

Brian Lenardo

blenardo@stanford.edu | (301) 919-8095 | 382 Via Pueblo Mall, Stanford, CA 94305

Research summary

I am an experimental physicist studying fundamental particles and their interactions. In particular, I specialize in the development of instrumentation and techniques for ultra-low-background experiments searching for rare processes. My primary project at present is the nEXO experiment, which will search for the neutrinoless double beta decay of ^{136}Xe using a liquid xenon time projection chamber (TPC). I am also involved in the development of detectors to search for coherent elastic neutrino-nucleus scattering ($\text{CE}\nu\text{NS}$) and WIMP dark matter, and more broadly, the development of new radiation detection techniques with a variety of applications.

Education

PhD, Physics, University of California – Davis Advisor: Mani Tripathi Dissertation: “ <i>Measurements and Modeling of Low Energy Nuclear Recoils in Liquid Xenon for Dark Matter and Neutrino Detection</i> ”	March 2018
MS, Physics, University of California – Davis	December 2013
BS, Physics, University of Maryland	May 2012

Research experience

SLAC, Panofsky Fellow (Associate Staff Scientist) <i>Fundamental Physics Directorate</i>	October 2022 - Present
Stanford University, Postdoctoral Research Fellow <i>Neutrino Physics Group (PI: Giorgio Gratta)</i>	April 2018 - Sept. 2022
Lawrence Livermore National Laboratory Lawrence Graduate Scholar <i>Rare Event Detection Group (Group leader: Adam Bernstein)</i>	July 2014 - March 2018
UC Davis, Graduate Research Assistant <i>Experimental High Energy Physics Group (PI: Mani Tripathi)</i>	June 2013 - July 2014

Teaching experience

Mt. Tamalpais College (San Quentin State Prison) Volunteer Faculty / Study Group Lead <ul style="list-style-type: none">• Lead instructor and curriculum developer for Introduction to Astronomy; Spring 2022• Co-taught 25-person class in Elementary Algebra / led weekly 2-8 person study groups; Spring 2019, Spring 2020, & Fall 2021	January 2019 - Present
University of California, Davis Teaching Assistant, Introductory Physics <ul style="list-style-type: none">• Led discussion/laboratory sections of general physics courses for life sciences majors, focused on thermodynamics and waves, with weekly office hours	October 2012 - June 2013

Selected publications

1. **B. Lenardo** *et al.* (nEXO Collaboration), “Development of a ^{127}Xe calibration source for nEXO,” *Journal of Instrumentation (JINST)* **17** (2022), arXiv:2201.04681
2. G. Adhikari *et al.* (nEXO Collaboration), “nEXO: Neutrinoless double beta decay search beyond 10^{28} year half-life sensitivity,” *J. Phys G* **49** (2021), arXiv:2106.16243
3. S. Wu, **B. Lenardo**, G. Gratta, “Measurement of the ionization yield of neutron-induced proton recoils in tetramethylsilane,” *Journal of Instrumentation (JINST)* **16** (2021), arXiv:2104.04684
4. S. Haselschwardt, **B. Lenardo**, P. Pirinen, J. Suhonen, “Solar neutrino detection in liquid xenon via charged-current scattering to excited states,” *Phys. Rev D* **102** (2020), arXiv:2009.00535
5. S. Wu, **B. Lenardo**, M. Weber, G. Gratta, “A Tetramethylsilane TPC with Cherenkov light readout and 3D reconstruction,” *Nucl. Inst. Meth. A* **972** (2020), arXiv:1911.12887
6. C. Wittweg, **B. Lenardo**, A. Fieguth, C. Weinheimer, “Detection prospects for the second-order weak decays of ^{124}Xe with multi-ton xenon TPCs,” *Eur. Phys. J. C* **80** (2020), arXiv:2002.04239
7. **B. Lenardo**, J. Xu, S. Pereverzev, *et al.*, “Low-energy physics reach of xenon detectors for nuclear-recoil-based dark matter and neutrino experiments,” *Phys. Rev. Lett.* **123** (2019)
8. G. Anton *et al.* (EXO-200 Collaboration), “Search for neutrinoless double- β decay with the complete EXO-200 Dataset,” *Phys. Rev. Lett.* **123** (2019), arXiv:1906.02723
9. D.S. Akerib *et al.* (LUX Collaboration), “Results from a Search for Dark Matter in the Complete LUX Exposure,” *Phys. Rev. Lett.* **118** (2017), arXiv:1608.07648
10. D.S. Akerib *et al.* (LUX Collaboration), “Improved Limits on Scattering of WIMPs from Re-analysis of 2013 LUX Data,” *Phys. Rev. Lett.* **116** (2016) arXiv:1512.03506
11. **B. Lenardo**, K. Kazkaz, A. Manalaysay, *et al.*, “A Global Analysis of Light and Charge Yields in Liquid Xenon,” *IEEE Trans. on Nucl. Sci.* **62** (2015). arXiv:1412.4417

Academic honors

Panofsky Fellowship, SLAC	October 2022 - October 2027
Karl Van Bibber Postdoctoral Fellowship	February 2019 - January 2020
Lawrence Graduate Scholar Fellowship	July 2014 - March 2018
Graduate Assistance in Areas of National Need Fellowship	Academic year 2013-2014

Invited seminars and colloquia

1. University of New Mexico, *Department of Physics Colloquium*, April 15, 2022
2. University of British Columbia, *Special Colloquium*, February 14, 2022
3. University of Texas at Austin, *Department of Physics Colloquium*, January 25, 2022
4. Pennsylvania State University, *HEPAP/CMA Seminar*, February 1, 2022
5. SLAC National Accelerator Lab, *Fundamental Physics Division Seminar*, November 23, 2021
6. Yale University, *Wright Lab – Nuclear, Particle, and Astrophysics Seminar*, May 6, 2021
7. Texas A&M University, *Physics and Astronomy Colloquium*, April 5, 2021
8. Caltech, *High Energy Physics Seminar*, March 24, 2021
9. LZ Collaboration, *All-Hands Meeting*, October 26, 2020
10. SuperCDMS Collaboration, *General Science Meeting*, October 19, 2019
11. Stanford University, *HEPL Seminar*, March 21, 2018
12. MIT, *Laboratory for Nuclear Science Lunchtime Seminar*, October 17, 2017

Selected conference presentations

1. “Sensitivity of the nEXO neutrinoless double beta decay experiment,” September 14, 2021, *Light Detection in Noble Elements (LIDINE) 2021* (Virtual), Contributed
2. “Development of internal calibration sources for the nEXO experiment,” April 17, 2021, *April Meeting of the American Physical Society 2021* (Virtual), Contributed
3. “The nEXO neutrinoless double beta decay experiment,” February 23, 2021, *XIX International Workshop on Neutrino Telescopes* (Virtual), Contributed
4. “Measurement of low-energy nuclear recoil quenching factors in liquid xenon,” November 10, 2019, *Magnificent CEνNS 2019* (Chapel Hill, NC, USA), Invited
5. “The nEXO neutrinoless double beta decay experiment,” October 17, 2019, *Fall Meeting of the American Physical Society, Division of Nuclear Physics* (Crystal City, VA, USA), Contributed
6. “Antineutrino detectors as a tool for global security,” July 31, 2017, *Union of Concerned Scientists’ Summer Symposium*, TU Darmstadt (Darmstadt, Germany), Invited
7. “Liquid Xe Scintillation Measurements and PSD in the LUX detector,” June 17, 2017, *International Conference on Applications of Nuclear Techniques* (Rethimno, Greece), Contributed
8. “Measuring Sub-keV Ionization Yields in Liquid Argon,” Apr. 17 2016, *April Meeting of the American Physical Society*, Salt Palace Center (Salt Lake City, UT, USA), Contributed

Professional development

National Conference for Higher Education in Prison 2019 (November 14-18, 2019) Hyatt Regency by the Arch (St. Louis, MO, USA).

Union of Concerned Scientists’ Summer Symposium on Science and World Affairs (July 22 - Aug. 1, 2017) Technische Universität Darmstadt (Darmstadt, Germany).

Joint ICTP-IAEA School on Nuclear Data Measurements for Science and Applications (Oct. 19 - 30, 2015) International Centre for Theoretical Physics (Trieste, Italy).

Public Policy and Nuclear Threats Boot Camp (June 21 - July 1 2015), Institute on Global Conflict and Cooperation (San Diego, CA, USA).

Media

Physics Today, Vol 73: <i>Teaching Science in Prison Brings Rewards</i>	Interviewee (2020)
Scorpion (CBS), Ep. 417: <i>Dumbster Fire</i>	Scientific Consultant (2018)
Science Friday (WNYC): <i>4850 Feet Below: The Hunt for Dark Matter</i>	Interviewee (2015)

All publications

1. T. Pershing, D. Naim, **B. Lenardo**, J. Xu *et al.*, “Calibrating the light and charge responses of xenon recoils for high-energy dark matter searches,” *Phys. Rev. D* **106** (2022), arXiv:2207.08326
2. S. Al Kharusi *et al.* (EXO-200 Collaboration), “Search for MeV Electron Recoils from Dark Matter in EXO-200,” *Submitted to Phys. Rev. D* (2022), arXiv:2207.00897
3. **B. Lenardo** *et al.* (nEXO Collaboration), “Development of a ^{127}Xe calibration source for nEXO,” *Journal of Instrumentation (JINST)* **17** (2022), arXiv:2201.04681
4. A. Avasthi *et al.* “Kilotonne-scale xenon detectors for neutrinoless double beta decay and other new physics searches,” *Phys. Rev. D* **104** (2021), arXiv:2110.01537

5. S. Al Kharusi *et al.* (EXO-200 Collaboration), “Search for Majoron-emitting modes of ^{136}Xe double beta decay with the complete EXO-200 dataset,” *Phys. Rev. D* **104** (2021) arXiv:2109.01327
6. G. Adhikari *et al.* (nEXO Collaboration), “nEXO: Neutrinoless double beta decay search beyond 10^{28} year half-life sensitivity,” *J. Phys. G* **49** (2021), arXiv:2106.16243
7. S. Wu, **B. Lenardo**, G. Gratta, “Measurement of the ionization yield of neutron-induced proton recoils in tetramethylsilane,” *Journal of Instrumentation (JINST)* **16** (2021), arXiv:2104.04684
8. D.S. Akerib *et al.* (LUX Collaboration), “Constraints on Effective Field Theory Couplings Using 311.2 days of LUX Data,” *Accepted in Phys. Rev. D* (2021), arXiv:2102.06998
9. D.S. Akerib *et al.* (LUX Collaboration), “Improving sensitivity to low-mass dark matter in LUX using a novel electrode background mitigation technique,” *Phys. Rev. D* **104** (2021), arXiv:2011.09602
10. T. Stiegler *et al.* (nEXO Collaboration), “Event reconstruction in a liquid xenon time projection chamber with an optically-open field cage,” *Nucl. Inst. Meth. A* **1000** (2021), arXiv:2009.10231
11. D.S. Akerib *et al.* (LUX Collaboration), “An Effective Field Theory analysis of the first LUX dark matter search,” *Phys. Rev. D* **103** (2021), arXiv:2003.11141
12. S. Haselschwardt, **B. Lenardo**, P. Pirinen, J. Suhonen, “Solar neutrino detection in liquid xenon via charged-current scattering to excited states,” *Phys. Rev. D* **102** (2020), arXiv:2009.00535
13. D.S. Akerib *et al.* (LZ Collaboration), “The LUX-ZEPLIN (LZ) radioactivity and cleanliness control programs,” *Eur. Phys. J. C* **80** (2020), arXiv:2006.02506
14. D.S. Akerib *et al.* (LUX Collaboration), “Investigation of background electron emission in the LUX detector,” *Phys. Rev. D* **102** (2020), arXiv:2004.07791
15. D.S. Akerib *et al.* (LUX Collaboration), “Discrimination of electronic recoils from nuclear recoils in two-phase xenon time projection chambers,” *Phys. Rev. D* **102** (2020), arXiv:2004.06304
16. C. Wittweg, **B. Lenardo**, A. Fieguth, C. Weinheimer, “Detection prospects for the second-order weak decays of ^{124}Xe with multi-ton xenon Time Projection Chambers,” *Eur. Phys. J. C* **80** (2020), arXiv:2002.04239
17. S. Al Kharusi *et al.* (EXO-200 Collaboration) “Measurement of the spectral shape of the beta-decay of ^{137}Xe to the Ground State of ^{137}Cs in EXO-200,” *Phys. Rev. Lett.* **124** (2020)
18. D.S. Akerib *et al.* (LUX Collaboration), “Search for two-neutrino double electron capture of ^{124}Xe and ^{126}Xe in the full exposure of the LUX detector,” *J. Phys. G* (2020), arXiv:1912.02742
19. P. Lv *et al.* (nEXO Collaboration), “Reflectance of silicon photomultipliers at vacuum ultraviolet wavelengths,” *IEEE Trans. on Nucl. Sci.* (2020), arXiv:1912.01841
20. S. Wu, **B. Lenardo**, M. Weber, G. Gratta, “A Tetramethylsilane TPC with Cherenkov light readout and 3D reconstruction,” *Nucl. Inst. Meth. A* **972** (2020), arXiv:1911.12887
21. O. Njaya *et al.* (nEXO Collaboration), “Measurements of electron transport in liquid and gas xenon using a laser-driven photocathode,” *Nucl. Inst. Meth. A* **972** (2020), arXiv:1911.11580
22. D.S. Akerib *et al.* (LZ Collaboration), “The LUX-ZEPLIN (LZ) Experiment,” *Online only* (2019), arXiv:1910.09124
23. P. Nakarmi *et al.* (nEXO Collaboration), “Reflectivity and PDE of VUV4 Hamamatsu SiPMs in liquid xenon,” *Journal of Instrumentation (JINST)* **15** (2020), arXiv:1910.06438
24. D.S. Akerib *et al.* (LUX Collaboration), “Improved modeling of β electronic recoils in liquid xenon using LUX calibration data,” *Journal of Instrumentation (JINST)* **15** (2020), arXiv:1910.04211

25. G. Anton *et al.* (EXO-200 Collaboration), “Measurement of the scintillation and ionization response of liquid xenon at MeV energies in the EXO-200 experiment,” *Phys. Rev. C* **101** (2020), arXiv:1908.04128
26. D.S. Akerib *et al.* (LUX Collaboration), “First direct detection constraints on mirror dark matter kinetic mixing using LUX 2013 data,” *Phys. Rev. D* **101** (2020), arXiv:1908.03479
27. D.S. Akerib *et al.* (LZ Collaboration), “Projected WIMP sensitivity of the LUX-ZEPLIN dark matter experiment,” *Phys. Rev. D* **101** (2020), arXiv:1802.06039
28. **B. Lenardo**, J. Xu, S. Pereverzev, *et al.*, “Low-energy physics reach of xenon detectors for nuclear-recoil-based dark matter and neutrino experiments,” *Phys. Rev. Lett.* **123** (2019)
29. **B. Lenardo**, J. Xu, S. Pereverzev, *et al.*, “Measurement of the ionization yield from nuclear recoils in liquid xenon between 0.3-6 keV with single-ionization-electron sensitivity,” *Online only* (2019), arXiv:1908.00518
30. Z. Li *et al.* (nEXO Collaboration), “Simulation of charge readout with segmented tiles in nEXO,” *Journal of Instrumentation (JINST)* **14** (2019), arXiv:1907.07512
31. D.S. Akerib *et al.* (LUX Collaboration), “Extending light WIMP searches to single scintillation photons in LUX,” *Phys. Rev. D* **101** (2020), arXiv:1907.06272
32. G. Anton *et al.* (EXO-200 Collaboration), “Search for neutrinoless double- β decay with the complete EXO-200 Dataset,” *Phys. Rev. Lett.* **123** (2019), arXiv:1906.02723
33. J. Xu, S. Pereverzev, **B. Lenardo**, J. Kingston, D. Naim, A. Bernstein, K. Kazkaz, and M. Tripathi, “Electron extraction efficiency study for dual-phase xenon dark matter experiments,” *Phys. Rev. D* **99** (2019) arXiv:1904.02885
34. D.S. Akerib *et al.* (LUX Collaboration), “Improved measurements of the β -decay response of liquid xenon with the LUX detector,” *Phys. Rev. D* **100** (2019), arXiv:1903.12372
35. G. Gallina *et al.* (nEXO Collaboration), “Characterization of the Hamamatsu VUV4 MPPCs for nEXO,” *Nucl. Inst. Meth. A* **940** (2019), arXiv:1903.03663
36. D.S. Akerib *et al.* (LUX Collaboration), “Results of a search for Sub-GeV dark matter using 2013 LUX data,” *Phys. Rev. Lett.* **122** (2019), arXiv:1811.11241
37. D.S. Akerib *et al.* (LUX Collaboration), “Search for annual and diurnal rate modulations in the LUX experiment,” *Phys. Rev. D* **98** (2018), arXiv:1807.07113
38. S. Al Kharusi (nEXO Collaboration), “nEXO pre-Conceptual Design Report,” *Online only* (2018), arXiv:1805.11142
39. D.S. Akerib *et al.* (LUX Collaboration), “LUX trigger efficiency,” *Nucl. Inst. Meth. A* **908** (2018), arXiv:1802.07784
40. D.S. Akerib *et al.* (LUX Collaboration), “Liquid Xenon Scintillation Measurements and Pulse Shape Discrimination in the LUX Dark Matter Detector,” *Phys. Rev. D* **97** (2018), 1802.06162
41. D.S. Akerib *et al.* (LUX Collaboration), “Calibration, event reconstruction, data analysis, and limits calculation for the LUX dark matter experiment,” *Phys. Rev. D* **97** (2018), arXiv:1712.05696
42. D.S. Akerib *et al.* (LUX Collaboration), “Position reconstruction in LUX,” *Journal of Instrumentation (JINST)* **13** (2018), arXiv:1710.02752
43. D.S. Akerib *et al.* (LUX Collaboration), “Chromatographic separation of radioactive noble gases from xenon,” *Astroparticle Physics* **97** (2018), arXiv:1605.03844
44. D.S. Akerib *et al.* (LUX Collaboration), “Ultra-low energy calibration of LUX detector using ^{127}Xe electron capture,” *Phys. Rev. D* **96** (2017), arXiv:1709.00800

45. D.S. Akerib *et al.* (LUX Collaboration), “3D modeling of electric fields in the LUX detector,” *Journal of Instrumentation* **12** (2017), arXiv:1709.00095
46. D.S. Akerib *et al.* (LUX Collaboration), “ ^{83m}Kr calibration of the 2013 LUX dark matter search,” *Phys. Rev. D* **96** (2017), arXiv:1708.02566
47. D.S. Akerib *et al.* (LUX Collaboration), “Limits on spin-dependent WIMP-nucleon cross section obtained from the complete LUX exposure,” *Phys. Rev. Lett.* **118** (2017), arXiv:1705.03380
48. D.S. Akerib *et al.* (LUX Collaboration), “First searches for axions and axion-like particles with the LUX experiment,” *Phys. Rev. Lett.* **118** (2017), arXiv:1704.02297
49. B.J. Mount *et al.* (LZ Collaboration), “LUX-ZEPLIN (LZ) Technical Design Report,” *Online only* (2017), arXiv:1703.09144
50. D.S. Akerib *et al.* (LUX Collaboration), “Signal yields, energy resolution, and recombination fluctuations in liquid xenon,” *Phys. Rev. D* **95** (2017), arXiv:1610.02076
51. D.S. Akerib *et al.* (LUX Collaboration), “Results from a Search for Dark Matter in the Complete LUX Exposure,” *Phys. Rev. Lett.* **118** (2017), arXiv:1608.07648
52. **B. Lenardo**, Y. Li, A. Manalaysay, J. Morad, C. Payne, S. Stephenson, M. Szydagis, M. Tripathi, “Position reconstruction of bubble formation in liquid nitrogen using piezoelectric sensors,” *Journal of Instrumentation (JINST)* **11** (2016). arXiv:1511.04390
53. D.S. Akerib *et al.* (LUX Collaboration), “Results on the Spin-Dependent Scattering of Weakly Interacting Massive Particles on Nucleons from the Run 3 Data of the LUX Experiment,” *Phys. Rev. Lett.* **116** (2016) arXiv:1602.03489
54. D.S. Akerib *et al.* (LUX Collaboration), “Improved Limits on Scattering of WIMPs from Reanalysis of 2013 LUX Data,” *Phys. Rev. Lett.* **116** (2016) arXiv:1512.03506
55. D.S. Akerib *et al.* (LUX Collaboration), “Tritium calibration of the LUX dark matter experiment,” *Phys. Rev. D* **93** (2016), arXiv:1512.03133
56. D.S. Akerib *et al.* (LUX Collaboration), “FPGA-based trigger system for the LUX dark matter experiment,” *Nucl. Inst. Meth. A* **818** (2016), arXiv:1511.03541
57. D.S. Akerib *et al.* (LUX Collaboration), “Low-energy (0.7-74 keV) Nuclear Recoil Calibration of the LUX Dark Matter Experiment Using D-D Neutron Scattering Kinematics,” *Submitted to Phys. Rev. C* (2016) arXiv:1608.05381
58. **B. Lenardo**, K. Kazkaz, A. Manalaysay, J. Mock, M. Szydagis, and M. Tripathi, “A Global Analysis of Light and Charge Yields in Liquid Xenon,” *IEEE Trans. on Nucl. Sci.* **62** (2015). arXiv:1412.4417