscillations from Disappearance Searches in the MINOS, Daya Bay, and Bugey-3 Experiments**. Phys. Rev. Lett. **117**, 151801.
10.1103/PhysRevLett.117.151801

P. Adamson, *et al.* (MINOS Collab.) **Search for Sterile Neutrinos Mixing with Muon Neutrinos in MINOS**. Phys. Rev. Lett. **117**, 151803.
10.1103/PhysRevLett.117.151803

P. Adamson, *et al.* (MINOS Collab.) **Measurement of single π^0 production by coherent neutral-current νFe interactions in the MINOS Near Detector**. Phys. Rev. D **94**, 072006.
10.1103/PhysRevD.94.072006

P. Adamson, *et al.* (MINOS Collab.) **Constraints on large extra dimensions from the MINOS experiment**. Phys. Rev. D **94**, 111101(R).
10.1103/PhysRevD.94.111101

2015 P. Adamson, *et al.* (MINOS Collab.) **Observation of seasonal variation of atmospheric multiple-muon events in the MINOS Near and Far Detectors**. Phys. Rev. D **91**, 112006.
10.1103/PhysRevD.91.112006

P. Adamson, *et al.* (MINOS Collab.) **Study of quasielastic scattering using charged-current ν_μ-iron interactions in the MINOS near detector**. Phys. Rev. D **91**, 012005.
10.1103/PhysRevD.91.012005

P. Adamson, *et al.* (MINOS Collab.) **Precision measurement of the speed of propagation of neutrinos using the MINOS detectors**. Phys. Rev. D **92**, 052005.
10.1103/PhysRevD.92.052005

2014 P. Adamson, *et al.* (MINOS Collab.) **Combined Analysis of ν_μ Disappearance and $\nu_\mu \to \nu_\mathrm{e}$ Appearance in MINOS Using Accelerator and Atmospheric Neutrinos**. Phys. Rev. Lett. **112**, 191801.
10.1103/PhysRevLett.112.191801

P. Adamson, *et al.* (MINOS Collab.) **Observation of muon intensity variations by season with the MINOS near detector**. Phys. Rev. D **90**, 012010.
10.1103/PhysRevD.90.012010

2013 P. Adamson, *et al.* (MINOS Collab.) **Measurement of Neutrino and Antineutrino Oscillations Using Beam and Atmospheric Data in MINOS**. Phys. Rev. Lett. **110**, 251801.
10.1103/PhysRevLett.110.251801

Proceedings

2023 H. R. Gadey, R. Howard, *et al.* **Using Cosmic Ray Muons to Assess Geological Characteristics in the Subsurface**. International High-Level Radioactive Waste Management (IHLRWM).
arXiv.2306.02439

2022 S. C. Tognini, P. Canal, *et al.* **Celeritas: GPU-accelerated particle transport for detector simulation in High Energy Physics experiments**. Submitted to the Proceedings of the US Community Study on the Future of Particle Physics (Snowmass 2021).
arXiv.2203.09467

2021 S. R. Johnson, S. C. Tognini, *et al.* **Novel features and GPU performance analysis for EM particle transport in the Celeritas code**. 25th International Conference on Computing in High Energy and Nuclear Physics (CHEP 2021). EPJ Web of Conferences **251**, 03030.
10.1051/epjconf/202125103030

2020 T. M. Evans, S. R. Johnson, *et al*. **Celeritas—a nascent GPU detector simulation code**. Letter of Interest for Snowmass 2021.
www.snowmass21.org/docs/files/summaries/CompF/SNOWMASS21-CompF2_CompF1-053.pdf

2017 A. Habig, M. Goodman, P. Schreiner, S. C. Tognini, and R. A. Gomes. (On behalf of the NOνA Collaboration) **Seasonal Variation of Multiple-Muon Events in MINOS and NOνA**. 35th International Cosmic Ray Conference (ICRC), Bexco, Busan, Korea.
10.22323/1.301.0200

2012 S. C. Tognini and R. A. Gomes. **Simulation of atmospheric temperature effects on cosmic ray muon flux**. NuInt12: Eight International Workshop on Neutrino-Nucleus Interactions in the Few-GeV Region, Rio de Janeiro (RJ), Brazil. AIP Conf. Proc. **1663**, 120015.
10.1063/1.4919521

Technical reports

2023 H. Gadey, R. Howard, *et al*. **Muon Detection System Calibratino and Experimental Plan — FY 23 Status Update**. Sponsor Report PNNL-34979.

S. C. Tognini, J. Bae, *et al*. **URL Muon Detector Project Simulation Status Report**. Sponsor Report ORNL/SPR-2023/2987.

2022 S. C. Tognini, H. R. Gadey, *et al*. **URL Muon Detector Project Simulation Status Report**. Sponsor Report ORNL/SPR-2022/2568.

H. R. Gadey, R. Howard, *et al*. **Muon Detector Development Status Report**. Sponsor Report PNNL-32802.

2021 J. Meszaros, S. C. Tognini, *et al*. **Underground Research Laboratory Muon Detector Project Progress Report**. Sponsor Report ORNL/SPR-2021/2077.