Luke Zoltan Kelley

Curriculum Vitae
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Lindheimer & Cottrell postdoctoral fellow | CIERA
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Research Interests

Understanding the origin and evolution of the most energetic objects in the universe. Theoretical astrophysics at the interface of gravitational waves (GW), transients, and cosmological environments. Primary focus: multimessenger (GW + electromagnetic) signatures of supermassive black hole binaries, whose GWs are now becoming detectable by pulsar timing arrays, like NANOGrav. Also the physics of active galactic nuclei, LIGO and GRB sources, and tidal disruption events.

Education & Positions

2021 – **Cottrell Fellow**, CIERA, Northwestern University

2020 – **Chair, Astrophysics Working Group**, NANOGrav Collaboration

2018 – **CIERA Lindheimer Fellow**, CIERA, Northwestern University

2018 **PhD, Harvard University**, Astronomy & Astrophysics
advisor: **Lars Hernquist** & Laura Blecha
Massive Black-Hole Binary Mergers: Dynamics, Environments & Expected Detections

2013 **MA, Harvard University**, Astronomy & Astrophysics
advisor: **Ramesh Narayan** & Alexander Tchekhovskoy
Tidal Disruption Events and Magnetic Flux Capture

2011 **BS with Honors, UC Santa Cruz**, Astrophysics
advisor: **Enrico Ramirez-Ruiz**
Coalescing Compact Binaries: implications for gravitational-wave observations
BS with Honors, UC Santa Cruz, Biology

Funding & Awards

2021 Cottrell Fellowships Award — The Research Corporation

ATP (Collaborator, 21-ATP21-0028) — NASA
Bridging the Gap from Galactic Scales to Black Hole Accretion Flows in a Multiphase ISM

2019 AAG (Co-PI & Institutional PI, 1910209) — NSF
Impacts of massive black hole formation and evolution on Gravitational Wave sources

ATP (Collaborator, 19-ATP19-0031) — NASA
Probing the AGN/Galaxy Connection with a Novel, Explicit Feedback Implementation

2018 Lindheimer Prize Fellowship — Northwestern
CIERA Fellowship

2011 Smith Family Graduate Science and Engineering Fellowship — Harvard

Kenneth and Ann Thimann Scholarship — UCSC
Dean's Award, Chancellor's Award
Steck Award - *best undergraduate senior thesis*

References

advisor Claude-André Faucher-Giguère (Northwestern; postdoctoral mentor)
Lars Hernquist (Harvard; PhD advisor)
Enrico Ramirez-Ruiz (UC Santa Cruz; undergraduate advisor)

collaborator Laura Blecha (U.Florida)
Zoltan Haiman (Colombia)
Sasha Tchekhovskoy (Northwestern)
Wen-fai Fong (Northwestern)
Raffaella Margutti (Berkeley)
Stephen Taylor (Vanderbilt; NANOGrav)

NANOGrav Scott Ransom (NRAO, UVA; NANOGrav chair)
Maura McLaughlin (WVU)
Sarah Burke-Spolaor (WVU)

Advising

graduate	Bence Becsy (Montana State)	2021 –
	Michael Zevin (Northwestern → Hubble Fellow, U.Chicago)	2019 – 2020
	Michael Bueno (Northwestern)	2019 – 2020
	Michael Katz (Northwestern → Postdoc, MPI/AEI)	2018 – 2019
	Magdalena Siwek (Harvard)	2018 –
	Mohammad Sayeb (U. Florida)	2018 –
undergrad	Katherine Cella (Vanderbilt)	2020 –
	Megan Tillman (Texas A&M → Rutgers)	2018 – 2022
	Estephani TorresVillanueva (Northwestern REU → UW Madison)	Summer 2020
	Sophia Taylor (Northwestern REU)	Summer 2019
	Tenley Hutchinson (Harvard Banneker Institute → UC Santa Cruz)	Summer 2017
peer-mentor	graduate student mentor, Northwestern Physics & Astronomy	2018 – 2019
	summer student mentor, Harvard Banneker & Aztlan Institutes	2015 – 2016
	graduate student mentor, Harvard Astronomy & Astrophysics	2014 – 2016

Teaching

lecturer	Northwestern University, Physics & Astronomy	
	Astr 329/429 - Cosmology and Extragalactic Astrophysics (guest lectures)	Fall 2021
	Harvard Banneker & Aztlan Institutes	
	Python For Astrophysics (week-long series)	Summer 2017
	Order of Magnitude Astrophysics (week-long series)	Summer 2016
assistant	Harvard University, Astronomy & Astrophysics	
	Bok Center, distinction in teaching award	Spring 2014
	Astr 16 - Stellar and Planetary Astrophysics (Prof. John Johnson)	Spring 2014
	Astr 17 - High Energy Astrophysics (Prof. Daniel Eisenstein)	Fall 2013
	UC Santa Cruz, Astronomy & Astrophysics	
	Astr 111 - Order of Magnitude Astrophysics (Prof. Enrico Ramirez-Ruiz)	Fall 2010

Professional Service & Community Impact

service	Chair, Membership Management Team, LISA Consortium	2022 –
	Chair, NANOGrav Astrophysics Working Group	2020 –
	AAS Climate Site Visit Team	2019 –
	CIERA, astro-ph/arXiv discussion organizer	2018 – 2020
	Membership Management Team, LISA Consortium	2021 – 2022
	Northwestern, Physics & Astronomy Equity Committee	2020 – 2021
	SOC: COSPAR 2020, Sydney, Australia	Aug. 2020
	Volunteer: Adler After Dark / Astronomy on Tap Chicago	Aug. 2019
	SOC: NANOGrav Spring Meeting, UW Bothell	Mar. 2019
	CIERA, REU admissions committee	Jan. 2019; Jan. 2020
	LOC: Conf. for Undergrad Women in Physics (CUWiP), Northwestern	Jan. 2019
	NANOGrav Equity & Climate Committee	2018 – 2019
	University-wide Public Safety Committee, Harvard	2017 – 2018
	Harvard graduate student admissions committee	2015
	Harvard Observing Program for Undergraduates	2014 – 2015
reviewer	Nature Astronomy, ApJ, ApJ Letters, MNRAS, MNRAS Letters	
	HST DDT, NASA FINESST	
data	Kinematically Offset Binary AGN data set (**Kelley 2020**; zenodo.4068485)	
	Illustris & IllustrisTNG public data releases. Nelson **et al.** 2015, 2018	
software	*creator:* `kalepy` (**Kelley 2021**; 10.21105/joss.02784) | `holodeck` (**Kelley** ***in prep.***)	
	contributor: `numpy`, `astropy`, `matplotlib`,	
	and the `open supernova catalog` (Guillochon, Parrent, **Kelley** et al. 2017)	

Publications [ads link]

42 papers *(2300 ref. citations)*, 11 first-author *(400 ref. citations)*
6 student-led papers: 3 as primary advisor (**), 3 as co-advisor

first-author

Gravitational Self-Lensing in Populations of Massive Black Hole Binaries
Kelley, L.Z.; D'Orazio, Daniel J.; Di Stefano, Rosanne MNRAS, Dec 2021

`kalepy`: a python package for kernel density estimation and sampling
Kelley, L.Z. JOSS, Jan 2021

Basic Considerations for the Observability of Kinematically Offset Binary AGN
Kelley, L.Z.; MNRAS, Jan 2021

Massive BH Binaries as Periodically-Variable AGN
Kelley, L.Z.; Haiman, Z.; Sesana, A.; Hernquist, L. MNRAS, May 2019

*Multi-Messenger Astrophysics with Pulsar Timing Arrays
Kelley, L.Z.; Charisi, M.; Burke-Spolaor, S.; et al. white paper, Mar 2019

Single sources in the low-frequency gravitational wave sky
properties and time to detection by pulsar timing arrays MNRAS, Jun 2018
Kelley, L.Z.; Blecha, L.; Hernquist, L.; Sesana, A.; Taylor, S.

The Gravitational Wave Background from Massive Black Hole Binaries in Illustris
spectral features and time to detection with pulsar timing arrays MNRAS, Nov 2017
Kelley, L.Z.; Blecha, L.; Hernquist, L.; Sesana, A.; Taylor, S.

Massive Black Hole Binary Mergers in Dynamical Galactic Environments
Kelley, L.Z.; Blecha, L.; Hernquist, L. MNRAS, Oct 2016

Tidal Disruption and Magnetic Flux Capture
Powering a Jet from a Quiescent Black Hole MNRAS, Oct 2014
Kelley, L.Z.; Tchekhovskoy, A.; Narayan, R.

Electromagnetic transients as triggers in searches for gravitational waves
from compact binary mergers PRD, Jun 2013
Kelley, L.Z.; Mandel, I.; Ramirez-Ruiz, E.

The Distribution of Coalescing Compact Binaries in the Local Universe
Prospects for Gravitational-Wave Observations ApJL, Dec 2010
Kelley, L.Z.; Ramirez-Ruiz, E.; Zemp, M.; Diemand, J.; Mandel, I.

student-led

Running Late: Testing Delayed Supermassive Black Hole Growth
Models Against the Quasar Luminosity Function MNRAS, Apr 2022
Tillman, M.T.; Wellons, S.; Faucher-Giguère, C.-A.; **Kelley, L.Z.**; et al.

Astrophysics Milestones For Pulsar Timing Array
Gravitational Wave Detection ApJL, Apr 2021
Pol, N.S.; Taylor, S.R.; **Kelley, L.Z.**; et al.

Massive Black Hole Binary Inspiral And Spin Evolution
In A Cosmological Framework
Sayeb, M.; Blecha, L.; **Kelley, L.Z.**; et al. MNRAS, Feb 2021

** Forward-Modeling of Double Neutron Stars:
Insights from Highly-Offset Short Gamma-ray Bursts ApJ, Dec 2020
Zevin, M.; **Kelley, L.Z.**; Nugent, A.; Fong, W.; Berry, C. P. L.; Kalogera, V.

** The effect of differential accretion on the Gravitational Wave Background
and the present day MBH Binary population MNRAS, Aug 2020
Siwek, M.; **Kelley, L.Z.**; Hernquist, L.

** Probing Massive Black Hole Binary Populations with LISA MNRAS, Jan 2020
Katz, M.; **Kelley, L.Z.**; Dosopouloui, F.; Berry, S.; Blecha, L.; Larson, S.

NANOGrav (selection)

The International Pulsar Timing Array second data release: Search for an isotropic gravitational wave background
Antoniadis, J.; **et al.** MNRAS, Mar 2022

The NANOGrav 12.5-year data set: Search for Non-Einsteinian Polarization Modes in the Gravitational-Wave Background
Arzoumanian, Z.; **et al.** ApJLetters, Dec 2021

Searching For Gravitational Waves From Cosmological Phase Transitions With The NANOGrav 12.5-year dataset
Arzoumanian, Z.; **et al.** PRL, Dec 2021

The NANOGrav 11yr Data Set: *Limits on SMBH Binaries in Galaxies within 500Mpc*
Arzoumanian, Z.; **et al.** ApJ, Jun 2021

The NANOGrav 12.5-year Data Set: *Search For An Isotropic Stochastic Gravitational-Wave Background*
Arzoumanian, Z.; **et al.** ApJLetters, Dec 2020

The NANOGrav 12.5-year Data Set: *Observations and Narrowband Timing of 47 Millisecond Pulsars*
Alam, Md. F.; **et al.** ApJS, Jan 2021

Multimessenger Gravitational-wave Searches with Pulsar Timing Arrays: *Application to 3C 66B Using the NANOGrav 11-year Data Set*
Arzoumanian, Z.; **et al.** ApJ, Sep 2020

Modeling the Uncertainties of Solar System Ephemerides for Robust *Gravitational-wave Searches with Pulsar-timing Arrays*
Vallisneri, M.; **et al.** ApJ, Apr 2020

The NANOGrav 11 yr Data Set: Limits on Gravitational Wave Memory
Aggarwal, K.; **et al.** ApJ, Jan 2020

The NANOGrav 11-Year Data Set: *Limits on Gravitational Waves from Individual Supermassive Black Hole Binaries*
Aggarwal, K.; **et al.** ApJ, Jul 2019

The Astrophysics of Nanohertz Gravitational Waves
Burke-Spolaor, S.; Taylor, S.R.; Charisi, M.; **et al.** A&AR, Jun 2019

*Supermassive Black-hole Demographics & Environments With Pulsar Timing Arrays
Taylor, S.R.; Burke-Spolaor, S.; Baker, P.T.; **et al.** white paper, Mar 2019

other works (selection)

Radio Analysis of SN 2004C Reveals an Unusual CSM Density Profile as a Harbinger of Core Collapse
DeMarchi, L.; Margutti, R.; Dittman, J; **et al.** *Subm. 2203.07388*

On the formation of direct collapse black hole seeds: *gas spin and Lyman Werner flux*
Bhowmick, A. K.; Blecha, L.; Torrey, P.; **et al.** MNRAS, Feb 2022

Probing the progenitors of spinning binary black-hole mergers with long GRBs
Bavera, S. S.; Fragos, T.; Zapartas, E.; **et al.** A&A, Jan 2022

Impact of gas-based seeding on supermassive black hole populations at $z \geq 7$
Bhowmick, A. K.; Blecha, L.; Torrey, P.; **et al.** MNRAS, Oct 2021

The IllustrisTNG Simulations: Public Data Release
Nelson, D.; Springel, V.; Pillepich, A.; **et al.** CA&C, May 2019

Testing the binary hypothesis: *pulsar timing constraints on SMBH binary candidates*
Sesana, A.; Haiman, Z.; Kocsis, B.; **Kelley, L.Z.;** ApJ, Mar 2017

An Open Catalog for Supernova Data
Guillochon, J.; Parrent, J.; **Kelley, L.Z.**; Margutti, R. ApJ, Jan 2017

Recoiling black holes: prospects for detection and implications of spin alignment
Blecha, L.; Sijacki, D.; **Kelley, L.Z.;** Torrey, P.; Vogelsberger, M.; et. al. MNRAS, Feb 2016

Swift J1644+57 gone MAD: *the case for dynamically-important magnetic flux threading the black hole in a jetted tidal disruption event*
Tchekhovskoy, A.; Metzger, B.D.; Giannios, D.; **Kelley, L.Z.** MNRAS, Jan 2014

Talks & Presentations

35 invited talks (**), 48 presentations

2022	** Astronomy Colloquium, Penn State	State College, PA	Apr 06
	** Physics Seminar, Oregon State	remote	Mar 08
	** Physics Colloquium, Oregon State	remote	Mar 07
	** Physics Colloquium, Montana State	Bozeman, MT	Mar 04
	** Physics Seminar, Montana State	Bozeman, MT	Mar 03
	** Astronomy Seminar, Dartmouth	remote	Feb 02
	** Physics Colloquium, Dartmouth	remote	Feb 01
	** Astrophysics Seminar, Northwestern	Evanston, IL	Jan 25
	Aspen Winter Conference	Aspen, CO	Jan 05
2021	NANOGrav Fall Meeting, Vanderbilt	Nashville, TN	Oct 13
	NANOGrav Spring Meeting	remote	May 21
	** Transients Group Meeting, UCSC+UCLA	remote	Mar 30
	** Physics & Astronomy Seminar, Purdue	West Lafayette, IN	Mar 09
	** Energy extraction from supermassive blackholes, COSPAR 43	remote	Feb 01
	** Special Session, American Astronomical Society	remote	Jan 13
2020	** Physics & Astronomy Seminar, Vanderbilt	Nashville, TN	Oct 30
2019	** CGCA Seminar, UWM	Milwaukee, WI	Oct 04
	** TAPIR Seminar, Caltech	Pasadena, CA	Jun 13
	** NANOGrav Meeting, U.W. Bothell	Bothell, WA	Mar 29
	** Astrophysics Seminar, U. Florida	Gainesville, FL	Feb 27
	Astrophysics with GW Populations	Aspen, CO	Feb 12
	** Brown Bag Seminar, Northwestern	Evanston, IL	Jan 29
	AAS Thesis Talk	Seattle, WA	Jan 07
2018	** Astronomy Seminar, U. Connecticut	Storrs, CT	Apr 25
	** Theoretical Astrophysics Seminar, U. Florida	Gainesville, FL	Apr 18
	** LISA Consortium Special Seminar	remote	Oct 09
	Joint Galaxies Meeting, U. Chicago	Chicago, IL	Sep 14
	LISA Symposium	Chicago, IL	Jul 12
2017	NANOGrav Meeting, Lafayette	Lafayette, PA	Nov 09
	Kavli Meeting, Niels Bohr Institute	Copenhagen, Denmark	Aug 14
	HPC Meeting - keynote lecture, U. Mass Amherst	Amherst, MA	May 25
	CosmoFest, Harvard CfA	Cambridge, MA	May 22
	NANOGrav Meeting, WVU	Morgantown, WV	Apr 21
	** ITC Luncheon, Harvard CfA	Cambridge, MA	Apr 13
	** ITC Lunch Seminar, Harvard CfA	Cambridge, MA	Mar 01
	The Dawning Era of GW Astrophysics	Aspen, CO	Feb 09
2016	** TAPIR Seminar, Caltech	Pasadena, CA	Dec 02
	** Astronomy Lunch Talk, UC Berkeley	Berkeley, CA	Dec 01
	** Cosmology Group Seminar, LBNL	Berkeley, CA	Nov 29
	** Kavli Seminar, MIT	Cambridge, MA	Nov 07
	** Astrophysics Seminar, Colombia	New York, NY	Sep 29
	** Astrophysics Luncheon, IAS	Princeton, NJ	Sep 29
	** HEAD Seminar, Harvard CfA	Cambridge, MA	Aug 14

	** Radio/Millimeter/Submillimeter Science Futures II	Baltimore, MD	Aug 08
	** NANOGrav Meeting, CalTech	Pasadena, CA	Mar 17
2013	** Astrophysics Seminar, University of Birmingham	Birmingham, UK	Aug 15
2012	** LIGO (LSC) Special Seminar	remote	Sep 28
2011	** Astrophysics Seminar, MIT Kavli	Cambridge, MA	Jan 24

Public Outreach

talks	The Arecibo Observatory CIERA Live	YouTube Live	Jan 29, 2021
	The Astrophysics of Supermassive Black Holes NANOStars, Undergraduate Telecon	remote	Nov 20, 2020
	Supermassive Black Holes, Active Galactic Nuclei & Quasars Astronomy on Tap Chicago	Evanston, IL	Dec 12, 2019
	Active Galactic Nuclei: the Fire at Galaxy Centers Chicago Astronomical Society, Adler Planetarium	Chicago, IL	Oct 08, 2019
	What is Astronomy and being an Astronomer? Jouett Middle School (*AVID classrooms*)	Charlottesville, VA	Sep 22, 2019
	The New Era Of Gravitational Wave Astrophysics Pint of Science	Boston, MA	May 23, 2016
	The Era of Gravitational Wave Astrophysics Society of Physics Students, UMass Boston	Boston, MA	Apr 07, 2016
lectures	Gravity, Relativity and Black Holes	Brookline, MA	May 04, 2014
	Light, Relativity and Spacetime		May 18, 2014
	Orbits, Dynamics and Space Travel		Jun 01, 2014
tutoring	Cogitania advanced education program	Brookline, MA	2013 – 2014
	Academic Aptos Tutoring Center	Aptos, CA	2007 – 2009