

Andrew Chael | CV

CONTACT	411A Jadwin Hall Center for Theoretical Science Princeton University Princeton, NJ 08540	<i>Phone:</i> (609) 258-1149 <i>E-mail:</i> achael@princeton.edu <i>Website:</i> achael.github.io <i>GitHub:</i> github.com/achael
RESEARCH INTERESTS	Astrophysical black holes, accretion, relativistic jets, magnetohydrodynamic simulations, computational imaging.	
EDUCATION	Harvard University , Cambridge, MA <i>Ph.D. in Physics, May 2019</i> <i>A.M. in Physics, March 2015</i>	2013 – 2019
	Carleton College , Northfield, MN <i>B.A. in Physics summa cum laude, June 2013</i> <i>Secondary Concentration in Medieval and Renaissance Studies</i>	2009 – 2013
PROFESSIONAL EXPERIENCE	NASA Hubble Fellowship Program Einstein Fellow <i>Princeton Center for Theoretical Science</i> <ul style="list-style-type: none">• Proposal: Simulating and Imaging Flaring Black Holes on Horizon Scales	2019 –
	Black Hole Initiative Visiting Postdoctoral Fellow <i>Center for Astrophysics Harvard & Smithsonian</i>	2019
	Graduate Student Researcher <i>Accretion Theory, Center for Astrophysics Harvard & Smithsonian</i> <ul style="list-style-type: none">• Adviser: Ramesh Narayan	2015 – 2019
	Graduate Student Researcher <i>VLBI Imaging, Center for Astrophysics Harvard & Smithsonian</i> <ul style="list-style-type: none">• Advisers: Sheperd Doeleman and Michael Johnson	2014 – 2019
	Graduate Student Researcher <i>Cosmology, Harvard University Department of Physics</i> <ul style="list-style-type: none">• Adviser: Cora Dvorkin	2015
	Undergraduate Student Researcher <i>Pulsar Astronomy, CSIRO Astronomy and Space Science</i> <ul style="list-style-type: none">• Adviser: Ryan Shannon	2011 – 2012
	Undergraduate Student Researcher <i>Pulsar Astronomy, Carleton College</i> <ul style="list-style-type: none">• Adviser: Joel Weisberg	2010 – 2013

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>	
	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>	
ACADEMIC SERVICE	EHT Polarimetry Working Group Coordinator,	2021-present
	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
	Reviewer, NASA FINESST proposals.	2021
	Reviewer, <i>The Astrophysical Journal Letters</i> .	2020
	Reviewer, <i>The Astrophysical Journal</i> .	2020-2021
	Reviewer, <i>Astronomy and Astrophysics</i> .	2020-2021
	Reviewer, <i>Monthly Notices of the Royal Astronomical Society</i> .	2019-2021
	Internal Reviewer, EHT Collaboration.	2019-2021
	Member, EHT Committee on Diversity and Inclusion,	2020-present

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 **A Chael**, MD Johnson, A Lupsasca.
AND PRIMARY “Observing the inner shadow of a black hole: a direct view of the event
COLLABORATION horizon.”

PUBLICATIONS *ApJ* 918, 6, 2021. doi:[10.3847/1538-4357/ac09ee](https://doi.org/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.”

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, M 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)

R Narayan, **A Chael**, K Chatterjee, A Ricarte, B Curd.

“Jets in magnetically arrested accretion flows: geometry, power and black hole spindown.”

Submitted to *MNRAS* arXiv:[2108.12380](https://arxiv.org/abs/2108.12380)

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/10.1038/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 Transactions on Computational 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 supermassive black hole accretion flows: magnetic fields, jets, and
 inner shadows”

Princeton Gravity Initiative Seminar
 September 2021

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

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

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

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

“The eht-imaging software library”
Event Horizon Telescope Winter Collaboration Meeting
 December 2020.

“Photographing a black hole with the Event Horizon Telescope”
SciPy 2020 Keynote
 July 2020.

“Towards understanding black hole accretion and jet launching”
APS April Virtual Meeting
 April 2020.

“VLBI imaging techniques.”
University of Arizona BH PIRE Webinar
 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.”
90th 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)

“The Inner Shadow of the Black Hole in M87*”
16th Marcel Grossman Meeting on General Relativity.
 July 2018.

“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.