Nicholas Kern

MIT Pappalardo Fellow

| CONTACT INFORMATION | MIT Kavli Institute for Astrophysics & Space Research
77 Massachusetts Ave., Building 37-241
Cambridge, MA, 02139 | *E-mail:* nkern@mit.edu
Web: nkern.github.io |

EMPLOYMENT

Pappalardo Fellow — September 2020 – present
Department of Physics & MIT Kavli Institute for Astrophysics and Space Research
Massachusetts Institute of Technology, Cambridge, MA, USA

EDUCATION

Ph.D., Astrophysics, University of California, Berkeley — August 2020
Advisor: Aaron R. Parsons

M.A., Astrophysics, University of California, Berkeley — May 2017

B.S., Physics, Astrophysics, University of Michigan, Ann Arbor — May 2015
Advisor: Christopher Miller

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	2020 – 2023
Mary Elizabeth Uhl Dissertation Prize, UC Berkeley, Department of Astronomy	2020
Teaching Effectiveness Award, UC Berkeley	2017
Outstanding Graduate Student Instructor Award, UC Berkeley	2017
Graduated with Highest Honors and Distinction, University of Michigan	2015
Excellence in Astrophysics Research Award, University of Michigan	2015
Foreign Language & Area Studies (FLAS) Fellow, University of Michigan	2014
International Institute Fellow, University of Michigan	2014
Upper-Level Writing Prize in the Natural Sciences, University of Michigan	2014

PUBLICATIONS LED OR COLLABORATION EQUIVALENT

8. Barry, N., Bernardi, G., Greig, B., **Kern, N.** (corresponding author) and Mertens, F. 2021, *SKA-Low Intensity Mapping Pathfinder Updates: Deeper 21 cm Power Spectrum Limits from Improved Analysis Frameworks*, arxiv:2110.06173

7. HERA Collaboration 2021, including **Kern, N.** (corresponding author), *First Results from HERA Phase I: Upper Limits on the Epoch of Reionization 21 cm Power Spectrum*, arxiv:2108.02263

6. **Kern, N.** & Liu, A. 2021, *Gaussian Process Foreground Subtraction and Power Spectrum Estimation for 21 cm Cosmology*, MNRAS 501 1463K

5. **Kern, N.**, Dillon, J. S., Parsons, A. R., Carilli, C., Bernardi, G. et al. 2020, *Absolute Calibration Strategies for the Hydrogen Epoch of Reionization Array and Their Impact on the 21 cm Power Spectrum*, ApJ 890 122

4. **Kern, N.**, Parsons, A. R., Dillon, J. S., Lanman, A. E., et al. 2020, *Mitigating Internal Instrument Coupling for 21cm Cosmology. II. A Method Demonstration with the Hydrogen Epoch of Reionization Array*, ApJ 888 70

3. **Kern, N.**, Parsons, A. R., Dillon, J. S., Lanman, A. E., Fagnoni, N. and de Lera Acedo, E. 2019, *Mitigating Internal Instrument Coupling for 21cm Cosmology. I. Temporal and Spectral Modeling in Simulations*, ApJ 884 105

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

OTHER
PUBLICATIONS AS
A CONTRIBUTING
AUTHOR

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*, 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*, 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., Pober, 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*, arxiv:2109.12733

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*, 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*, arxiv:2104.12240

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

STUDENTS ADVISED

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

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
- Graduate Representative, UC Berkeley Faculty Search Committee   2020
- Instructor & Mentor, HERA Undergraduate Summer Research Bootcamp   2017 – 2019
- Organizer, Astronomy Career Development Seminar   2016 – 2017
- Organizer, Graduate Student Colloquium Speaker Seminar   2015 – 2016

TALKS

Colloquia

INAF Joint Astrophysical Colloquium, Bologna, Italy *New HERA Power Spectrum Limits and their Science Implications*	November 2021

Invited Talks

3rd URSI Atlantic Radio Science Meeting Gran Canaria, Spain	June 2022
Royal Astronomical Society Specialist Discussion Virtual	December 2021
Science at Low Frequencies VIII Virtual	December 2021
Astrophysics Seminar John Hopkins University, Baltimore, MA	November 2021
Pappalardo Research Symposium MIT, Cambridge, MA, USA	May 2021
A Precursor View of the SKA Sky Virtual	March 2021
Observing the First Billion Years IIT Indore, Indore, India	January 2020
BCCP Cosmology Workshop University of California, Berkeley, CA, USA	January 2018
JILA Astrophysics Seminar University of Colorado, Boulder, CO, USA	October 2017
NASA Machine Learning Workshop NASA Ames, Mountain View, CA, USA	August 2017