

Michael William Coughlin

CONTACT INFORMATION Assistant Professor of Physics
School of Physics and Astronomy
University of Minnesota
Minneapolis, MN 55455
E-mail: cough052@umn.edu
Tel. No.: (952) 836-7113

CITIZENSHIP USA

RESEARCH COLLABORATIONS **The Kitt Peak EMCCD Demonstrator (KPED)** (Project Scientist) 2018-present
The Zwicky Transient Facility (ZTF) 2017-present
Panoramic Survey Telescope and Rapid Response System (Pan-STARRS)
and **The Asteroid Terrestrial-impact Last Alert System (ATLAS)** surveys for
EM counterparts of GWs, 2015-present
Large Synoptic Survey Telescope (LSST), 2013-present
Laser Interferometer Gravitational-wave Observatory (LIGO), 2008-present

RESEARCH HIGHLIGHTS I have been fortunate to work on a variety of projects related to astrophysics. As an undergraduate at Carleton College, I performed detector characterization related studies for LIGO and Virgo, spending a summer doing seismic site analyses at Virgo. As a Churchill scholar at the Institute of Astronomy in Cambridge, I performed parameter estimation of gravitational wave data, in particular compact binary coalescences. During graduate school at Harvard, I joined LSST, whereby I built and characterized a prototype calibration system as well as an all-sky camera system for site monitoring. I also used arrays of seismometers on the Earth and moon to set upper limits on a low-frequency gravitational-wave background and developed novel gravitational-wave detection algorithms used on the most recent LIGO data. I was then a post-doc at the California Institute of Technology, where I continued working to bridge the gap between gravitational-wave and observational astronomers working in the electromagnetic regime with ZTF. I am now an Assistant Professor of Physics at the University of Minnesota, where I am building a group working in this new era of multi-messenger astronomy.

PROFESSIONAL EXPERIENCE **University of Minnesota**, Minneapolis, MN
Assistant Professor of Physics
January 2020 - present: Assistant Professor in School of Physics and Astronomy

California Institute of Technology, Pasadena, CA

David and Ellen Lee Prize Postdoctoral Fellow

September 2017 - December 2019: Postdoctoral Fellow in Physics to Professor Rana Adhikari, PhD, California Institute of Technology; Professor of Physics.

Undergraduate Researcher

June 2011 to August 2011: Research Assistant to Dr. Jan Harms, PhD,

California Institute of Technology

Harvard University, Cambridge, MA USA

Postdoctoral Fellow **September 2016 - September 2017: Postdoctoral Fellow in Physics to Professor Christopher Stubbs, PhD, Harvard University; Professor of Physics.**

Graduate Researcher **September 2013 through September 2016: Research Assistant in Physics to Professor Christopher Stubbs, PhD, Harvard University; Professor of Physics.**

University of Cambridge, Cambridge, UK

Graduate Researcher

August 2012 through July 2013: Research Assistant in Astronomy to Jonathan Gair, PhD, University of Cambridge.

Virgo Gravitational Wave Detector, Cascina, Italy

Undergraduate Researcher **June 2010 to August 2010: Research Assistant to Dr. Irene Fiori, PhD, European Gravitational Wave Observatory**

Carleton College, Northfield, MN USA

Undergraduate Researcher

September 2008 through June 2012: Research Assistant in Physics to Professor Nelson L. Christensen, PhD, Carleton College; Professor of Physics.

Undergraduate Researcher

September 2009 through June 2010: Research Assistant in Physics to Professor Dwight Luhman, PhD, Carleton College; Professor of Physics.

Mathematica Tutor

March 2009 through June 2012: Part-time tutor in the Mathematica lab.

EDUCATION

Harvard University, Cambridge, Massachusetts, USA

PhD, Physics, September 2016

- Thesis title: “Gravitational wave astronomy in the LSST era”

AM, Physics, 2015

University of Cambridge, Cambridge, England

MPhil, Astronomy, 2013

- Thesis title: “Parameter estimation of gravitational-wave data”
- Churchill Scholar

Carleton College, Northfield, Minnesota USA

B.A., Physics and Astronomy and B.A., Mathematics, 2012

- Summa Cum Laude
- Phi Beta Kappa
- Elected to Sigma Xi

AWARDS

Post-Doctoral

David and Ellen Lee Prize Postdoctoral Fellowship, Caltech, 2017
Harold T. White Prize for Excellence in Teaching Physics, Harvard, 2017
Breakthrough Prize in Fundamental Physics (LIGO and Virgo Collaborations), 2016
Classical and Quantum Gravity Outstanding Reviewer Award, 2016

Graduate

Gertrude and Maurice Goldhaber Prize, Harvard (outstanding graduate student in experimental physics), 2016
National Science Foundation Graduate Research Fellow, 2013-2016
Winston Churchill Scholar, 2012

Undergraduate

California Institute of Technology Summer Undergraduate Research Fellowship, 2011
Barry M. Goldwater Scholarship, Honorable Mention, 2011
National Science Foundation Gravitational Physics International REU, 2010
Carleton College

- Patricia V. Damon Scholar (awarded to ten juniors based upon merit) (2011)
- Dean's List Recognition
- National Merit Scholar Award (2008-2012)
- Distinguished Scholar Award (2008-2012)
- Kolenkow Reitz Physics Research Fellow (2008-2012)

COURSES TAUGHT

Harvard University (Teaching Fellow)

Spring Semester 2017: PS12a

Spring Semester 2016: PS12a

February 2016: MATLAB Bootcamp

INVITED

RESEARCH VISITS

June 2016: Queens University, Belfast, UK

June 2015: University of Washington, Seattle, WA

SCIENTIFIC TALKS & PRESENTATIONS (SELECTED)

July 2019: The Beginnings and Ends of Double White Dwarfs, Copenhagen, Denmark

“The Kitt Peak EMCCD Demonstrator”

June 2019: Astrophysics Seminar - Observatoire de la Cte d'Azur, Nice, France
“Before and after merger: Multi-messenger searches for compact binaries”

May 2019: GRAPPA Seminar - University of Amsterdam, Amsterdam, Netherlands
“Before and after merger: Multi-messenger searches for compact binaries”

May 2019: Gran Sasso Science Institute Physics Seminar, L'Aquila, Italy
“Before and after merger: Multi-messenger searches for compact binaries”

April 2019: LSST Next-Gen Workshop, Argonne National Laboratory, Lemont, IL
“Calibration of the Large Synoptic Survey Telescope”

March 2019: Columbia University Physics Seminar, New York City, NY
“Before and after merger: Multi-messenger searches for compact binaries”

March 2019: Carnegie Mellon University Physics Seminar, Pittsburgh, PA
“Before and after merger: Multi-messenger searches for compact binaries”

February 2019: Minnesota Institute for Astrophysics Seminar, Minneapolis, MN
“Before and after merger: Multi-messenger searches for compact binaries”

January 2019: Tsinghua University GW-EM workshop, Beijing, China
“Searching for the aftermath of binary neutron star mergers”

January 2019: Kavli Institute for Cosmological Physics - University of Chicago Seminar, Chicago, IL
“Multimessenger searches for compact binaries”

November 2018: Future by the Future, New York City, NY
“Compact White Dwarf Binaries in the Optical Time Domain”

September 2018: Institut d'Astrophysique de Paris Seminar, Paris, France
“Search for and characterization of optical counterparts of gravitational waves”

August 2018: IAU General Assembly 2018, Vienna, AUS
“Testing of the LSST's photometric calibration strategy at the CTIO 0.9 meter telescope”

May 2018: Gravitational-Wave Advanced Detector Workshop, Girdwood, AK
“Implications of dedicated seismometer measurements on Newtonian-noise cancellation for Advanced LIGO”

January 2018: AAS Meeting, Oxon Hill, MD
“On the sensitivity of ATLAS and PS1 followup of O2 LIGO events”

March 2017: LIGO-Virgo Collaboration Meeting, Pasadena, CA
“Limiting the effects of earthquakes on gravitational-wave interferometers”

September 2016: LIGO Seminar, Pasadena, CA
“Maximizing the sensitivity of LIGO and the electromagnetic followup of its events”

June 2016: SPIE Astronomical Telescopes + Instrumentation, Edinburgh, UK
“A collimated beam projector for precise LSST throughput calibration”

February 2016: Harvard Physics Colloquium, Cambridge, MA
“GW150914: Observation of a binary black hole merger”

January 2015: MIT General Relativity Informal Tea-Time Series, Cambridge, MA
“Gravitational Waves and Cross-correlation”

March 2013: LIGO-Virgo Collaboration Meeting, Bethesda, MD
“EQMon: A ground-based interferomic gravitational-wave detector earthquake monitor”

March 2012: LIGO-Virgo Collaboration Meeting, Cambridge, MA
“Global characterization of seismic noise”

July 2011: LIGO Seminar, Pasadena, CA
“Transient searches, and physical environmental monitoring with the STAMP pipeline”

June 2011: LIGO-Virgo Collaboration Meeting, Orsay, France
“STAMP: Progress on searches for long gravitational-wave transients”

TECHNICAL SKILLS Computer Programming: Matlab, Python, C, HTML, Mathematica, Bash Shell Scripting, LINUX, git, mysql.
Computer Applications: \TeX (\LaTeX , \BibTeX), vi, emacs
Computer-Aided Design: AutoCad

SERVICE

Special Appointment: Winston Churchill Scholarship Science/ Mathematics/ Engineering: Scholar Selection Committee 2018-2019

Referee for PR(L, X, D), PASP, ApJ(L), MNRAS(L), JGR, CQG, Applied Ocean Research, Physica Scripta

STEM PUBLIC OUTREACH

Volunteer at in science and “Maker Space” classroom, Galtier Elementary, St. Paul, MN, January 2020 - present

Volunteer at elementary school science nights, Pasadena School District, Pasadena, CA, October 2017 - December 2019

Lecturer in science program, Columbus Elementary, Medford, MA, October 2015 - present

Crazy 8’s recreational after-school math and science club, Cambridgeport Elementary, Cambridge, MA, October 2015 - June 2017

May 2016: Trinity School at River Ridge Senior Class, Eagan, MN

May 2016: Burnsville High School Science Club, Burnsville, MN

December 2015: Burnsville High School Robotics and local Junior High FTC, Burnsville, MN

OTHER PUBLIC OUTREACH

Coach for youth basketball, YMCA, Cambridge, MA, 2016 - 2017

BOOKS

Slight of Mind (MIT Press, 2020): Co-author of “Quantum Mechanics” chapter

When Stars Collide: How the First Observation of Merging Neutron Stars Opened a New Era in Multi-Messenger Astronomy (MIT Press, expected 2021): Co-author

PUBLICATIONS

I have authored or co-authored 212 papers in total. As a member of LIGO, I am co-author on the major discovery papers released in 2016. I highlight here 12 of the 43 papers in which I have significantly contributed as either lead or 2nd author.

- [1] Coughlin et al. ZTF J1901+5309: a 40.6-min orbital period eclipsing double white dwarf system. *Monthly Notices of the Royal Astronomical Society: Letters*, 494(1):L91–L96, 03 2020.
- [2] Coughlin et al. GROWTH on s190425z: Searching thousands of square degrees to identify an optical or infrared counterpart to a binary neutron star merger with the zwicky transient facility and palomar gattini-IR. *The Astrophysical Journal*, 885(1):L19, oct 2019.
- [3] Michael W Coughlin, Tim Dietrich, Ben Margalit, and Brian D Metzger. Multi-messenger Bayesian parameter inference of a binary neutron star merger. *Monthly Notices of the Royal Astronomical Society: Letters*, 489(1):L91–L96, 08 2019.
- [4] Michael W Coughlin, Tim Dietrich, Zoheyr Doctor, Daniel Kasen, Scott Coughlin, Anders Jerkstrand, Giorgos Leloudas, Owen McBrien, Brian D Metzger, Richard OShaughnessy, and Stephen J Smartt. Constraints on the neutron star equation of state from at2017gfo using radiative transfer simulations. *Monthly Notices of the Royal Astronomical Society*, 480(3):3871–3878, 2018.
- [5] M. W. Coughlin, J. Harms, J. Driggers, D. J. McManus, N. Mukund, M. P. Ross, B. J. J. Slagmolen, and K. Venkateswara. Implications of dedicated seismometer measurements on newtonian-noise cancellation for advanced ligo. *Phys. Rev. Lett.*, 121:221104, Nov 2018.
- [6] Coughlin et al. Optimizing searches for electromagnetic counterparts of gravitational wave triggers. *Monthly Notices of the Royal Astronomical Society*, 478(1):692–702, 2018.
- [7] Michael Coughlin, Tim Dietrich, Kyohei Kawaguchi, Stephen Smartt, Christopher Stubbs, and Maximiliano Ujevic. Toward rapid transient identification and characterization of kilonovae. *The Astrophysical Journal*, 849(1):12, 2017.
- [8] Michael Coughlin, T. M. C. Abbott, Kairn Brannon, Chuck Claver, Peter Doherty, Merlin Fisher-Levine, Patrick Ingraham, Robert Lupton, Nicholas Mondrik, and Christopher Stubbs. A collimated beam projector for precise telescope calibration. *Proc. SPIE*, 9910:99100V–99100V–10, 2016.
- [9] Michael Coughlin, Christopher Stubbs, and Chuck Claver. A daytime measurement of the lunar contribution to the night sky brightness in lsst’s ugrizy bands—initial results. *Experimental Astronomy*, pages 1–16, 2016.
- [10] M. Coughlin and J. Harms. Upper limit on a stochastic background of gravitational waves from seismic measurements in the range $0.05\text{--}1$ hz. *Phys. Rev. Lett.*, 112:101102, Mar 2014.
- [11] Michael W. Coughlin and Jan Harms. Seismic topographic scattering and future GW detector site selection in the US. *Class. Quantum Grav.*, 29(7):075004, 2012.
- [12] Michael Coughlin for the LIGO Scientific Collaboration and the Virgo Collaboration. Identification of long-duration noise transients in LIGO and Virgo. *Class. Quantum Grav.*, 28(23):235008, 2011.