

Andrew Chael | CV

CONTACT	465 Jadwin Hall Princeton Gravity Initiative Princeton University Princeton, NJ 08540	<i>Phone:</i> (505) 974-0538 <i>E-mail:</i> achael@princeton.edu <i>Website:</i> achael.github.io <i>GitHub:</i> github.com/achael
RESEARCH INTERESTS	black holes, accretion, relativistic jets, magnetohydrodynamic simulations, computational imaging.	
EDUCATION	Harvard University , Cambridge, MA	2013 – 2019
	<i>Ph.D. in Physics, May 2019</i>	
	<i>A.M. in Physics, March 2015</i>	
	Carleton College , Northfield, MN	2009 – 2013
	<i>B.A. in Physics summa cum laude, June 2013</i>	
	<i>Secondary Concentration in Medieval and Renaissance Studies</i>	
	Princeton Gravity Initiative Postdoctoral Fellow	2022 –
	NASA Hubble Fellowship Program Einstein Fellow	2019 – 2022
PROFESSIONAL EXPERIENCE	<i>Princeton Center for Theoretical Science</i>	
	Black Hole Initiative Visiting Postdoctoral Fellow	2019
	<i>Center for Astrophysics / Harvard & Smithsonian</i>	
	Graduate Student Researcher: Accretion Theory	2015 – 2019
	<i>Center for Astrophysics / Harvard & Smithsonian</i>	
	• Adviser: Ramesh Narayan	
	Graduate Student Researcher: VLBI Imaging	2014 – 2019
	<i>Center for Astrophysics / Harvard & Smithsonian</i>	
	• Advisers: Sheperd Doeleman and Michael Johnson	
	Undergraduate Student Researcher	2011 – 2012
	<i>CSIRO Astronomy and Space Science</i>	
	• Adviser: Ryan Shannon	
	Undergraduate Student Researcher	2010 – 2013
	<i>Carleton College</i>	
	• Adviser: Joel Weisberg	

TEACHING AND MENTORSHIP EXPERIENCE	Resident Tutor	2015 – 2019
	<i>Dunster House, Harvard College</i>	
	Fellowship Committee Chair	2017 – 2019
	<i>Dunster House, Harvard College</i>	
	Teaching Consultant	2016 – 2018
	<i>Department of Physics, Harvard University</i>	
ACADEMIC SERVICE	Teaching Fellow	2015 – 2016
	<i>Department of Physics, Harvard University</i>	
	• PHYS 125: Widely Applied Physics, Fall 2015. (Prof. John Doyle)	
	• PHYS 175: Modern Optical Physics, Spring 2016. (Prof. Markus Greiner)	
	Physics Tutor	2010 – 2013
	<i>Carleton College Department of Physics</i>	
	Writing Consultant	2010 – 2013
	<i>Carleton College Writing Center</i>	
	EHT Collab. Polarimetry Working Group Coordinator,	2021–
	Member, EHT Collab. Committee on Diversity and Inclusion.	2020–
	Reviewer, <i>The Astrophysical Journal Letters</i> .	2020–
	Reviewer, <i>The Astrophysical Journal</i> .	2020–
	Reviewer, <i>Astronomy and Astrophysics</i> .	2020–
	Reviewer, <i>Monthly Notices of the Royal Astron. Soc.</i>	2019–
	Internal Reviewer, EHT Collaboration.	2019–
	Reviewer, NASA FINESST proposals.	2021
	SOC Member, Princeton workshop on Improving black hole accretion models with accretion theory.	Feb. 2023
	SOC Member, EHT Winter Collaboration Meeting	Dec. 2021
	Primary Organizer, Princeton Workshop on Polarized Radiation from Supermassive Black Holes (virtual).	May 2021
	SOC Member, 3 rd EHT Imaging Workshop (virtual).	May 2020
	SOC Member, EHT Polarization Workshop, Bonn, Germany.	July 2019

	SOC Member, 2 nd EHT Imaging Workshop, Cambridge, MA.	July 2018
	SOC Member, 1 st EHT Imaging Workshop, Cambridge, MA.	Nov. 2017
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
	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	<p>A Chael, D Pesce, S Issaoun, MD Johnson, A Ricarte. “Multi-frequency black hole imaging for the next-generation Event Horizon Telescope.” <i>Submitted to ApJ</i>. ArXiv:2210.12226</p> <p>The Event Horizon Telescope Collaboration et al. “First Sagittarius A* Event Horizon Telescope results III: imaging of the Galactic Center supermassive black hole.” (paper writing team) <i>ApJ Letters</i> 930, L14, 2022. doi:10.3847/2041-8213/ac6429</p> <p>A Chael, MD Johnson, A Lupsasca. “Observing the inner shadow of a black hole: a direct view of the event horizon.” <i>ApJ</i> 918, 6, 2021. doi:10.3847/1538-4357/ac09ee</p>	

The Event Horizon Telescope Collaboration et al. (**paper coordinator**)
 “First M87 Event Horizon Telescope results VIII: magnetic field structure near the event horizon.”

ApJ Letters 910, L13, 2021. doi:[10.3847/2041-8213/abe4de](https://doi.org/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.”

ApJ Letters 910, L12, 2021. doi:[10.3847/2041-8213/abe71d](https://doi.org/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](https://doi.org/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.”

ApJ Letters 875, L4, 2019. doi:[10.3847/2041-8213/ab0e85](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/10.3847/0004-637X/829/1/11)

OTHER PUBLICATIONS (SELECTED)

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](https://doi.org/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](https://arxiv.org/abs/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.”

ApJ Letters 930, L12, 2022. doi:[10.3847/2041-8213/ac6674](https://doi.org/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.”

ApJ Letters 930, L13, 2022. doi:[10.3847/2041-8213/ac6675](https://doi.org/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.”

ApJ Letters 930, L15, 2022. doi:[10.3847/2041-8213/ac6736](https://doi.org/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.”

ApJ Letters 930, L16, 2022. doi:[10.3847/2041-8213/ac6672](https://doi.org/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.”

ApJ Letters 930, L17, 2022. doi:[10.3847/2041-8213/ac6756](https://doi.org/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.”

ApJ Letters 930, L18, 2022. doi:[10.3847/2041-8213/ac6615](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/10.1038/s43588-021-00078-z)

S Issaoun et al.

“Persistent non-Gaussian structure in the image of Sagittarius A* at 86 GHz.”

ApJ 915, 2, 2021. doi:[10.3847/1538-4357/ac00b0](https://doi.org/10.3847/1538-4357/ac00b0)

R Narayan et al.

“The polarized image of a synchrotron-emitting ring of gas orbiting a black hole.”

ApJ 912, 35, 2021. doi:[10.3847/1538-4357/abf117](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/10.1126/sciadv.aaz1310)

L Blackburn et al.

“Studying black holes on horizon scales with VLBI arrays.”

Astro2020 White Paper arXiv:[1909.01411](https://arxiv.org/abs/1909.01411)

The Event Horizon Telescope Collaboration et al.

“First M87 Event Horizon Telescope results I: the shadow of the supermassive black hole.”

ApJ Letters 875, L1, 2019. doi:[10.3847/2041-8213/ab0ec7](https://doi.org/10.3847/2041-8213/ab0ec7)

The Event Horizon Telescope Collaboration et al.

“First M87 Event Horizon Telescope results II: array and instrumentation.”

ApJ Letters 875, L2, 2019. doi:[10.3847/2041-8213/ab0c96](https://doi.org/10.3847/2041-8213/ab0c96)

The Event Horizon Telescope Collaboration et al.

“First M87 Event Horizon Telescope results III: data processing and calibration.”

ApJ Letters 875, L3, 2019. doi:[10.3847/2041-8213/ab0c57](https://doi.org/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.”

ApJ Letters 875, L5, 2019. doi:[10.3847/2041-8213/ab0f43](https://doi.org/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.”

ApJ Letters 875, L6, 2019. doi:[10.3847/2041-8213/ab1141](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/10.1088/0004-637X/755/1/39)

INVITED TALKS “Imaging 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/Modeling of Sgr A*”
EHT US Collaboration 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 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 Harvard BHI 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)

“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.

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

INTERVIEWS & MEDIA

Black Holes: The Edge of All We Know Documentary [2021](#)

Quanta Magazine [20/5/2021](#)

The New York Times [24/3/2021](#)

Inverse [24/3/2021](#)

New Scientist [24/3/2021](#)

Carleton College Voice [Winter 2020](#)

Undark podcast [30/4/2019](#)

The Washington Post [12/4/2019](#)

WIRED.com [11/4/2019](#)