

# Nicholas Kern

MIT Pappalardo Fellow

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CONTACT INFORMATION	MIT Kavli Institute for Astrophysics & Space Research 77 Massachusetts Ave., Building 37-241 Cambridge, MA, 02139	<i>E-mail:</i> <a href="mailto:nkern@mit.edu">nkern@mit.edu</a> <i>Web:</i> <a href="https://nkern.github.io">nkern.github.io</a>
EMPLOYMENT	<b>Pappalardo Fellow</b> Department of Physics & MIT Kavli Institute for Astrophysics and Space Research Massachusetts Institute of Technology, Cambridge, MA, USA	September 2020 – present
EDUCATION	<b>Ph.D., Astrophysics, University of California, Berkeley</b> Advisor: Aaron R. Parsons	August 2020
	<b>M.A., Astrophysics, University of California, Berkeley</b>	May 2017
	<b>B.S., Physics, Astrophysics, University of Michigan, Ann Arbor</b> Advisor: Christopher Miller	May 2015
RESEARCH INTERESTS	Cosmological data analysis, radio interferometry, star and galaxy formation, cosmological large scale structure, astrostatistics and machine learning	
HONORS & AWARDS	Pappalardo Fellow, MIT, Department of Physics Mary Elizabeth Uhl Dissertation Prize, UC Berkeley, Department of Astronomy Teaching Effectiveness Award, UC Berkeley Outstanding Graduate Student Instructor Award, UC Berkeley Graduated with Highest Honors and Distinction, University of Michigan Excellence in Astrophysics Research Award, University of Michigan Foreign Language & Area Studies (FLAS) Fellow, University of Michigan International Institute Fellow, University of Michigan Upper-Level Writing Prize in the Natural Sciences, University of Michigan	2020 – 2023 2020 2017 2017 2015 2015 2014 2014 2014
PUBLICATIONS LED OR COLLABORATION EQUIVALENT	<ol style="list-style-type: none"><li>8. Barry, N., Bernardi, G., Greig, B., <b>Kern, N.</b> (corresponding author) and Mertens, F. 2021, <i>SKA-Low Intensity Mapping Pathfinder Updates: Deeper 21 cm Power Spectrum Limits from Improved Analysis Frameworks</i>, <a href="#">JATIS 8(1) 011007</a></li><li>7. HERA Collaboration 2021, including <b>Kern, N.</b> (corresponding author), <i>First Results from HERA Phase I: Upper Limits on the Epoch of Reionization 21 cm Power Spectrum</i>, <a href="#">Accepted to ApJ, arxiv:2108.02263</a></li><li>6. <b>Kern, N.</b> &amp; Liu, A. 2021, <i>Gaussian Process Foreground Subtraction and Power Spectrum Estimation for 21 cm Cosmology</i>, <a href="#">MNRAS 501 1463K</a></li><li>5. <b>Kern, N.</b>, Dillon, J. S., Parsons, A. R., Carilli, C., Bernardi, G. et al. 2020, <i>Absolute Calibration Strategies for the Hydrogen Epoch of Reionization Array and Their Impact on the 21 cm Power Spectrum</i>, <a href="#">ApJ 890 122</a></li><li>4. <b>Kern, N.</b>, Parsons, A. R., Dillon, J. S., Lanman, A. E., et al. 2020, <i>Mitigating Internal Instrument Coupling for 21cm Cosmology. II. A Method Demonstration with the Hydrogen Epoch of Reionization Array</i>, <a href="#">ApJ 888 70</a></li><li>3. <b>Kern, N.</b>, Parsons, A. R., Dillon, J. S., Lanman, A. E., Fagnoni, N. and de Lera Acedo, E. 2019, <i>Mitigating Internal Instrument Coupling for 21cm Cosmology. I. Temporal and Spectral Modeling in Simulations</i>, <a href="#">ApJ 884 105</a></li></ol>	

2. **Kern, N.**, Liu, A., Parsons, A. R., Mesinger, A., & Greig, B. 2017, *Emulating Simulations of Cosmic Dawn for 21 cm Power Spectrum Constraints on Cosmology, Reionization and X-ray Heating*, [ApJ 848 23](#)
1. **Kern, N. S.**, Keown, J. A., Tobin, J. J., Mead, A., & Gutermuth, R. 2016, *Radio Properties of Young Stellar Objects in the Serpens South Infrared Dark Cloud*, [AJ 151 42](#)
18. HERA Collaboration 2021, including **Kern, N.**, *HERA Phase I Limits on the Cosmic 21-cm Signal: Constraints on Astrophysics and Cosmology During the Epoch of Reionization*, [Accepted to ApJ, arxiv:2108.07282](#)
17. Aguirre, J., Murray, S., ..., **Kern, N.**, et al. 2021, *Validation of the HERA Phase I Epoch of Reionization 21 cm Power Spectrum Software Pipeline*, [Accepted to ApJ, arxiv:2104.09547](#)
16. LaPlante, P., Williams, P. K. G., ..., **Kern, N.**, et al. 2021, *A Real Time Processing System for Big Data in Astronomy: Applications to HERA*, [A&C 3600489L](#)
15. Tan, J., Liu, A., **Kern, N.**, et al. 2021, *Methods of Error Estimation for Delay Power Spectra in 21cm Cosmology*, [ApJS 255 26T](#)
14. Ewall-Wice, A., **Kern, N.**, Dillon, J. S., et al. 2021, *DAYENU: A Simple Filter of Smooth Foregrounds for Intensity Mapping Power Spectra*, [MNRAS 500 5195E](#)
13. Nunhokee, C. D., Parsons, A. R., **Kern, N.**, et al. 2020, *Measuring HERA's primary beam in-situ: methodology and first results*, [ApJ 897 5N](#)
12. Thyagarajan, N., Carilli, C., Nikolic, B., ..., **Kern, N.**, et al. 2020, *Detection of Cosmic Structures using the Bispectrum Phase. II. First Results from Application to Cosmic Reionization Using the Hydrogen Epoch of Reionization Array*, [Phys. Rev. D 102, 022002](#)
11. Dillon, J. S., Lee, M., Ali, Z. S., ..., **Kern, N.**, et al. 2020, *Redundant-Baseline Calibration of the Hydrogen Epoch of Reionization Array*, [MNRAS 499 5840D](#)
10. Ghosh, A., Mertens, F., Bernardi, G., ..., **Kern, N.**, et al. 2020, *Foreground modelling via Gaussian process regression: an application to HERA data*, [MNRAS 495 2813G](#)
9. Carilli, C., Thyagarajan, N., Kent, J., ..., **Kern, N.**, et al. 2020, *Imaging and Modeling Data from the Hydrogen Epoch of Reionization Array*, [ApJS 247 67](#)
8. Lanman, A. E., Poher, J. C., **Kern, N.**, et al. 2020, *Quantifying EoR delay spectrum contamination from diffuse radio emission*, [MNRAS 494 3712L](#)
7. Monsalve, R. A., Greig, B., Bowman, J. D., ..., **Kern, N.**, et al. 2018, *Results from EDGES High-Band: II. Constraints on Parameters of Early Galaxies*, [ApJ 863 11](#)
6. Kohn, S. A., Aguirre, J. E., La Plante, P., ..., **Kern, N.**, et al. 2018, *The HERA-19 Commissioning Array: Direction Dependent Effects*, [ApJ 882 58K](#)
5. Dillon, J. S., Kohn, S. A., Parsons, A. R., ..., **Kern, N.**, et al. 2017, *Polarized redundant-baseline calibration for 21 cm cosmology without adding spectral structure*, [MNRAS 477 5670](#)
4. Miller, C. J., Stark, A., Gifford D., & **Kern, N.** 2016, *Inferring Gravitational Potentials from Mass Densities in Cluster-Sized Halos*, [ApJ 822 41](#)
3. Stark, A., Miller, C. J., **Kern, N.**, Gifford, D., et al. 2016, *Probing Theories of Gravity with Phase Space-Inferred Potentials of Galaxy Clusters*, [Phys. Rev. D 93, 084036](#)
2. Gifford, D., **Kern, N.**, & Miller, C. 2016, *Stacking Caustic Masses from Galaxy Clusters*, [ApJ 834 204](#)
1. Gifford, D., Miller, C. J., & **Kern, N.** 2013, *A Systematic Analysis of Caustic Methods for Galaxy Cluster Masses*, [ApJ 773 116](#)

COLLABORATION  
PUBLICATIONS

4. Storer, D., Dillon, J., Jacobs, D., ..., **Kern, N.**, et al. 2021, *Automated Detection of Antenna Malfunctions in Large-N Interferometers: A Case Study with the Hydrogen Epoch of Reionization Array*, [Accepted to Radio Science](#), [arxiv:2109.12733](#)
3. Gehlot, B., Jacobs, D., ..., **Kern, N.**, et al. 2021, *Effects of model incompleteness on the drift-scan calibration of radio telescopes*, [MNRAS 506 4578G](#)
2. Fagnoni, N., de Lera Acedo, E., ..., **Kern, N.**, et al. 2021, *Understanding the HERA Phase I receiver system with simulations and its impact on the detectability of the EoR delay power spectrum*, [MNRAS 500 1232F](#)
1. Kerrigan, J., La Plante, P., ..., **Kern, N.**, et al. 2019, *Optimizing sparse RFI prediction using deep learning*, [MNRAS 488 2605](#)

GRANTS AND  
COMPUTE  
ALLOCATIONS

- Principal Investigator**, *Bayesian Frameworks for New 21 cm Telescopes* 2022  
230,000 CPU & 8,000 GPU hours, XSEDE, PSC Bridges2 Cluster
- Principal Investigator**, *ML Tools for 21 cm Constraints on Fundamental Physics* 2022  
120,000 CPU & 28,000 GPU hours, NERSC, Perlmutter Cluster

STUDENTS  
ADVISED

- Eleanor Rath, MIT PhD student Fall 2021 – present  
*A Bayesian framework for modeling antenna beam perturbations*
- Ntsikelelo Charles, U. Rhodes, South Africa, PhD student Spring 2021 – present  
*Mitigating diffuse foregrounds for interferometric calibration*
- Duncan Rocha, Harvey Mudd undergrad (→ U. Chicago grad) Summer 2017  
*Detectability of Alcock Paczynski effects for 21 cm intensity mapping*
- Timothy Wilson, UCLA undergrad (→ UCLA grad) Summer 2016  
*An MCMC sampler for semi-numerical Cosmic Dawn simulations*

TEACHING  
EXPERIENCE

- Session Instructor for *Interferometric Calibration and Imaging* Summer 2018 – present  
- Designed and taught a 3-hour lesson for the HERA summer undergraduate bootcamp
- Head Instructor for *Python Programming in Astronomy* at UC Berkeley Summer 2017  
- Developed course material for an intensive 6-week undergraduate summer class  
- Lectured daily, held office hours, wrote and graded midterms, oversaw final projects
- Graduate Instructor for *Introduction to Astrophysics* at UC Berkeley Fall 2016  
- Led discussion section, developed interactive worksheets, graded homework & exams  
- Awarded department-wide “Outstanding Graduate Instructor” and university-wide “Teaching Effectiveness Award”
- Graduate Instructor for *Stellar Structure & Evolution* at UC Berkeley Fall 2015  
- Led discussion section, developed interactive worksheets, graded homework & exams
- Undergraduate Instructor for *Introduction to Mechanics* at U. Michigan Spring 2015  
- Taught undergraduates in breakout coding sessions, held office hours

SERVICE

**To the Astrophysics Community:**

- Referee, Radio Science 2020 – present
- Referee, Monthly Notices of the Royal Astronomical Society 2019 – present
- Referee, Astrophysical Journal 2018 – present

**At the Massachusetts Institute of Technology**

- Co-Coordinator, HERA Undergraduate Summer Research Bootcamp 2021
- Instructor & Mentor, HERA Undergraduate Summer Research Bootcamp 2020 – 2021

**At the University of California, Berkeley**

	<ul style="list-style-type: none"> <li>• Graduate Representative, UC Berkeley Faculty Search Committee</li> <li>• Instructor &amp; Mentor, HERA Undergraduate Summer Research Bootcamp</li> <li>• Organizer, Astronomy Career Development Seminar</li> <li>• Organizer, Graduate Student Colloquium Speaker Seminar</li> </ul>	2020 2017 – 2019 2016 – 2017 2015 – 2016
INVITED TALKS AND PRESENTATIONS	3rd URSI Atlantic Radio Science Meeting, Invited Talk Gran Canaria, Spain	June 2022
	USNC-URSI National Radio Science Meeting, Contributed Talk Boulder, CO, USA	January 2022
	Royal Astronomical Society Specialist Discussion, Invited Talk Virtual	December 2021
	Science at Low Frequencies VIII, Invited Talk Virtual	December 2021
	Astrophysics Seminar, Invited Talk John Hopkins University, Baltimore, MA	November 2021
	INAF Joint Astrophysical Colloquium, Invited Talk INAF, Bologna, Italy	November 2021
	Pappalardo Research Symposium, Invited Talk MIT, Cambridge, MA, USA	May 2021
	A Precursor View of the SKA Sky, Invited Talk Virtual	March 2021
	Science at Low Frequencies VII, Contributed Talk Virtual	December 2020
	Observing the First Billion Years, Invited Talk IIT Indore, Indore, India	January 2020
	235th American Astronomical Society Meeting, Contributed Talk Honolulu, HI, USA	January 2020
	Science at Low Frequencies VI, Contributed Talk Arizona State University, Tempe, AZ, USA	December 2019
	Observational Cosmology Seminar, Invited Talk California Institute of Technology, Pasadena, CA, USA	December 2019
	Center for Astrophysics SMA Seminar, Invited Talk Center for Astrophysics, Cambridge, MA, USA	November 2019
	MIT Kavli Institute Brown Bag Lunch Talks, Invited Talk MIT, Cambridge, MA, USA	November 2019
	Intergalactic Medium 2018, Contributed Talk University of Tokyo, Tokyo, Japan	September 2018
	BCCP Cosmology Workshop, Invited Talk University of California, Berkeley, CA, USA	January 2018
	JILA Astrophysics Seminar, Invited Talk University of Colorado, Boulder, CO, USA	October 2017
	NASA Machine Learning Workshop, Invited Talk NASA Ames, Mountain View, CA, USA	August 2017
	Science at Low Frequencies III, Contributed Talk California Institute of Technology, Pasadena, CA, USA	December 2016
	225th American Astronomical Society Meeting, Contributed Poster Seattle, WA, USA	January 2015

