

Nicholas Flood Cothard

CONTACT INFORMATION	NASA GSFC, Code 665 8800 Greenbelt Rd Greenbelt, MD 20771	(301) 614-5868 nicholas.f.cothard@nasa.gov ncothard.github.io
EDUCATION	Cornell University , Ithaca, NY Ph.D., Applied and Engineering Physics M.S., Applied and Engineering Physics	August 2021 July 2018
	University of Rochester , Rochester, NY B.S., Physics, <i>cum laude</i> , with highest distinction in Physics & Astronomy Minor, Mathematics	May 2015
RESEARCH INTERESTS	Emerging technology development for ultra-low noise sensors. Recent research has focused on optics, superconducting detectors, and control & measurement systems for far-infrared space telescopes. Namely, NASA's PRobe far-Infrared Mission for Astrophysics. This work has included microfabrication of superconducting resonators & sensors, microfabrication of silicon based optics & metamaterial filters, cryogenic characterization of superconducting devices, and development control & analysis software. Previous research focused on similar technologies for cosmic microwave background (CMB) and epoch of reionization (EoR) ground-based observatories in the Chilean Atacama Desert.	
HONORS AND AWARDS	NASA Postdoctoral Program Fellowship, Goddard Space Flight Center NRC Postdoctoral Research Fellowship, NIST Boulder (Declined) NASA Space Technology Research Fellowship Watt W Webb Graduate Fellowship, Kavli Institute at Cornell for Nanoscale Science Phi Beta Kappa National Honors Society Undergraduate Teaching Award, University of Rochester, Physics & Astronomy Sigma Pi Sigma National Physics Honors Society Department of Energy National Undergraduate Fellowship in Plasma Physics National Science Foundation Research Experience for Undergraduates Dean's List, University of Rochester	2021 – Present 2021 2017 – 2021 2016 – 2017 2015 2015 2014 2014 2013 2011 – 2015
RESEARCH EXPERIENCE	NASA Goddard Space Flight Center , Greenbelt, MD NASA Postdoctoral Fellow Characterized sensitivity and response of superconducting kinetic inductance detector designs Developed cryogenic characterization testbeds including warm and cold readout electronics Operated and optimized dilution, He3/He4 sorption, and adiabatic demagnetization refrigerators Interfaced multiple fabrication teams, producing lens-coupled superconducting detector arrays Developed FPGA testbed for multiplexed readout of superconducting microwave resonators Constructed mid/far-infrared Fourier Transform Spectrometer and control/analysis software Developed data reduction pipeline for JWST NIRCAM imaging of Galaxy NGC 4258 Successfully led the proposal process for multiple competitive NASA internal R&D grants	2021 – Present
	Cornell University , Ithaca, NY Graduate Student Fellow Research related to the detector and optics development for current and future millimeter and sub-millimeter ground-based telescopes. Specifically, <i>CCAT-prime</i> – Metamaterial-based Fabry-Perot spectrometer design, silicon anti-reflection coatings microfabrication development, dilution refrigerator testing, thermometry calibration.	2015 – 2021

Simons Observatory – Transition edge sensor heat capacity, time constants, and complex impedance characterization. Cold readout component screening testbeds design and operation.

Advanced ACTPol – Atacama Cosmology Telescope Remote Observing Coordinator, in-situ optical systematics measurements, detector and readout characterization, flexible superconducting circuitry design.

Fermi National Accelerator Laboratory, Batavia, IL 2011 – 2015
Student Researcher

Conducted search for Dirac magnetic monopoles in many years of Fermilab’s CDF data under guidance of Dr Jonathan Lewis. Wrote portions of the collision data search algorithm, trigger diagnostics code, and Monte Carlo simulations.

General Atomics – DIII-D Fusion Facility, San Diego, CA Summer 2014
DOE National Undergraduate Fellow in Plasma Physics

Researched energetic ion losses in the DIII-D Tokamak Fusion Reactor under guidance of Dr David Pace. Developed new analysis methods for improved energy-trajectory phase-space measurements for ion loss detector. Improved fidelity and time-resolution of measurement and studied their evolution during Tokamak plasma cycle.

SRI International – Molecular Physics Lab, Menlo Park, CA Summer 2013
NSF REU Student Researcher

Developed methods for the assembly, alignment, and calibration of the Compact Echelle Spectrograph for Aeronomical Research (CESAR) under the guidance of Dr Daniel Matsiev. Conducted diagnostic measurements and designed prototype user interface software.

TEACHING
EXPERIENCE

Teaching Assistant - Cornell University, Ithaca, NY

AEP 2640: Analog to Digital Lab Spring 2016
AEP 3330: Classical Mechanics Fall 2015

Teaching Intern - University of Rochester, Rochester, NY

PHY121P: Self-Pace Mechanics for Engineers Spring 2014, 2015
PHY141: Honors Mechanics Fall 2014
PHY142: Honors Electricity & Magnetism Fall 2013

UNDERGRADUATE
MENTORSHIP

Akimasa Ihara, Cornell Class of 2023 Summer 2021
Kshama Sridevi Malavalli, Cornell Class of 2022 2019 – 2021
Willow Martin, Cornell Class of 2022 (Now PhD student at Stanford) 2019 – 2020
Jesse Smith, Cornell Class of 2021 (Now PhD student at NYU) 2018 – 2019
Michael Jack, SERCCS Summer Student Summer 2018
Mahiro Abe, Cornell Class of 2020 (Now PhD student at Stanford) 2018 – 2020
Philip Jacobson, Cornell Class of 2019 (Now PhD student at UC Berkeley) 2017 – 2019
Kenny Vetter, Cornell Class of 2018 (Now PhD student at UC Berkeley) 2017 – 2018

OUTREACH AND
SERVICE

Subject matter expert in NASA peer reviews 2023 – Present
Reviewer, Royal Astronomical Society Techniques and Instruments 2023 – Present
Reviewer, Journal of Low Temperature Physics 2019 – Present
Instructor/Volunteer, Cornell – Cortland High School Experimental Cosmology Day 2019, 2021
Co-President, Co-Founder, Applied Physics Graduate Student Society, Cornell Univ. 2016 – 2017
President, Tutor, Society of Physics Students, University of Rochester 2014 – 2015
Peer Advisor, College Center for Academic Services, University of Rochester 2014 – 2015

PRESENTATIONS

NGC 4258: A Laboratory for AGN and Star Formation Impacts on the ISM, The 243rd Meeting of the American Astronomical Society, New Orleans, LA (January 2024, [poster](#))

NGC 4258: A Laboratory for AGN and Star Formation Impacts on the ISM, James Webb Space Telescope First Year of Science Conference, Space Telescope Science Institute, Baltimore, MD (September 2023, [poster](#))

Monolithic Kilopixel Silicon Microlens Arrays for Future Far-Infrared Observatories, Low Temperature Detectors 20, Daejeon, South Korea (July 2023, [poster](#))

Parallel Plate Capacitor Aluminum KIDs for Future Far-Infrared Space-Based Observatories, Low Temperature Detectors 20, Daejeon, South Korea (July 2023, [poster](#))

Parallel plate capacitor TiN KID array development for the Balloon Experiment for Galactic Infrared Science, SPIE Astronomical Telescopes and Instrumentation 2022, Montreal, Canada (July 2022, [poster](#))

Science and Detector Technology Development for the PRIMA Far-IR Probe Concept, NASA GSFC Science & Exploration Directorate Director's Seminar, Greenbelt, MD (June 2022, invited talk)

Comparing complex impedance and bias step measurements of Simons Observatory transition edge sensors, SPIE Astronomical Telescopes and Instrumentation 2020, Remote Conference (December 2020, [poster](#))

The Design of The CCAT-prime Epoch of Reionization Spectrometer Instrument, Low Temperature Detectors 18, Milan, Italy (July 2019, [poster](#))

Optimizing the efficiency of Fabry-Perot interferometers with silicon-substrate mirrors, SPIE Astronomical Telescopes and Instrumentation 2018, Austin, TX (June 2018, [poster](#))

Sidelobe measurements and models for large aperture CMB experiments, PICO Science Meeting, University of Minnesota (May 2018, [poster](#))

Development of Single and Double Layer Anti-Reflection Coatings for Astronomical Instruments, Cornell NanoScale Science and Technology Facility Annual Meetings (August 2016, 2017, and 2018, posters)

Evolution of Phase Space Sensitivity for Energetic Ion Loss Measurements in DIII-D, American Physical Society Division of Plasma Physics 56th Annual Meeting, New Orleans, LA, (October 2014, poster)

The Search for Dirac Magnetic Monopoles with the CDF II Detector, Rochester Symposium for Physics Students, Rochester, NY, (April 2013, poster)

PUBLICATIONS,
MAIN AUTHOR

N. F. Cothard et al. *Parallel Plate Capacitor Aluminum KIDs for Future Far-Infrared Space-Based Observatories*, Journal of Low Temperature Physics (in press, 2023), [DOI:10.1007/s10909-023-03039-0](https://doi.org/10.1007/s10909-023-03039-0), [arXiv:2311.00773](https://arxiv.org/abs/2311.00773)

N. F. Cothard et al. *Monolithic Silicon Microlens Arrays for Far-Infrared Astrophysics*, Applied Optics (2024), [DOI:10.1364/AO.510409](https://doi.org/10.1364/AO.510409), [arXiv:2311.00819](https://arxiv.org/abs/2311.00819)

N. F. Cothard et al. *Comparing complex impedance and bias step measurements of Simons Observatory transition edge sensors*, Proc. SPIE (2020), [DOI:10.1117/12.2575912](https://doi.org/10.1117/12.2575912), [arXiv:2012.08547](https://arxiv.org/abs/2012.08547)

N. F. Cothard et al. *The Design of The CCAT-prime Epoch of Reionization Spectrometer Instrument*, Journal of Low Temperature Physics (2020), [DOI:10.1007/s10909-019-02297-1](https://doi.org/10.1007/s10909-019-02297-1), [arXiv:1911.11687](https://arxiv.org/abs/1911.11687)

J. R. Stevens, **N. F. Cothard**, E. M. Vavagiakis, et al. *Characterization of Transition Edge Sensors*

for the Simons Observatory, *Journal of Low Temperature Physics* (2020), DOI:10.1007/s10909-020-02375-9, arXiv:1912.00860

E. M. Vavagiakis, **N. F. Cothard**, J. R. Stevens, et al. *Developing AlMn films for Argonne TES fabrication*, *Journal of Low Temperature Physics* (2020), DOI:10.1007/s10909-019-02281-9, arXiv:1910.10199

N. F. Cothard et al. *Optimizing the efficiency of Fabry-Perot interferometers with silicon-substrate mirrors*, *Proc. SPIE* (2018), DOI:10.1117/12.2313483, arXiv:1807.06019

P. A. Gallardo, **N. F. Cothard**, R. Puddu, et al. *Far Sidelobes from Baffles and Telescope Support Structures in the Atacama Cosmology Telescope*, *Proc. SPIE* (2018), DOI:10.1117/12.2313005, arXiv:1808.05101

B. J. Koopman, **N. F. Cothard**, et al. *Advanced ACTPol Low-Frequency Array: Readout and Characterization of Prototype 27 and 39 GHz Transition Edge Sensors*, *Journal of Low Temperature Physics* (2018), DOI:10.1007/s10909-018-1957-5, arXiv:1711.02594

P. A. Gallardo, B. J. Koopman, **N. F. Cothard**, et al. *Deep Reactive Ion Etched Anti-Reflection Coatings for Sub-millimeter Silicon Optics*, *Applied Optics* (2017), DOI:10.1364/AO.56.002796, arXiv:1610.07655

PUBLICATIONS,
COLLABORATION

L. Foote et al. (including **N. F. Cothard**) *High-sensitivity Kinetic Inductance Detector Arrays for the Probe Far-Infrared Mission for Astrophysics*, *Journal of Low Temperature Physics* (2024), DOI:10.1007/s10909-023-03041-6, arXiv:2311.02175

J. Perido et al. (including **N. F. Cothard**) *Parallel-Plate Capacitor Titanium Nitride Kinetic Inductance Detectors for Infrared Astronomy*, *Journal of Low Temperature Physics* (in review, 2023), arXiv:2312.17378

E. Kane et al. (including **N. F. Cothard**) *Modeling of Cosmic Rays and Near-IR photons in aluminum KIDs*, *Journal of Low Temperature Physics* (in review, 2023), DOI:10.1007/s10909-023-03044-3, arXiv:2311.04859

W. Coulton et al. (including **N. F. Cothard**) *The Atacama Cosmology Telescope: High-resolution component-separated maps across one-third of the sky*, *PhysRevD* (in review, 2023), arXiv:2307.01258

M. Madhavacheril et al. (including **N. F. Cothard**) *The Atacama Cosmology Telescope: DR6 Gravitational Lensing Map and Cosmological Parameters*, *ApJ* (in press, 2023), arXiv:2304.05203

F. Qu et al. (including **N. F. Cothard**) *The Atacama Cosmology Telescope: A Measurement of the DR6 CMB Lensing Power Spectrum and its Implications for Structure Growth*, *ApJ* (in review, 2023), arXiv:2304.05202

J. Perido et al. (including **N. F. Cothard**) *Cross-slot Metal-mesh Bandpass Filters for Far-Infrared Astronomy*, *Proc. SPIE* (2022), DOI:10.1117/12.2630571, arXiv:2312.15085

T. Nikola et al. (including **N. F. Cothard**) *CCAT-prime: the Epoch Reionization Spectrometer for prime-cam on FYST*, *Proc. SPIE* (2022), DOI:10.1117/12.2629338

B. Zou et al. (incl. **N. F. Cothard**) *CCAT-prime: The Design and Characterization of the Silicon Mirrors for the Fabry-Perot Interferometer in the Epoch of Reionization Spectrometer*, *Proc. SPIE* (2022), DOI:10.1117/12.2629518, arXiv:2207.08318

Z. Huber et al. (incl. **N. F. Cothard**) *The Simons Observatory: Magnetic Shielding Measurements*

for the Universal Multiplexing Module, Journal of Low Temperature Physics, DOI:10.1007/s10909-022-02875-w, arXiv:2111.11495

S. Choi et al. (incl. **N. F. Cothard**) *CCAT-prime: Characterization of the First 280 GHz MKID Array for Prime-Cam*, Journal of Low Temperature Physics, DOI:10.1007/s10909-022-02787-9, arXiv:2111.01055

The CCAT-Prime Collaboration (incl. **N. F. Cothard**) *CCAT-prime Collaboration: Science Goals and Forecasts with Prime-Cam on the Fred Young Submillimeter Telescope*, ApJ (2022), DOI:10.3847/1538-4365/ac9838, arXiv:2107.10364

G. Chesmore et al. (incl. **N. F. Cothard**) *The Simons Observatory: HoloSim-ML: machine learning applied to the efficient analysis of radio holography measurements of complex optical systems*, Applied Optics (2021), DOI:10.1364/AO.435007, arXiv:2107.04138

H. McCarrick et al. (incl. **N. F. Cothard**) *The Simons Observatory microwave SQUID multiplexing detector module design*, (2021), DOI:10.3847/1538-4357/ac2232, arXiv:2106.14797

Y. Guan et al. (incl. **N. F. Cothard**) *The Atacama Cosmology Telescope: Microwave Intensity and Polarization Maps of the Galactic Center*, ApJ (2021), DOI:10.3847/1538-4357/ac133f, arXiv:2105.05267

S. Naess et al. (incl. **N. F. Cothard**) *The Atacama Cosmology Telescope: A search for Planet 9*, ApJ (2021), DOI:10.3847/1538-4357/ac2307, arXiv:2104.10264

Z. Xu et al. (incl. **N. F. Cothard**) *The Simons Observatory: the Large Aperture Telescope (LAT)*, AAS Research Note (2021), DOI:10.3847/2515-5172/abf9ab, arXiv:2104.09511

N. Zhu et al. (incl. **N. F. Cothard**) *The Simons Observatory Large Aperture Telescope Receiver*, ApJS (2021), DOI:10.3847/1538-4365/ac0db7, arXiv:2103.02747

E. M. Vavagiakis et al. (incl. **N. F. Cothard**) *The Atacama Cosmology Telescope: Probing the Baryon Content of SDSS DR15 Galaxies with the Thermal and Kinematic Sunyaev-Zel'dovich Effects*, Phys. Rev. D (2021), DOI:10.1103/PhysRevD.104.043503, arXiv:2101.08373

V. Calafut et al. (incl. **N. F. Cothard**) *The Atacama Cosmology Telescope: Detection of the Pairwise Kinematic Sunyaev-Zel'dovich Effect with SDSS DR15 Galaxies*, Phys. Rev. D (2021), DOI:10.1103/PhysRevD.104.043502, arXiv:2101.08374

S. Naess et al. (incl. **N. F. Cothard**) (incl. **N. F. Cothard**) *The Atacama Cosmology Telescope: Detection of mm-wave transient sources*, ApJ (2020), DOI:10.3847/1538-4357/abfe6d, arXiv:2012.14347

E. M. Vavagiakis et al. (incl. **N. F. Cothard**) *The Simons Observatory: Magnetic Sensitivity Measurements of Microwave SQUID Multiplexers*, Applied Superconductivity Conference IEEE Proceedings (2020), DOI:10.1109/TASC.2021.3069294, arXiv:2012.04532

Y. Li et al. (incl. **N. F. Cothard**) *In situ Performance of the Low Frequency Array for AdvACT*, IEEE Transactions on Applied Superconductivity (2021), DOI:10.1109/TASC.2021.3063334, arXiv:2101.02658

J. E. Gudmundsson, P. A. Gallardo, R. Puddu, S. R. Dicker, et al. (incl. **N. F. Cothard**) *The Simons Observatory: Modeling Optical Systematics in the Large Aperture Telescope*, Applied Optics (2021), DOI:10.1364/AO.411533, arXiv:2009.10138

C. J. Duell, et al. (incl. **N. F. Cothard**) *CCAT-prime: Designs and status of the first light 280 GHz MKID array and mod-cam receiver*, Proc. SPIE (2020), DOI:10.1117/12.2562757, arXiv:2012.10411

- E. Healy, et al. (incl. **N. F. Cothard**) *Assembly development for the Simons Observatory focal plane readout module*, Proc. SPIE (2020), DOI:10.1117/12.2561743, arXiv:2204.05869
- J. Seibert, et al. (incl. **N. F. Cothard**) *Development of an optical detector testbed for the Simons Observatory*, Proc. SPIE (2020), DOI:10.1117/12.2562045
- K. Harrington, et al. (incl. **N. F. Cothard**) *The integration and testing program for the Simons Observatory Large Aperture Telescope optics tubes*, Proc. SPIE (2020), DOI:10.1117/12.2562647, arXiv:2102.02129
- Z. Xu et al. (incl. **N. F. Cothard**) *The Simons Observatory: the Large Aperture Telescope Receiver (LATR) integration and validation results*, Proc. SPIE (2020), DOI:10.1117/12.2576151, arXiv:2012.07862
- S. Choi et al. (incl. **N. F. Cothard**) *The Atacama Cosmology Telescope: A Measurement of the Cosmic Microwave Background Power Spectra at 98 and 150 GHz*, JCAP (2020), DOI:10.1088/1475-7516/2020/12/045, arXiv:2007.07289
- S. Aiola et al. (incl. **N. F. Cothard**) (incl. **N. F. Cothard**) *The Atacama Cosmology Telescope: DR4 Maps and Cosmological Parameters*, JCAP (2020), DOI:10.1088/1475-7516/2020/12/047, arXiv:2007.07288
- S. Naess et al. (incl. **N. F. Cothard**) *The Atacama Cosmology Telescope: arcminute-resolution maps of 18,000 square degrees of the microwave sky from ACT 2008-2018 data combined with Planck*, JCAP (2020), DOI:10.1088/1475-7516/2020/12/046, arXiv:2007.07290
- P. A. Gallardo, M. D. Niemack, et al. (incl. **N. F. Cothard**) *Characterization of aliased noise in the Advanced ACTPol receiver*, Journal of Low Temperature Physics (2020), DOI:10.1007/s10909-020-02344-2, arXiv:1912.02902
- S. Choi et al. (incl. **N. F. Cothard**) *Sensitivity of the Prime-Cam Instrument on the CCAT-prime Telescope*, Journal of Low Temperature Physics (2019), DOI:10.1007/s10909-020-02428-z, arXiv:1908.10451
- Y. Li et al. (incl. **N. F. Cothard**) *Assembly and Integration Process of the High-Density Detector Array Readout Modules for the Simons Observatory*, Journal of Low Temperature Physics (2020), DOI:10.1007/s10909-020-02386-6, arXiv:2101.02658
- A. Suzuki et al. (incl. **N. F. Cothard**) *Commercially Fabricated Antenna-Coupled Transition Edge Sensor Bolometer Detectors for Next-Generation Cosmic Microwave Background Polarimetry Experiment*, Journal of Low Temperature Physics (2020), DOI:10.1007/s10909-019-02325-0, arXiv:1912.12782
- The CCAT-prime Collaboration (incl. **N. F. Cothard**) *The CCAT-Prime Submillimeter Observatory*, Astro2020 Decadal Project Whitepaper (2019), arXiv:1909.02587
- The Simons Observatory Collaboration (incl. **N. F. Cothard**) *The Simons Observatory: Astro2020 Decadal Project Whitepaper*, Astro2020 Decadal Project Whitepaper (2019), arXiv:1907.08284
- The Simons Observatory Collaboration (incl. **N. F. Cothard**) *The Simons Observatory: science goals and forecasts*, Journal of Cosmology and Astroparticle Physics (2019), DOI:10.1088/1475-7516/2019/02/056, arXiv:1808.07445
- R. Puddu, **N. F. Cothard**, P. A. Gallardo, R. Dünner, P. Fluxá, *Sidelobe analysis for the Atacama Cosmology Telescope: a novel method for importing models in GRASP*, (2019), arXiv:1903.04689

- E. M. Vavagiakis et al. (incl. **N. F. Cothard**) *Magnetic Sensitivity of AlMn TESes and Shielding Considerations for Next-Generation CMB Surveys*, Journal of Low Temperature Physics (2018), DOI:10.1007/s10909-018-1920-5, arXiv:1710.08456
- P. A. Gallardo et al. (incl. **N. F. Cothard**) *Studies of Systematic Uncertainties for Simons Observatory: Optical Effects and Sensitivity Considerations*, Proc. SPIE (2018), DOI:10.1117/12.2312971, arXiv:1808.05152
- S. M. Simon et al. (incl. **N. F. Cothard**) *The Advanced ACTPol 27/39 GHz Array*, Journal of Low Temperature Physics (2018), DOI:10.1007/s10909-018-1963-7
- Y. Li et al. (incl. **N. F. Cothard**) *Performance of the advanced ACTPol low frequency array*, Proc. SPIE (2018), DOI:10.1117/12.2313942
- E. M. Vavagiakis et al. (incl. **N. F. Cothard**) *Prime-Cam: A first-light instrument for the CCAT-prime telescope*, Proc. SPIE (2018), DOI:10.1117/12.2313868, arXiv:1807.00058
- G. J. Stacey et al. (incl. **N. F. Cothard**) *CCAT-prime: Science with an Ultra-widefield Submillimeter Observatory at Cerro Chajnantor*, Proc. SPIE (2018), DOI:10.1117/12.2314031, arXiv:1807.04354
- S. C. Parshley et al. (incl. **N. F. Cothard**) *CCAT-prime: a novel telescope for submillimeter astronomy*, Proc. SPIE (2018), DOI:10.1117/12.2314046, arXiv:1807.06675
- S. P. Ho et al. (incl. **N. F. Cothard**) *Highly uniform 150 mm diameter multichroic polarimeter array deployed for CMB detection*, Proc. SPIE (2017), DOI:10.1117/12.2233113
- S. W. Henderson, J. R. Stevens, et al. (incl. **N. F. Cothard**) *Readout of two-kilopixel transition-edge sensor arrays for Advanced ACTPol*, Proc. SPIE (2016), DOI:10.1117/12.2233895, arXiv:1607.06064