Andrew Chael | CV

CONTACT

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Princeton Gravity Initiative
Princeton University
Princeton, NJ 08540

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GitHub: github.com/achael

RESEARCH INTERESTS

black holes, accretion, relativistic jets,
magnetohydrodynamic simulations, computational imaging.

EDUCATION

Harvard University, Cambridge, MA — 2013 – 2019
Ph.D. in Physics, May 2019
A.M. in Physics, March 2015

Carleton College, Northfield, MN — 2009 – 2013
B.A. in Physics summa cum laude*, June 2013*
Secondary Concentration in Medieval and Renaissance Studies

PROFESSIONAL EXPERIENCE

Princeton Gravity Initiative Postdoctoral Fellow — 2022 –

NASA Hubble Fellowship Program Einstein Fellow — 2019 – 2022
Princeton Center for Theoretical Science

Black Hole Initiative Visiting Postdoctoral Fellow — 2019
Center for Astrophysics | Harvard & Smithsonian

Graduate Student Researcher: Accretion Theory — 2015 – 2019
Center for Astrophysics | Harvard & Smithsonian
- Adviser: Ramesh Narayan

Graduate Student Researcher: VLBI Imaging — 2014 – 2019
Center for Astrophysics | Harvard & Smithsonian
- Advisers: Sheperd Doeleman and Michael Johnson

Undergraduate Student Researcher — 2011 – 2012
CSIRO Astronomy and Space Science
- Adviser: Ryan Shannon

Undergraduate Student Researcher — 2010 – 2013
Carleton College
- Adviser: Joel Weisberg

Teaching and Mentorship Experience

Undergraduate Summer Research Program Mentor 2023
Princeton Department of Astrophysical Sciences

Resident Tutor 2015 – 2019
Dunster House, Harvard College

Fellowship Committee Chair 2017 – 2019
Dunster House, Harvard College

Teaching Consultant 2016 – 2018
Department of Physics, Harvard University

Teaching Fellow 2015 – 2016
Department of Physics, Harvard University
- PHYS 125: Widely Applied Physics, Fall 2015. (Prof. John Doyle)
- PHYS 175: Modern Optical Physics, Spring 2016. (Prof. Markus Greiner)

Physics Tutor 2010 – 2013
Carleton College Department of Physics

Writing Consultant 2010 – 2013
Carleton College Writing Center

Students Mentored

Antonio Fuentes (IAA, Spain)
Tejahni Desire (Princeton)
Zack Gelles (Princeton)

Academic Service

Coordinator, EHTC Polarimetry Working Group 2021–

Member, EHTC Committee on Diversity and Inclusion 2020–

Organizer, Princeton Gravity Initiative Colloquium Series 2023

Panel Member, Hubble Space Telescope Cycle 31 TAC 2023

Reviewer, *The Astrophysical Journal Letters* 2020–

Reviewer, *The Astrophysical Journal* 2020–

Reviewer, *Astronomy and Astrophysics* 2020–

Reviewer, *Monthly Notices of the Royal Astronomical Society* 2019–

Internal Reviewer, EHT Collaboration. 2019–

Conference Organization	SOC Member, IAS-EHT Wkshp. on Accretion Models Princeton, NJ	Nov. 2023
	SOC Member, "Modeling Plasmas Around Black Holes" Lorentz Center, Leiden, Netherlands	Sep. 2023
	SOC Member, EHT Summer Collaboration Meeting Taichung, Taiwan	Jun. 2023
	SOC Member, "Improving Accretion Models with Plasma Theory" Princeton, NJ	Feb. 2023
	SOC Member, EHT Winter Collaboration Meeting Virtual	Dec. 2021
	Primary Organizer, "Polarized Radiation from SMBHs" Princeton, NJ	May 2021
	SOC Member, 3rd EHT Imaging Workshop Virtual	May 2020
	SOC Member, EHT Polarization Workshop Bonn, Germany	Jul. 2019
	SOC Member, 2nd EHT Imaging Workshop Cambridge, MA	Jul. 2018
	SOC Member, 1st EHT Imaging Workshop Cambridge, MA	Nov. 2017
Grants & Computer Time Allocations	TACC Stampede2 Resource, 418,268 node hours (AST190053)	2020
	TACC Stampede2 Resource, 915,000 node hours (AST190053, Renewal)	2022
Honors	PCTS John Archibald Wheeler Fellow	2021
	Event Horizon Telescope Early Career Award	2020
	Event Horizon Telescope Outstanding Thesis Award	2020

Breakthrough Prize in Theoretical Physics (to 347 members of the EHT collaboration)	2019
Eric Keto Prize in Theoretical Astrophysics, Harvard Astronomy	2019
Queerty.com Pride 50	2019
Harvard University Certificate of Distinction in Teaching	2016
NSF Graduate Research Fellowship Honorable Mention	2014
Phi Beta Kappa, Carleton College	2013
Distinction in Physics and Integrative Exercise, Carleton College	2013
Lawrence McKinley Gould Prize in Natural Science, Carleton College	2013
Catherine Boyd Prize in Medieval Studies, Carleton College	2013
Rhodes Scholarship Finalist	2013
Patricia Damon Merit Scholarship, Carleton College	2012
Phillip Niles Prize in Medieval Studies, Carleton College	2011
Dean's List, Carleton College	2010, 2011, 2012
United States Department of Education Presidential Scholar	2009

First Author and Primary Collaboration Publications

A Chael, A Lupsasca, GN Wong, E Quataert
"Black Hole Polarimetry I: A Signature of Electromagnetic Energy Extraction."
ApJ 958, 65, 2023. doi:10.3847/1538-4357/acf92d

The Event Horizon Telescope Collaboration et al. **(paper coordinator)**
"First Event Horizon Telescope Results IX: detection of near-horizon circular polarization."
ApJL 957, L20, 2023. doi:10.3847/2041-8213/acff70

A Chael, D Pesce, S Issaoun, MD Johnson, A Ricarte, CM Fromm, Y Mizuno
"Multifrequency black hole imaging for the next-generation Event Horizon Telescope."
ApJ 945, 40, 2023. doi:10.3847/1538-4357/acb7e4

The Event Horizon Telescope Collaboration et al. **(paper writing team)**
"First Sagittarius A* Event Horizon Telescope Results III: imaging of the Galactic Center supermassive black hole."
ApJL 930, L14, 2022. doi:10.3847/2041-8213/ac6429

A Chael, MD Johnson, A Lupsasca.
"Observing the inner shadow of a black hole: a direct view of the event horizon."
ApJ 918, 6, 2021. doi:10.3847/1538-4357/ac09ee

The Event Horizon Telescope Collaboration et al. **(paper coordinator)**
"First M87 Event Horizon Telescope Results VIII: magnetic field structure near the event horizon."
ApJL 910, L13, 2021. doi:10.3847/2041-8213/abe4de

The Event Horizon Telescope Collaboration et al. **(paper writing team)**
"First M87 Event Horizon Telescope Results VII: polarization of the ring."
ApJL 910, L12, 2021. doi:10.3847/2041-8213/abe71d

A Chael, R Narayan, MD Johnson.
"Two-temperature, Magnetically Arrested Disc simulations of the supermassive black hole in M87."
MNRAS 486, p.2873-2895, 2019. doi:10.1093/mnras/stz988

The Event Horizon Telescope Collaboration et al. **(paper coordinator)**
"First M87 Event Horizon Telescope Results IV: imaging the central supermassive black hole."
ApJL 875, L4, 2019. doi:10.3847/2041-8213/ab0e85

A Chael, M Rowan, R Narayan, MD Johnson, L Sironi.
"The role of electron heating physics in images and variability of the Galactic Center black hole Sagittarius A*."
MNRAS 478, p.5209-5229, 2018. doi:10.1093/mnras/sty1261

A Chael, MD Johnson, KL Bouman, L Blackburn, K Akiyama, R Narayan.
"Interferometric imaging directly with closure phases and closure amplitudes."
ApJ 857, 23, 2018. doi:10.3847/1538-4357/aab6a8

A Chael, R Narayan, A Sadowski.
"Evolving non-thermal electrons in simulations of black hole accretion."
MNRAS 470, p.2367–2386, 2017. doi:10.1093/mnras/stx1345

A Chael, MD Johnson, R Narayan, SS Doeleman, J Wardle, KL Bouman.
"High-resolution linear polarimetric imaging for the Event Horizon Telescope."
ApJ 829, 11, 2016. doi:10.3847/0004-637X/829/1/11

Other Publications (Selected)

A Fuentes et al
"Filamentary structures as the origin of blazar jet radio variability."
Nature Astronomy 2023. doi:10.1038/s41550-023-02105-7

DCM Palumbo, GN Wong, **A Chael**, MD Johnson
"Demonstrating photon ring existence with single-baseline polarimetry."
ApJL 952, L31, 2023. doi:10.3847/2041-8213/ace630

MD Johnson et al.
"Key science goals for the next-generation Event Horizon Telescope." *Galaxies* 11, 3, 2023. doi:10.3390/galaxies11030061

S Issaoun et al.
"Enabling transformational ngEHT science via the inclusion of 86 GHz capabilities."
Galaxies 11, 1, 2023. doi:10.3390/galaxies11010028

S Issaoun et al.
"Resolving the inner parsec of the blazar J1924-2914 with the Event Horizon Telescope."
ApJ 934, 2, 2022. doi:10.3847/1538-4357/ac7a40

A Levis, P Srinivasan, **A Chael**, R Ng, KL Bouman.
"Gravitationally lensed black hole emission tomography."
IEEE Proceedings of the CVPR, 2022. arXiv:2204.03715

The Event Horizon Telescope Collaboration et al.
"First Sagittarius A* Event Horizon Telescope Results I: the shadow of the supermassive black hole in the center of the Milky Way."
ApJL 930, L12, 2022. doi:10.3847/2041-8213/ac6674

The Event Horizon Telescope Collaboration et al.
"First Sagittarius A* Event Horizon Telescope Results II: EHT and multiwavelength observations, data processing, and calibration."
ApJL 930, L13, 2022. doi:10.3847/2041-8213/ac6675

The Event Horizon Telescope Collaboration et al.
"First Sagittarius A* Event Horizon Telescope Results IV: variability, morphology, and black hole mass."
ApJL 930, L15, 2022. doi:10.3847/2041-8213/ac6736

The Event Horizon Telescope Collaboration et al.
"First Sagittarius A* Event Horizon Telescope Results V: testing astrophysical models of the Galactic Center black hole."
ApJL 930, L16, 2022. doi:10.3847/2041-8213/ac6672

The Event Horizon Telescope Collaboration et al.
"First Sagittarius A* Event Horizon Telescope Results V: testing the black hole metric."
ApJL 930, L17, 2022. doi:10.3847/2041-8213/ac6756

J Farah, P Galison, K Akiyama, KL Bouman, G Bower, **A Chael** et al.
"Selective dynamical imaging of interferometric data."
ApJL 930, L18, 2022. doi:10.3847/2041-8213/ac6615

R Narayan, **A Chael**, K Chatterjee, A Ricarte, B Curd.
"Jets in magnetically arrested accretion flows: geometry, power and black hole spindown."
MNRAS 511, p.3795-3813, 2022. doi:10.1093/mnras/stac285

M Janssen et al.
"Event Horizon Telescope observations of the jet launching and collimation in Centaurus A."
Nature Astronomy, 2021. doi:0.1038/s41550-021-01417-w

K Akiyama, **A Chael**, D Pesce.
"New views of black holes from computational imaging."
Nature Computational Science, 2021. doi:10.1038/s43588-021-00078-z

S Issaoun et al.
"Persistant non-Gaussian structure in the image of Sagittarius A* at 86 GHz."
ApJ 915, 2, 2021. doi:10.3847/1538-4357/ac00b0

R Narayan et al.
"The polarized image of a synchrotron-emtting ring of gas orbiting a black hole."
ApJ 912, 35, 2021. doi:10.3847/1538-4357/abf117

M Wielgus et al.
"Monitoring the morphology of M87* in 2009-2017 with the Event Horizon Telescope."
ApJ 901, 67, 2020. doi:10.3847/1538-4357/abac0d

L Blackburn, D Pesce, MD Johnson, M Wielgus, **A Chael**, P Christian, SS Doeleman.
"Closure statistics in interferometric data."
ApJ 894, 31, 2020. doi:10.3847/1538-4357/ab8469

J-Y Kim et al.
"Event Horizon Telescope Imaging of the archetypal blazar 3C 279 at an extreme 20 microarcsecond resolution"
A&A 640, A69, 2020. doi:10.1051/0004-6361/202037493

MD Johnson et al.
"Universal interferometric signatures of a black hole's photon ring"
Science Advances 6,12, 2020. doi:10.1126/sciadv.aaz1310

L Blackburn et al.
"Studying black holes on horizon scales with VLBI arrays."
Astro2020 White Paper arXiv:1909.01411

The Event Horizon Telescope Collaboration et al.
"First M87 Event Horizon Telescope Results I: the shadow of the supermassive black hole."
ApJL 875, L1, 2019. doi:10.3847/2041-8213/ab0ec7

The Event Horizon Telescope Collaboration et al.
"First M87 Event Horizon Telescope Results II: array and instrumentation."
ApJL 875, L2, 2019. doi:10.3847/2041-8213/ab0c96

The Event Horizon Telescope Collaboration et al.
"First M87 Event Horizon Telescope Results III: data processing and calibration."
ApJL 875, L3, 2019. doi:10.3847/2041-8213/ab0c57

The Event Horizon Telescope Collaboration et al.
"First M87 Event Horizon Telescope Results V: physical origin of the asymmetric ring."
ApJL 875, L5, 2019. doi:10.3847/2041-8213/ab0f43

The Event Horizon Telescope Collaboration et al.
"First M87 Event Horizon Telescope Results VI: the shadow and mass of the central black hole."
ApJL 875, L6, 2019. doi:10.3847/2041-8213/ab1141

S Issaoun, MD Johnson, L Blackburn, M Moscibrodzka, **A Chael**, H Falcke.
"VLBI imaging of black holes via second moment regularization."
A&A 629, A32, 2019. doi:10.1051/0004-6361/201936156

S Issaoun et al.
"The size, shape and scattering of Sagittarius A* at 86 GHz: first VLBI with ALMA."
ApJ 871, 30, 2019. doi:10.3847/1538-4357/aaf732

W Lu, C Dvorkin, **A Chael**.
"Probing sub-GeV dark matter-baryon scattering with cosmological observables."
Physical Review D 97, 103530, 2018. doi:10.1103/PhysRevD.97.103530

KL Bouman, MD Johnson, A Dalca, **A Chael**, F Roelofs, SS Doeleman, W Freeman.
"Reconstructing video from interferometric measurements of time-varying sources."
IEEE Trans. Comp. Imaging, 2018. doi:10.1109/TCI.2018.2838452

MD Johnson, KL Bouman, L Blackburn, **A Chael**, J Rosen, H Shiokawa, F Roelofs, K Akiyama, V Fish, SS Doeleman.
"Dynamical imaging with interferometry."
ApJ 850, 172, 2018. doi:10.3847/1538-4357/aa97dd

A Sadowski, M Wielgus, R Narayan, D Abarca, J McKinney, **A Chael**.
"Radiative, two-temperature simulations of low-luminosity black hole accretion flows in general relativity."
MNRAS 466, p.705-725, 2018. doi:10.1093/mnras/stw3116

V Fish et al.
"Persistent asymmetric structure of Sagittarius A* on event horizon scales."
ApJ 820, 90, 2016. doi:10.3847/0004-637X/820/2/90

MD Johnson et al.
"Resolved magnetic field structure and variability near the event horizon of Sagittarius A*."
Science 350, p.1242-1245, 2015. doi:10.1126/science.aac7087

MD Johnson, A Loeb, H Shiokawa, **A Chael**, SS Doeleman.
"Measuring the direction and angular velocity of a black hole accretion disk via lagged interferometric covariance."
ApJ 813, 132, 2015. doi:10.1088/0004-637X/813/2/132

P Verbiest, JM Weisberg, **A Chael**, K Lee, D Lorimer.
"On pulsar distance measures and their uncertainties."
ApJ 775, 39, 2012. doi:10.1088/0004-637X/755/1/39

Invited Talks

"Polarization spirals, energy extraction, and black hole spin"
Princeton-IAS Bahcall Lunch
Princeton, NJ. May 2023.

"The black hole-jet connection in simulations of M87"
Hamilton Workshop on Kinetic Models of Relativistic Plasmas
Dublin, Ireland. February 2023.

"Horizon-scale images of black hole accretion and jet launching"
Duke University Physics Colloquium
Durham, NC. February 2023.

"Horizon-scale images of black hole accretion and jet launching"
UC Berkeley Astronomy Colloquium
Berkeley, CA. February 2023.

"Imaging supermassive black holes with the Event Horizon Telescope"
Bard College Physics Colloquium
Annandale-on-Hudson, NY. November 2022.

"Multifrequency imaging for the ngEHT"
Broadening Horizons Workshop
Cambridge, MA. August 2022.

"Supermassive black holes and relativistic jets: insights from simulations and EHT observations"
IAU Focus Meeting 1
Busan, Korea. August 2022

"Polarization with the Event Horizon Telescope"
EHT Collaboration Summer Meeting
Granada, Spain. June 2022.

"Dynamic Imaging and Modeling of Sgr A*"
EHT US Focus Meeting
Tucson, Arizona. November 2021.

"Imaging supermassive black hole accretion flows: magnetic fields, jets, and inner shadows"
Princeton Gravity Initiative Seminar
Princeton, NJ. September 2021

"Observing the inner shadow of a black hole"
Goethe University Frankfurt Astronomy Seminar
Virtual. July 2021.

"Accretion, jet launching, and magnetic fields in M87 revealed by the EHT"
Event Horizon Telescope Summer Meeting
Virtual. June 2021.

"Magnetic fields at a supermassive black hole's event horizon"
CU Boulder Astronomy Colloquium
Virtual. April 2021.

"Magnetic fields at the event horizon in M87"
Princeton Center for Theoretical Science Seminar
Virtual. April 2021.

"ngEHT insights from radiative simulations: jets and lensed horizons"
Next-Generation Event Horizon Telescope Science Meeting
Virtual. February 2021.

"The eht-imaging software library"
Event Horizon Telescope Winter Collaboration Meeting
Virtual. December 2020.

"Photographing a black hole with the Event Horizon Telescope"
SciPy 2020 Keynote
Virtual. July 2020.

"Towards understanding black hole accretion and jet launching"
APS April Virtual Meeting

Virtual. April 2020.

"VLBI imaging techniques."
University of Arizona BH PIRE Webinar
Virtual. March 2020.

"Photographing a black hole with the Event Horizon Telescope."
NMSU College of Engineering Distinguished Lecture Series
Las Cruces, NM. February 2020.

"The black hole and jet in M87: connecting simulations and VLBI images."
Princeton Gravity Group Meeting
Princeton, NJ. November 2019.

"The black hole and jet in M87: connecting simulations and VLBI images."
Caltech TAPIR Seminar
Pasadena, CA. November 2019.

"The black hole and jet in M87: connecting simulations and VLBI images."
University of Waterloo Astronomy Seminar
Waterloo, ON. October 2019.

"In the shadow of the black hole."
GitHub Satellite 2019
Berlin, Germany. May 2019.

"Reconstructing an image of the black hole in M87 from EHT data."
2019 Black Hole Initiative Conference
Cambridge, MA. May 2019.

"Photographing a black hole with the Event Horizon Telescope."
Carleton College Physics Special Lecture.
Northfield, MN. May 2019.

"Simulating and imaging supermassive black hole accretion flows."
Black Hole Initiative Colloquium.
Cambridge, MA. May 2019.

"Two-temperature, radiative, MAD simulations of the supermassive black hole in M87."
Center for Astrophysics ITC lunch. (Keto Prize Talk).
Cambridge, MA. May 2019.

"Photographing black holes: first results from the Event Horizon Telescope."
Harvard University Special Colloquium.
Cambridge, MA. April 2019.

"What will the EHT see? Electron heating in simulations of Sgr A* and M87."

Columbia Astronomy Thursday Seminar.
New York, NY. November 2018.

"Electron heating and particle acceleration in GRMHD simulations of Sgr A*."
The Central Arcsecond: Towards Testing GR in the Galactic Center.
Ringberg, Germany. November 2018.

"What will the EHT see? Electron heating in simulations of Sgr A* and M87."
Northwestern CIERA Theory Group Meeting.
Evanston, IL. October 2018.

"Imaging a black hole with the Event Horizon Telescope."
907th Amateur Telescope Makers of Boston Monthly Meeting.
Cambridge, MA. March 2018.

"Imaging techniques for the Event Horizon Telescope."
3rd Event Horizon Telescope Collaboration Meeting.
Cambridge, MA. December 2016.

"Probing Dynamical Activity near the Event Horizon with the EHT."
2nd Event Horizon Telescope Collaboration Meeting.
Waterloo, ON. November 2014.

Other Talks (Selected)

"Polarization, energy extraction, and spin in EHT images"
EHT Summer Collaboration Meeting.
Taichung, Taiwan. June 2023.

"Hybrid GRMHD and Force-Free Simulations"
EHT Summer Collaboration Meeting.
Granada, Spain. June 2022.

"The Inner Shadow of a Supermassive Black Hole"
AAS 240 Summer Meeting.
Pasadena, CA. June 2022.

"The Inner Shadow of the Black Hole in M87*"
16th Marcel Grossman Meeting on General Relativity.
Virtual. July 2021.

"Simulating and Imaging Black Hole Accretion Flows." (Thesis Talk)
235th Meeting of the American Astronomical Society.
Honolulu, HI. January 2020.

"The Black Hole and Jet in M87: Connecting Simulations and VLBI Images."
JSI Workshop 2019: The New Faces of Black Holes
Annapolis, MD. November 2019.

"Electron heating physics in images and variability of Sgr A*."

15th Marcel Grossman Meeting on General Relativity.
Rome, Italy. July 2018.

"The role of electron heating physics in images and variability of Sgr A*."
28th New England Regional Quasar and AGN Meeting.
New Haven, CT. May 2018.

'Evolving thermal and nonthermal electron distributions in simulations of Sagittarius A*."
231st Meeting of the American Astronomical Society.
Washington, DC. January 2018.

"Evolving nonthermal electron distributions in accretion simulations."
13th School of Modern Astrophysics.
Moscow, Russia. July 2017.

"Evolving thermal and nonthermal electron distributions in accretion simulations."
When Brandeis Met Jansky: Astrophysics and Beyond.
Waltham, MA. May 2017.

"Imaging black hole magnetic fields with the Event Horizon Telescope."
Towards the 100th Anniversary of the Discovery of Cosmic Jets.
Taipei, Taiwan. May 2016.