

# Michael P. Ross

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## Education

University of Washington	Seattle, WA
- Ph.D. Physics	2020
Dissertation: <i>Precision Mechanical Rotation Sensors for Terrestrial Gravitational Wave Observatories</i>	
- M.S. Physics	2017
Elective Coursework: quantum computing, machine learning, high performance computing, data analysis, seismology	
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Humboldt State University	Arcata, CA
- B.S. Physics	2015
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College of the Redwoods	Eureka, CA
- A.A. Science	2013
- A.A Science Exploration	2013

## Research Experience

University of Washington	Seattle, WA
Center for Experimental Nuclear Physics and Astrophysics (CENPA) Eöt-Wash Experimental Gravity Group	
- Postdoctoral Scholar	July 2020 - Present
- Research Assistant	Jan 2017 - June 2020
- Laboratory Technician	Aug 2015 - Sep 2016

The Eöt-Wash group specializes in cutting-edge tests of gravity and searches for new physics utilizing precision mechanical systems (torsion balances and beam balances). I was involved in a wide-range of projects but focused on instrumentation for the LIGO gravitational wave observatories and various torsion balance tests of gravity.

LIGO	Livingston, LA
Livingston Observatory	
- LIGO Scientific Collaboration Fellow	Feb 2018 - May 2018

As a LSC fellow, I built four precision ground rotation sensors and implemented the sensors in the observatory's seismic isolation system to correct the contamination of seismometer signals due to wind-driven tilts.

Humboldt State University	Arcata, CA
Gravity Lab	
- Undergraduate Researcher	Sep. 2013 - May 2015

The HSU Gravity Lab is constructing a torsion balance experiment to test both the inverse square law and equivalence principle. As a student researcher, I operated and maintained the apparatus, led the fabrication of the pendulum, the mechanical and electrostatic controls, and the in-vacuum attractor mass assembly.

## Teaching Experience

Humboldt State University  
Department of Physics & Astronomy  
- Lecturer  
- Instructional Student Assistant

Arcata, CA  
Jan 2021 – May 2021  
Sep 2013 – May 2015

Remotely taught an upper division modern physics course. Graded homework for algebra-based electromagnetism and modern physics courses.

University of Washington  
Department of Physics  
- Directed Reading Instructor  
- Teaching Assistant

Seattle, WA  
May 2019 – Dec 2019  
Sep 2016 – Dec 2016

Taught a one-on-one reading course for undergraduates that covered the basics of gravitational wave theory and contemporary subjects in gravitational wave astronomy. As a teaching assistant, I taught an algebra-based heat and electromagnetism lab and an introductory level calculus-based mechanics tutorial, assisted in exam grading for the introductory mechanics course, and tutored in an open lab study center.

College of the Redwoods  
Department of Mathematics  
- Peer Tutor

Eureka, CA  
Aug 2011 – May 2013

Tutored students in an open lab that were enrolled in courses ranging from basic arithmetic to multivariable calculus.

## Non-Academic Experience

**Scuba Diver** – PADI Open Water Diver + Dry Suit Certification, comfortable diving in low temperature and low visibility conditions

**Hazmat Removal** – Assisted in the removal and disposal of 3.5 tons of oxidized depleted uranium from decommissioned experiment

**Android Software Development** – Developed and published an Android app (now defunct) to display the data from personal weather stations

**Outdoorsman** – Avid hiker, paddleboarder, climber, and archer. Experienced in bushcraft, foraging, and navigating rugged terrain

## Research Interests

More details ([mpross.net](http://mpross.net))

**Gravitational wave astronomy:** Compact binary coalescence, Stochastic gravitational wave background, Measurements of Hubble's constant, Black hole populations, Neutron star equation of state

**Tests of Gravity:** Tests of the inverse square law, Equivalence principle verification, Searches for ultra-light dark matter, Gravitational wave tests of General Relativity

**Instrumentation:** Torsion balances, Beam balances, Precision angle sensing, Interferometric angle sensing, Gravitational calibration, Seismic isolation

**Seismology/Seismic Noise Sources:** Rotational seismology, Seismometer tilt contamination, Atmospheric-ground tilt coupling, Newtonian-noise subtraction, Elasto-gravity observation

**Gravitational Wave Astronomy:**

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*Limits on the stochastic gravitational wave background and prospects for single-source detection with GRACE Follow-On*, M.P. Ross, C.A. Hagedorn, E.A. Shaw, A.L. Lockwood, B.M. Iritani, J.G. Lee, K. Venkateswara, J.H. Gundlach - Physical Review D, 2020

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*GW190521: A Binary Black Hole Merger with a Total Mass of  $150 M_{\odot}$* , R. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Physical Review Letters, 2020

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*GW190814: gravitational waves from the coalescence of a 23 solar mass black hole with a 2.6 solar mass compact object*, R. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- The Astrophysical Journal Letters, 2020

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*GW190412: Observation of a binary-black-hole coalescence with asymmetric masses*, R. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Physical Review D, 2020

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*GW190425: Observation of a compact binary coalescence with total mass  $\sim 3.4 M_{\odot}$* , R. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- The Astrophysical Journal Letters, 2020

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*GWTC-1: a gravitational-wave transient catalog of compact binary mergers observed by LIGO and Virgo during the first and second observing runs*, B.P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Physical Review X, 2019

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*GW170608: Observation of a 19 solar-mass binary black hole coalescence*, B.P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Physical Review X, 2017

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*A gravitational-wave standard siren measurement of the Hubble constant*, B.P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Nature, 2017

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*GW170817: observation of gravitational waves from a binary neutron star inspiral*, B.P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Physical Review Letters, 2017

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*Multi-messenger Observations of a Binary Neutron Star Merger*, B.P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- The Astrophysical Journal Letters, 2020

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*GW170104: observation of a 50-solar-mass binary black hole coalescence at redshift 0.2*, B.P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Physical Review Letters, 2017

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**Tests of Gravity:**

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*A torsion-balance search for ultra low-mass bosonic dark matter*, E. A. Shaw, M. P. Ross, C. A. Hagedorn, E. G. Adelberger, J. H. Gundlach - Physical Review D, 2021

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*Tests of general relativity with the binary black hole signals from the LIGO-Virgo catalog GWTC-1*, R. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Physical Review D, 2019

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*Tests of general relativity with GW170817*, B.P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration)- Physical Review Letters, 2019

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*Experimental Progress Towards Testing the Behavior of Gravity at the 20-micron Distance Scale*  
Authors - M.P. Ross, J.S. Johnson, I.S. Guerrero, H.F. Leopardi, C.D. Hoyle - Journal of Undergraduate Research and Scholarly Excellence, 2018

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*Tests of Short-Range Gravity with a Novel Parallel-Plate Torsion Pendulum*, M.P. Ross - NCUR Proceedings, 2015

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## **Instrumentation:**

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*Essentials of Torsion Balances*, M. P. Ross - 2023

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*A Pseudo Plane-wave Gravitational Calibrator for Gravitational Wave Observatories*, M. P. Ross, J. H. Gundlach, E. G. Adelberger, C. M. Weller, E. A. Shaw, C. Gettings, J. Kissel, T. Mistry, L. Datrier, E. Daw, M. Hendry - Physical Review D, 2023

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*A modified Michelson interferometer to measure sub-milliradian changes in angle*, C. K. LeDesma, M. P. Ross, B. E. Daly, C. D. Hoyle, and M. M. Mola - AIP Advances, 2022

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*A cryogenic torsion balance using a liquid-cryogen free, ultra-low vibration cryostat*, S. M. Fleischer, M. P. Ross, K. Venkateswara, C. A. Hagedorn, E. A. Shaw, E. Swanson, B. R. Heckel, and J. H. Gundlach - Review of Scientific Instruments, 2022

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*Initial Results from the LIGO Newtonian Calibrator*, M.P. Ross, T. Mistry, L. Datrier, J. Kissel, K. Venkateswara, C. Weller, K. Kumar, C. Hagedorn, E. Adelberger, J. Lee, E. Shaw, P. Thomas, D. Barker, F. Clara, B. Gateley, T. M. Guidry, E. Daw, M. Hendry, J. Gundlach - Physical Review D, 2021

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*A Low-Frequency Torsion Pendulum with Interferometric Readout*, M.P. Ross, K. Venkateswara, C.A. Hagedorn, C.J. Leupold, P.W.F. Forsyth, J.D. Wegner, E.A. Shaw, J.G. Lee, J.H. Gundlach - Review of Scientific Instruments, 2021

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*Precision Mechanical Rotation Sensors for Terrestrial Gravitational Wave Observatories*, M.P. Ross - University of Washington, 2020

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*Particle swarming of sensor correction filters*, J.J. Carter, S.J. Cooper, E. Thrift, J. Briggs, J. Warner, M.P. Ross, C.M. Mow-Lowry - Classical and Quantum Gravity, 2020

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*Observation of a potential future sensitivity limitation from ground motion at LIGO Hanford*, J. Harms, E.L. Bonilla, M.W. Coughlin, J. Driggers, S.E. Dwyer, D.J. McManus, M.P. Ross, B.J.J. Slagmolen, K. Venkateswara - Physical Review D, 2020

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*Quantum correlations between light and the kilogram-mass mirrors of LIGO*, Haocun Yu, L. McCuller, M. Tse, N. Kijbunchoo, L. Barsotti, N. Mavalvala, et. al. (The LIGO Scientific Collaboration Instrument Science Authors) - Nature, 2020

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*Quantum-Enhanced Advanced LIGO Detectors in the Era of Gravitational-Wave Astronomy*, M. Tse et al. (The LIGO Scientific Collaboration Instrument Science Authors)- Physical Review Letters, 2019

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## **Seismology/Seismic Noise Sources:**

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*Towards windproofing LIGO: Reducing the effect of wind-driven floor tilt by using rotation sensors in active seismic isolation*, M.P. Ross, K. Venkateswara, J. Warner, C. Mow-Lowry, B. Lantz, J. Kissel, H. Radkins, T. Shaffer, R. Mittleman, S. Cooper, A. Pele, J. Gundlach - Classical and Quantum Gravity, 2020

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*Implications of dedicated seismometer measurements on Newtonian-noise cancellation for advanced LIGO*, M.W. Coughlin, J. Harms, J. Driggers, D.J. McManus, N. Mukund, M.P. Ross, B.J.J. Slagmolen, K. Venkateswara - Physical Review Letters, 2018

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*Low-Frequency Tilt Seismology with a Precision Ground-Rotation Sensor*, MP Ross, K Venkateswara, CA Hagedorn, JH Gundlach, JS Kissel, J Warner, H Radkins, TJ Shaffer, MW Coughlin, P Bodin - Seismological Research Letters, 2018

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## **Presentations**

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*Laboratory Tests of Gravity by the Eöt-Wash Group*, Testing Gravity, Vancouver, BC. 2023

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*Detecting Gravitational Waves on a Shaking Earth*, Seminar, Seattle University. 2022

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*University of Washington Eöt-Wash Group Overview, Gravitational Wave Astronomy Northwest Meeting, LIGO Hanford Observatory. 2022*

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*Rotation Sensor Installation on the Stanford ETF Platform, LVK Collaboration Meeting, Remote. 2022*

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*University of Washington Seattle Group Overview, Gravitational Wave Astronomy Northwest Meeting, Remote. 2021*

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*In-Vacuum Inertial Rotation Sensors, Low-frequency Workshop, Remote. 2021*

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*LIGO NCal Update, LIGO/Virgo collaboration meeting, Remote. 2021*

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*Recent Discoveries in Gravitational Wave Astrophysics, CENPA Seminar, Remote. 2020*

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*LIGO Newtonian Calibrator, LIGO/Virgo collaboration meeting, Remote. 2020*

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*University of Washington LIGO Group Overview, Gravitational Wave Astronomy Northwest Meeting, Remote. 2020*

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*Compact-BRS Update, LIGO/Virgo collaboration meeting, Warsaw, Poland. 2019*

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*Development and deployment of beam rotation sensors for the LIGO seismic isolation system, Gravitational Wave Astronomy Northwest Meeting, LIGO Hanford Observatory. 2019*

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*Development and deployment of beam rotation sensors for the LIGO seismic isolation system, Applied Physics Lab Seminar, University of Washington. 2019*

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*Development and deployment of beam rotation sensors for the LIGO seismic isolation system, SeismoLunch Seminar, University of Washington. 2019*

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*Integration of Beam Rotation Sensors to seismic isolation, A. Pele, M.P. Ross - Low-frequency sensing and control for aLIGO workshop, University of Birmingham, United Kingdom. 2018*

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*Beam Rotation Sensor Update, LIGO/Virgo collaboration meeting, Sonoma State University. 2018*

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*Tests of Short-range Gravity with a Novel Parallel Plate Torsion Pendulum, National Conference on Undergraduate Research, Eastern Washington University. 2015*

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*Experimental Progress on Tests of Gravity at 20 microns with a Parallel-Plate Torsion Pendulum, 31st Pacific Coast Gravity Meeting, University of Oregon. 2015*

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*Experimental Progress on Tests of Gravity at 20 microns. M.P. Ross and C. Cardenas - APS Far West Section Meeting, University of Nevada, Reno. 2014*

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