Angelo R. Ricarte

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Scientific Interests

Supermassive black hole assembly and galaxy co-evolution, from event horizon to cosmological scales, bridging theory with multi-messenger observations.

Positions Held

- **Smithsonian Astrophysical Observatory** (2025-present): Astrophysicist
  Supervisor: Michael D. Johnson

- **Black Hole Initiative | Harvard University** (2022-2025): Black Hole Initiative Fellow
  Supervisor: Ramesh Narayan

- **Center for Astrophysics | Harvard & Smithsonian** (2019-2022): Institute for Theory and Computation / Black Hole Initiative Postdoctoral Fellow
  Supervisor: Ramesh Narayan

Education

- **Yale University** (2013-2019): Ph.D. in Astronomy
  Advisor: Priyamvada Natarajan
  Thesis: The Assembly of Supermassive Black Holes: from the Seeding Epoch to the Present Day

- **University of California at Berkeley** (2009-2013): B.A. in Astrophysics and Applied Mathematics, High Honors
  Advisor: Jason Dexter
  Thesis: The Event Horizon Telescope: Exploring Strong Gravity and Accretion Physics

Collaboration Activities

- **Event Horizon Telescope (EHT)**, Theory Working Group Coordinator, formerly Polarization Working Group Coordinator and Sagittarius A* Polarization Theory Lead
- **Black Hole Explorer (BHEX)**, Black Hole Demographics Working Group Coordinator
- **Advanced X-ray Imaging Satellite (AXIS)**, AGN Demographics Sub-working Group Coordinator
- **Next-generation Event Horizon Telescope (ngEHT)**, member
- **Laser Interferometer Space Antenna (LISA)**, community member
- **N-body Shop**, member

Honors and Distinctions

- **Event Horizon Telescope Collaboration Early Career Award** (2024): Awarded for leadership and work on polarized images of both M87* and Sgr A*.
- **Achievement Recognition Award by the City of La Mirada, CA** (2021): Awarded by the city council of my hometown for scientific achievements.
- **Brouwer Prize** (2020): Awarded by the Yale astronomy department to students for contributions of unusual merit to any branch of astronomy.
- **Beatrice Tinsley Award** (2017): Best astronomy paper written by a Yale astronomy graduate student in 2016.
- **Gruber Science Fellowship** (2013-2020): Yale University's most prestigious award to highly ranked incoming Ph.D. students in life sciences, cosmology, and astrophysics
- **Daniel Edward Wark Award** (2012): Awarded to outstanding undergraduates in astronomy at U.C. Berkeley.
- **Edward Kraft Award** (2010): Awarded to undergraduates who maintain a 4.000 GPA throughout their first year.
- **Regents' and Chancellor's Scholarship** (2009): U.C. Berkeley's most prestigious award to highly ranked incoming undergraduates

Grants

- **NASA Earth and Space Science Fellowship** (2017-2019): Funding awarded to graduate students whose research furthers NASA's science goals. Program later renamed FINESST. $90k.

Selected Press Coverage

- "The Milky Way's central black hole could have a hidden jet," Astronomy Magazine, 2024
- "Supermassive black hole at center of Milky Way revealed, with help from local researchers," CBS News, 2022
- "'Substantial' Number of Wandering Black Holes Could Be Roaming Galaxies," Newsweek, 2021
- "Under pressure, black holes feast," YaleNews, 2020
- "Scientists Trace Supermassive Black Hole and Galaxy Co-Evolution in Romulus Simulation," SciTech Daily, 2019

Conferences and Workshops Organized

- **RN50**: LOC, CfA 2024
- **Boston-Area Black Hole Accretion Meeting (BABAM)**: SOC, CfA 2023
- **Black Holes Across Space and Time (BLAST)**: SOC/LOC, BHI Virtual 2023
- **First ngEHT Collaboration Meeting**: LOC, Granada, Spain 2022
- **Black Holes Across Space and Time (BLAST)**: SOC/LOC, BHI Virtual 2021
- **From Vision to Instrument, Designing the Next-Generation EHT to Transform Black Hole Science**: LOC, Virtual 2021

Classroom Teaching Experience

- **Black Hole Scholars** (2024-present): I coordinate and present at outreach events for the BHI to schools around the United States.
- **Skype a Scientist Program** (2021-present): I participate in a program in which I am matched up with classrooms around the world to chat about the process of science and becoming a scientist.
- **Relativistic Astrophysics** (Fall 2025): guest lecture "How to Build a Supermassive Black Hole"
- **International School of Boston** (2022): I gave an hour-long lecture to the astronomy club at a local high school.
- **National Science Teachers Association** (2022): I presented a one-hour long seminar about the Event Horizon Telescope to science teachers around the United States
- **Beacon Hill Seminar** (2021): 2-hour seminar on black holes to lifelong learners.
- **Smithsonian Astrophysical Observatory (SAO) EHT Education Team** (2021): I was part of a group helping design lesson plans and outreach materials about black holes.
- **Galaxies and the Universe** (Spring 2016): grading, homework help, and discussion sections, taught by Bob Zinn
- **Planets and Stars** (Fall 2015): grading, homework help, and discussion sections, taught by Louise Edwards
- **Galaxies and the Universe** (Spring 2014): grading, homework help, and discussion sections, taught by Jeffrey Kenney
- **Astrophysics Research Methods** (Fall 2013): grading, homework help, taught by Marla Geha

Students Mentored

- **Kratika Mazde** (Institut D'Astrophysique de Paris Ph.D., Fall 2024-present)
- **Tegan Thomas** (University of Virginia Ph.D., Summer 2024-present)
- **Nikola Bukowiecka** (University of Rhode Island Ph.D., Spring 2024-present)
- **Alice Zhang** (Harvard University Undergraduate/Pre-doctorate, 2023-2025)
- **Richard Qiu** (Harvard University Undergraduate, 2020-2023)
- **Roy Herrera** (Harvard University Undergraduate, Summer 2022)
- **Charlotte Zimmer** (Yale University Undergraduate, 2018-2019)

Public Outreach Activities

- **Astronomy On Tap** (2019, 2023-present): I am one of the main local organizers of Astronomy on Tap, Boston, and have personally given several public talks.
- **LISA Ambassadors Program** (2019-present): I am part of a group to help communicate LISA science to the broader public.
- **EHT Social Media Committee** (2022-2024): I was part of a committee managing the EHT collaboration's social media presence.
- **Harvard Observatory Night** (2024): I gave a half-hour lecture about EHT to a public audience.

- **MALOKA Interactive Museum of Science, Technology and Planetarium** (2024): I produced and inspirational educational video about the EHT for a Colombian museum.
- **AwesomeCon Black Hole Panel** (2022): I was part of a panel discussing black holes at a public convention in Washington D.C.
- **Center for Astrophysics Livestream Panel on EHT Results** (2022): I was part of a panel discussing the new image of Sagittarius A* streaming live on YouTube
- **Ask an Astronomer by Universe Unplugged** (2021): I participated in an "Ask an Astronomer" stream hosted by Phil Lamarr.
- **Wilderness Center Black Hole Day** (2021): I (virtually) presented a 45-minute-long public outreach talk at the Wilderness Center at Wilmot, Ohio, now available on YouTube.
- **Leitner Observatory and Planetarium** (2014-2019): I regularly presented planetarium shows and helped the facility with public observing nights.
- **Open Labs Science Café** (2019): I presented a public talk to high school students interested in science.

Invited Colloquium, Seminar, and Conference Presentations

- **The Multiscale Environment of AGN Across Cosmic Time** (2025): Accretion and Feedback from the Event Horizon
- **Institute for Advanced Study Seminar** (2025): Strongly Magnetized Black Hole Accretion Flows—Jets, Spin Evolution, and New Observational Probes
- **Bar-Ilan University Astrophysics Seminar** (2025): A New Spin on Black Holes in a MAD Universe
- **American Astronomical Society** (2025): First Sagittarius A* Event Horizon Telescope Results. VIII. Physical Interpretation of the Polarized Ring
- **Princeton Gravity Initiative Seminar** (2024): A New Spin on Black Holes in a MAD Universe
- **UC Berkeley Theoretical Astrophysics Center Seminar** (2024): AGN Jet Feedback and Spin Evolution in a MAD Universe
- **European Astronomical Society** (2024): First Sagittarius A* EHT Results, Physical Interpretation of the Polarized Ring
- **Wayne State Particle-Astro-Nuclear Physics Seminar** (2024): The Cosmic Assembly of Supermassive Black Holes
- **Radboud University Astrophysics Colloquium** (2023): The Cosmic History of Supermassive Black Holes: from megaparsecs to milliparsecs
- **George Mason University Physics Seminar** (2023): Unveiling Black Hole Accretion with the Event Horizon Telescope—and Beyond
- **Waterloo Astrophysics Seminar** (2023): Unveiling Black Hole Accretion with the Event Horizon Telescope—and Beyond
- **Institute for Advanced Study Seminar** (2022): Supermassive Black Holes from Microparsecs to Megaparsecs
- **Black Holes Across Space and Time Winter** (2021): The Evolution of Supermassive Black Holes: A Problem of Scales

- **Los Alamos National Labs Physics Seminar** (2021): Supermassive Black Holes: from Microparsecs to Megaparsecs
- **International Space Science Institute Game Changer's Series** (2021): Seeing the Unseeable – Imaging Black Holes with the Event Horizon Telescope
- **Black Hole Initiative Colloquium** (2021): Supermassive Black Holes: from Microparsecs to Megaparsecs
- **University of Florida Astrophysics Seminar** (2021): Supermassive Black Holes: from Microparsecs to Megaparsecs
- **University of Connecticut Astronomy Seminar** (2021): Supermassive Black Holes: from Event Horizon to Cosmological Scales
- **The Frontiers of Event Horizon Scale Accretion, KITP** (2020): Internal Faraday Rotation of Black Hole Accretion Flows
- **Wesleyan University Astronomy Colloquium** (2018): Modeling the Supermassive Black Hole-Galaxy Connection Over Cosmic Time
- **Black Hole Initiative Colloquium** (2018): Modeling the Black Hole-Galaxy Connection Over Cosmic Time

Contributed Colloquium, Seminar, and Conference Presentations

- **American Astronomical Society** (2025): Multimessenger Probes of Supermassive Black Hole Spin Evolution
- **The Formation and Evolution of Supermassive Black Holes** (2024): Multi-messenger Signatures of Jet-driven Spin Evolution Across Cosmic Time
- **Yale Tinsley Workshop** (2024): New Insights Into Super-Eddington Accretion
- **Harvard UMBRELA Seminar** (2024): A New Spin on Black Holes in a MAD Universe
- **Massive Black Holes in the First Billion Years** (2024): Spin Evolution, Magnetization, and Jets in the Super-Eddington Regime
- **Black Holes on Broadway** (2023): Event Horizon-scale Insights into Accretion, Feedback, and Spin Evolution
- **Plasma Around Black Holes Lorentz Center Workshop** (2023): Observing Plasma and Space-time Properties with the Event Horizon Telescope—and Beyond
- **AXIS Astrophysics Seminar** (2023): Constraining the Formation and Evolution of Supermassive Black Holes with AXIS
- **Carnegie Observatories Lunch Talk** (2022): Unveiling Black Hole Accretion with the Event Horizon Telescope—and Beyond
- **Young Astronomers on Galactic Nuclei** (2022): Theoretical Insights from the EHT and Beyond
- **What Drives the Growth of Black Holes?** (2022): Current Results on Sgr A* and M87*, and the Future of the EHT
- **Black Hole Initiative Conference** (2022): The Next Generation of Black Hole Science
- **Young Astronomers on Galactic Nuclei** (2021): Wandering Black Holes in the Romulus Cosmological Simulations
- **The Next-generation Event Horizon Telescope (ngEHT)** (2021): Faraday Effects in Models of M87*

- **N-body Shop Collaboration** (2021): Wandering Black Holes in the Romulus Cosmological Simulations
- **Black Hole Initiative Conference** (2021): The Internal Faraday Rotation of Black Hole Accretion Flows
- **Accretion History of AGN (AHA)** (2019): Modeling the AGN-Galaxy Connection with Sims and SAMs
- **Young Astronomers on Galactic Nuclei (YAGN)** (2019): Black Hole-Galaxy Coevolution in the Romulus Simulations
- **UC Santa Cruz Flash Talk** (2018): Black Hole Assembly Across Cosmic Time
- **Accretion History of AGN (AHA)** (2018): Modeling the Supermassive Black Hole-Galaxy Connection Over Cosmic Time
- **Santa Cruz Galaxy Workshop** (2018): Revealing the Signatures of Black Hole Seeding
- **Are AGN Special?** (2018): Modeling the BH-Galaxy Connection Over Cosmic Time
- **Gruber Fellow Symposium** (2018): Tracing the Origins of Supermassive Black Holes
- **NERQUAM** (2018): Semi-analytic Models of SMBH Assembly
- **Gruber Fellow Symposium** (2017): How do you make a supermassive black hole?
- **Theoretical and Computational Astrophysics Network (TCAN)** (2016): Semi-analytic Models of Black Hole Evolution
- **Theoretical and Computational Astrophysics Network (TCAN)** (2015): Stellar Tidal Disruption by a Supermassive Black Hole Binary

Posters Presented

- **Taking Spin Measurements for a Spin** (2025): Cosmological Spin Evolution with Blandford-Znajek Jets
- **Extreme Black Holes Aspen Workshop** (2023): How Spatially Resolved Polarimetry Informs BH Accretion Flow Models
- **Galaxy Cluster Formation (GCF)** (2021): Linking Ram Pressure and AGN in the RomulusC Simulation
- **Princeton Polarization Workshop** (2021): Magnetic Field Structure and Circularly Polarized Images
- **Signatures of Accretion Onto the First Massive Black Holes** (2019): The Observational Signatures of Black Hole Seeding Models
- **IAP Massive Black Holes** (2018): The Signatures of Black Hole Seeding
- **Snowcluster** (2018): The Black Hole-Galaxy Connection in the RomulusC Simulation
- **Saas-Fee Winter School** (2018): Exploring SMBH Assembly with Semi-analytic Modeling
- **Elusive AGN** (2017): A Stochastic Semi-analytic Model for SMBH Growth
- **EHT Meeting** (2014): Exploring Strong Gravity and Accretion Physics with the Event Horizon Telescope
- **AAS Meeting 225**: Stellar Tidal Disruption by a Supermassive Black Hole Binary

Publications

20 lead author, 91 total, h-index 40
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Directly supervised students are marked in orange.

First-author Publications

- "Dynamical Inference from Polarized Light Curves of Sagittarius A*," **A. Ricarte**, N. Conroy, M. Wielgus, D. Palumbo, R. Emami, and C. Chan 2025, ApJ, 987, 152
- "Multi-messenger Probes of Supermassive Black Hole Spin Evolution," **A. Ricarte**, P. Natarajan, R. Narayan, and D. C. M. Palumbo, 2025, ApJ, 980, 19
- "Recipes for Jet Feedback and Spin Evolution of Black Holes with Strongly Magnetized Super-Eddington Accretion Disks," **A. Ricarte**, R. Narayan, and B. Curd, 2023, ApJL, 954, 22
- "Probing Plasma Physics with Spectral Index Maps of Accreting Black Holes on Event Horizon Scales," **A. Ricarte**, C. Gammie, R. Narayan, and B. S. Prather, 2023, MNRAS, 519, 4203
- "The ngEHT's Role in Measuring Supermassive Black Hole Spins," **A. Ricarte**, P. Tiede, R. Emami, A. Tamar, and P. Natarajan, 2023, Galaxies, 11, 6
- "How Spatially Resolved Polarimetry Informs Black Hole Accretion Flow Models," **A. Ricarte**, M. D. Johnson, Y. Kovalev, D. C. M. Palumbo, R. Emami, 2023, Galaxies, 11, 5
- "Observational Signatures of Frame Dragging in Strong Gravity," **A. Ricarte**, D. C. M. Palumbo, R. Narayan, F. Roelofs, R. Emami, 2022, ApJL, 941L, 12
- "Unveiling the Population of Wandering Black Holes via Electromagnetic Signatures," **A. Ricarte**, M. Tremmel, P. Natarajan, and T. Quinn, 2021 ApJL, 916L, 18
- "Black hole magnetic fields and their imprint on circular polarization images," **A. Ricarte**, R. Qiu, and R. Narayan, 2021, MNRAS, 505, 523
- "Origins and demographics of wandering black holes," **A. Ricarte**, M. Tremmel, P. Natarajan, C. Zimmer, and T. Quinn, 2021, MNRAS, 503, 6098
- "Decomposing the Internal Faraday Rotation of Black Hole Accretion Flows", **A. Ricarte**, B. S. Prather, G. N. Wong, R. Narayan, C. Gammie, and M. D. Johnson, 2020, MNRAS, 498, 5468
- "A Link Between Ram Pressure Stripping and Active Galactic Nuclei," **A. Ricarte**, M. Tremmel, P. Natarajan, and T. Quinn, 2020, ApJL, 895L, 8
- "The Clustering of Undetected High-redshift Black Holes and their Signatures in Cosmic Backgrounds," **A. Ricarte**, F. Pacucci, N. Cappelluti, and P. Natarajan, 2019, MNRAS, 489, 1006
- "Tracing Black Hole and Galaxy Co-evolution in the Romulus Simulations," **A. Ricarte**, M. Tremmel, P. Natarajan, and T. Quinn, 2019, MNRAS, 489, 802
- "The Observational Signatures of Supermassive Black Hole Seeds," **A. Ricarte** and P. Natarajan, 2018, MNRAS, 481, 3278
- "Exploring Supermassive Black Hole Assembly with Semi-analytic Modelling," **A. Ricarte** and P. Natarajan, 2018, MNRAS, 474, 1995

- "Tidal Disruption Events by a Massive Black Hole Binary," **A. Ricarte**, P. Natarajan, L. Dai, and P. Coppi, 2016, MNRAS, 458, 1712
- "The Event Horizon Telescope: exploring strong gravity and accretion physics," **A. Ricarte** and J. Dexter, 2015, MNRAS, 446, 1973
- "Resolving the Moth at Millimeter Wavelengths," **A. Ricarte**, N. Moldvai, A. M. Hughes, G. Duchene, J. Williams, S. Andrews, D. Wilner, 2013, ApJ, 774, 80

Selected Co-authored Publications

- "First Sagittarius A* Event Horizon Telescope Results. VIII. Physical Interpretation of the Polarized Ring," Event Horizon Telescope Collaboration et al., ApJL, 2024, 964, 2
  Project lead, performed plurality of work.
- "First M87 Event Horizon Telescope Results. IX. Detection of Near-horizon Circular Polarization," Event Horizon Telescope Collaboration et al., ApJL, 2023, 957, 2
  Theory lead.
- "Accessing a New Population of Supermassive Black Holes with Extensions to the Event Horizon Telescope," X. A. Zhang, **A. Ricarte**, D. Pesce, et al., ApJ, 985, 41
  First author was my undergraduate/pre-doctoral student.
- "Unraveling Twisty Linear Polarization Morphologies in Black Hole Images," R. Emami, **A. Ricarte**, et al., 2023, ApJ, 950, 38
  Conceptualized the project, performed the second most amount of work, and produced several figures.
- "Using Machine Learning to link black hole accretion flows with spatially resolved polarimetric observables," R. Qiu, **A. Ricarte**, R. Narayan, G. Wong, A. Chael, and D. Palumbo, MNRAS, 2023, 520, 4867
  First author was my undergraduate student.
- "First Sagittarius A* Event Horizon Telescope Results. V. Testing Astrophysical Models of the Galactic Center Black Hole," Event Horizon Telescope Collaboration et al., 2022, ApJL, 930, 17
  Produced three of the simulated image libraries and performed analysis required for this paper.
- "Jets in Magnetically Arrested Hot Accretion Flows: Geometry, Power and Black Hole Spindown," R. Narayan, A. Chael, K. Chatterjee, **A. Ricarte**, and B. Curd, 2022, MNRAS, 511, 3795
  Performed calculations determining cosmological implications of spin-evolution implied by these models.
- "First M87 Event Horizon Telescope Results. VIII. Magnetic Field Structure near The Event Horizon," Event Horizon Telescope Collaboration et al., 2021, ApJL, 910L, 13
  Provided substantial original text and figures, especially concerning Faraday rotation and the rotation measure of M87.
- "Introducing RomulusC: A Cosmological Simulation of a Galaxy Cluster with Unprecedented Resolution," M. Tremmel, T. Quinn, **A. Ricarte**… et al., 2019, MNRAS, 483, 3336
  Performed analysis of quenching of cluster members.

- "Unveiling the first black holes with JWST: multi-wavelength spectral predictions," P. Natarajan, F. Pacucci, A. Ferrara, B. Agarwal, **A. Ricarte**, E. Zackrisson, and N. Cappelluti, 2017, ApJ, 838, 117
  Performed plotting and determined photometric cuts.

References

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