

Sheperd Doeleman - Curriculum Vitae

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Education

1986 BA in Physics, Reed College, Portland, OR.
1995 PhD in Physics, Massachusetts Institute of Technology, Cambridge, MA

Employment/Positions

1986-1988 Research Fellow, Bartol Research Institute, McMurdo Station Antarctica
1995-1998 Postdoctoral Fellow, MIT Haystack Observatory
1998-2009 Research Scientist, MIT Haystack Observatory
2009-2016 Principal Research Scientist, MIT Haystack Observatory
2010-2016 Assistant Director, MIT Haystack Observatory
2012-2016 Astrophysicist, Harvard-Smithsonian Center for Astrophysics
2016-present Senior Research Fellow, Harvard University, Astronomy Dept.
2016-present Senior General Engineer, Smithsonian Astrophysical Observatory
2016-present Assistant Director, Black Hole Initiative – Harvard University
2016-present Founding Director, Event Horizon Telescope Consortium

Teaching/Mentoring

1991 – 1994 Graduate Teaching Assistant, MIT Physics Department
Spring 1993 Recitation Instructor, Introductory Mechanics, MIT Physics Department
Spring 2002 Recitation Instructor, Introductory E+M, MIT School of Engineering
Spring 2004 Course Instructor, Introductory E+M, MIT School of Engineering
1998-present Mentor for 12 Undergraduate Students through the REU, UROP and SAO Research Intern programs.
2008-present Postdoctoral Fellows: Vincent Fish, Rusen Lu, Laura Vertatschitsch, Michael Johnson, Lindy Blackburn, Andre Young, Hotaka Shiokawa, Kazu Akiyama, Katie Bouman, Alex Raymond, Dominic Pesce, Maciek Wielgus, Mislav Balokovic, Christian Fromm, Freek Roelofs.
2012-present Graduate Students: Katherine Rosenfeld, Andrew Chael, Daniel Palumbo.

Awards

MIT Buechner Teaching Prize, 1993.
DAAD Grant for Research Visit to MPIfR in Bonn, 1996.
MIT Excellence Award – Awarded for Community Outreach, 2003.
Guggenheim Fellowship, 2012: “Building an event horizon telescope”
AAS Lancelot M. Berkeley Prize, 2020
National Academy of Sciences Henry Draper Medal, 2021
Smithsonian American Ingenuity Award (2019) - to SD and the EHT
AAS HEAD Bruno Rossi Prize (2020) - to SD and the EHT
NSF Diamond Achievement Award (2019) - to the EHT
Breakthrough Prize in Fundamental Physics (2020) - to the EHT
National Space Club & Foundation, Nelson P. Jackson Award (2020) - to the EHT
Albert Einstein Society, Einstein Medal (2020) - to the EHT

Professional Activities

Peer Reviewer: *Astrophysical Journal*, *Science*, *PASJ*, *Nature*, *MNRAS*
NSF Grant Reviewer: AST, OPP divisions
VLBI Future Committee (2003-2004)
Arecibo Users and Scientific Advisory Committee 2006-2008 (chair 2008)
NRAO Users Committee (2012 - 2015)
ALMA North America Science Advisory Committee – ANASAC (2012 – 2015)

Breakthrough Prize Committee (2020 - present)
Falling Walls Scientific Selection Jury (2020 - present)

Grant History: \$50M+ to create and sustain the EHT.

(Past Awards)

NSF AST-0096454

“Astronomical Research and Technical Support of Millimeter-Wavelength VLBI”

PI: A.E.E. Rogers co-PI: S.S. Doeleman, R.B. Phillips

May 2001 to April 2004, total amount \$1.2M

NSF AST-0352953

“Ultra High Sensitivity VLBI: A Leap in Bandwidth”

PI: S.S. Doeleman co-PI: C.J. Lonsdale, A.R. Whitney

August 2004 to July 2008, total amount \$950K

NSF AST-0521233

“Development of a Flexible Wideband Digital Backend for Radio Interferometry”

PI: A. Whitney co-PI: S.S. Doeleman, A.E.E. Rogers

April 2006 to April 2009, total amount \$631K

NSF AST-0603971

“Advanced Correlation Techniques for Next-Generation Radio Arrays”

PI: C. Lonsdale co-PI: S.S. Doeleman, D. Oberoi

May 2006 to May 2009, total amount \$400K

NSF AST-0705062

“Development of a Burst Mode Data Recorder for Radio Astronomy”

PI: A. Whitney co-PI: S.S. Doeleman

June 2007 to June 2010, total amount \$540K

NSF AST-0722168

“Development of a Cooled Sapphire Oscillator Frequency Standard for VLBI”

PI: A. Whitney co-PI: S.S. Doeleman

Aug 2007 to Aug 2011, total amount \$460K

NSF AST-0807843

“Techniques of Submm-VLBI: Observing an Event Horizon”

PI: S.S. Doeleman co-PI: A. Rogers

June 2008 to June 2011, total amount \$335K

NSF AST-0905844

“High Sensitivity VLBI Arrays: Towards Imaging an Event Horizon”

PI: S.S. Doeleman co-PI: A. Rogers, A. Whitney

Aug 2009 to July 2013, total amount \$2.7M

NSF AST-0908731

“Ultra Wideband VLBI: Origins of Extragalactic Jets”

PI: S.S. Doeleman

July 2009 to July 2012, total amount \$363K

NSF OIA-0922984

“MRI: Acquisition of a Stable Hydrogen Maser Frequency Standard for mm/submm VLBI Observations of a Black Hole Event Horizon”

PI: S.S. Doeleman

Sept 2009 to Sept 2012, total amount \$288K (plus \$123K international cost-sharing)

MIT International Science & Technology Initiatives (MISTI) Grant

“Phasing the Atacama Large Telescope Array for Observing a Black Hole Event Horizon”

PI: S.S. Doeleman

Jan 2012 – March 2015, total amount \$30K

Smithsonian Astrophysical Observatory

“Chandra HETG Ultra-deep Gratings Spectroscopy of SgrA* (CHUGSS)”

PI: F. Baganoff (MIT) co-PI: (multiple, including S.S. Doeleman)

Jan 2012 to Jan 2015, total amount \$4K

NSF OIA-1126433

“MRI: Development of an ALMA Beamformer for Ultra High Resolution VLBI and High Frequency Phased Array Science”

PI: S.S. Doeleman co-PI: A. Whitney

Aug 2011 to Aug 2015, total amount \$2.76M (plus \$1.3M international cost-sharing)

NSF AST-1207704

“Collaborative Research: Building an Event Horizon Telescope: (Sub)millimeter VLBI from the South Pole Telescope”

PI: S.S. Doeleman

July 2012 to July 2015, total amount \$191K

NSF AST-1211539

“Spatially Resolving the Black Hole Event Horizon: (sub)mm VLBI of SgrA* and M87”

PI: S.S. Doeleman co-PI: V. Fish

July 2012 to July 2015, total amount \$382K

NRAO ALMA Development Program

“ALMA Phasing Project Augmentation”

PI: S.S. Doeleman

Feb 2013 to Aug 2015, total amount \$260K

Gordon & Betty Moore Foundation: GBMF-3561

“Imaging supermassive black holes with an Earth-sized radio telescope”

PI: S.S. Doeleman co-PI: J. Weintroub

Feb 2013 to Feb 2017, total amount \$1.8M

NSF AST-1310896

“Building the Event Horizon Telescope: Observing Black Holes with Schwarzschild Radius Resolution”

PI: S.S. Doeleman

August 2013 to August 2017, total amount \$2.29M

NSF AST-1337663

“Acquisition of Stable Hydrogen Maser Frequency Standards for Millimeter/Submillimeter VLBI Observations of a Black Hole Event Horizon”

PI: S.S. Doeleman co-PI: J. Weintroub

August 2013 to present, total amount \$411K (plus \$176K institutional cost-sharing from SAO).

MIT International Science & Technology Initiatives (MISTI) Grant

“Imaging Black Holes with the Gran Telescopio Milimetrico”

PI: S.S. Doeleman

Jan 2014 – Jan 2016, total amount \$30K

Smithsonian Institution Competitive Grants Program for Science (CGPS) Grant

“VLBI with the LMT: Bringing Black Holes into Focus”

PI: S.S. Doeleman

Jan 2014 – Jan 2016, total amount \$100K

Smithsonian Institution Competitive Grants Program for Science (CGPS) Grant

“Weighing the neutrino with Radio Frequency Techniques”

PI: S.S. Doeleman

Jan 2015 – Jan 2017, total amount \$60K

NSF AST-1555365

“MRI: Development of an ALMA Beamformer for Ultra High Resolution VLBI and High Frequency Phased Array Science [Extension]”

PI: S.S. Doeleman

Sept 2015 – Sept 2016, total projected amount \$315K

NRAO: ALMA-NA Development Fund

“Digital Correlator and Phased Array Architectures for Upgrading ALMA”

PI: J. Weintraub co-PI's: S. Doeleman, R. Escoffier, A. Baudry, R. Lacasse, B. Carlson

Apr 2016 – Sept 2017, total amount \$148K

NRAO: ALMA-NA Development Fund

“Pulsars, Magnetars, and Transients with Phased ALMA”

PI: J. Cordes co-PI's: S. Doeleman, M. Kramer, S. Ransom

Feb 2016 – June 2017, total amount \$185K

NRAO: ALMA-NA Development Fund

“ALMA Study Project: Extensions and Enhancements to the ALMA Phasing System”

PI: L. Matthews co-PI's: S. Doeleman, G. Crew, V. Fish, M. Hecht

Feb 2016 – June 2017, total amount \$200K

John Templeton Foundation (Grant #60477)

“The Black Hole Initiative: Towards a Center for Interdisciplinary Research”

PI: S. Doeleman co-I's: A. Loeb, R. Narayan, A. Strominger, P. Galison, S.T. Yau

Sept 2016 – Sept 2019, total amount \$7.2M

NSF AST – 1716536 (Astronomy & Astrophysics Research Grants)

“Collaborative Research: Connecting 3D Simulations of Magnetized Disks and Jets with Direct Event Horizon Telescope Observations”

PI: S. Doeleman co-PI: M. Johnson

May 2017 – May 2020, total projected amount \$126K

NSF AST- 1440254 & AST-1952099 (Mid-Scale Innovation Program)

“The Event Horizon Telescope Experiment”

PI: S.S. Doeleman co-I's: N. Erickson, V. Fish, D. Marrone, G. Narayanan

Jan 2015 – Jun 2021, total projected amount \$7.8M

(Current Awards)

Gordon & Betty Moore Foundation: GBMF-5278

“Enhancing the Event Horizon Telescope: Sharpening Our Views of Black Holes”

PI: S.S. Doeleman co-PI: J. Weintraub, M. Johnson

Nov 2016 - Jan 2022, total projected amount \$2.0M

NSF AST- 1726637 (Major Research Instrumentation)

“MRI: Development of Next Generation Digital Signal Processing Platforms for Astronomy”

PI: S.S. Doeleman co-PI: J. Weintraub

Aug 2017 – Aug 2021, total projected amount \$1.2M (\$371K SAO cost-sharing included).

NSF AST-1743747 (Partnership for International Research and Education)

“PIRE: Black Hole Astrophysics in the Era of Distributed Resources and Expertise”

PI: D. Psaltis co-PI's: S. Doeleman, D. Marrone, F. Özel, C. Gammie

Aug 2017 – Aug 2022, total projected amount \$5.7M (\$790K sub-award to SAO, PI Doeleman).

NSF AST- 1828513 (Major Research Instrumentation)

“MRI: Development of a Cloud Computing Platform for Interferometric Processing”

PI: S.S. Doeleman co-PI: J. Weintroub

Aug 2018 – Aug 2021, total projected amount \$1.2M (\$363K SAO cost-sharing included).

John Templeton Foundation (Grant #61497)

“The Black Hole Initiative: Phase II”

PI: S. Doeleman co-I’s: A. Loeb, R. Narayan, A. Strominger, P. Galison, S.T. Yau

Sept 2019 – Sept 2022, total projected amount \$3.6M

NSF Mid-Scale Research Infrastructure (MSRI-I)

“Mid-scale RI-1 (M1:DP): Next Generation Event Horizon Telescope Design”

PI: S. Doeleman co-I’s: M. Johnson, L. Blackburn, J. Weintroub

Oct 2019 – Oct 2023, total projected amount \$12.7M

NSF Mid-Scale Innovation Program (MSIP)

“The Event Horizon Telescope: Resolving Black Holes in Time and Space”

PI: V. Fish co-I’s: S. Doeleman, D. Marrone

Oct 2020 – Aug 2024, total requested amount \$11.6M (\$1.9M sub-award to SAO, PI Doeleman).

Gordon & Betty Moore Foundation: GBMF-10423

“Enabling the Next-Generation Event Horizon Telescope: Towards Movies of Black Holes”

PI: S.S. Doeleman co-PI: M. Johnson

Jun 2021 - May 2025, total projected amount \$6.86M

Refereed Journal Publications

1. Kocherlakota, P., et al., “Constraints on black-hole charges with the 2017 EHT observations of M87*,” *PhRvD*, **103**, 104047, (2021). <https://ui.adsabs.harvard.edu/abs/2021PhRvD.103j4047K/abstract>
2. Narayan, R., et al., “The Polarized Image of a Synchrotron-emitting Ring of Gas Orbiting a Black Hole,” *ApJ*, **912**, 35, (2021). <https://iopscience.iop.org/article/10.3847/1538-4357/abf117>
3. EHT MWL Science Working Group, et al., “Broadband Multi-wavelength Properties of M87 during the 2017 Event Horizon Telescope Campaign,” *ApJL*, **911**, 11, (2021). <https://iopscience.iop.org/article/10.3847/2041-8213/abef71>
4. Raymond, A., Palumbo, D., Paine, S., Blackburn, L., Córdova-Rosado, R., Doeleman, S. S., Farah, J. R., Johnson, M. D., Roelofs, F., Tilanus, R. P. J., Weintroub, J., “Evaluation of New Submillimeter VLBI Sites for the Event Horizon Telescope,” *ApJS*, **253**, 5, (2021). <https://ui.adsabs.harvard.edu/abs/2021ApJS..253....5R/abstract>
5. Goddi, C, et al., “Polarimetric Properties of Event Horizon Telescope Targets from ALMA,” *ApJL*, **910**, 14, (2021). <https://iopscience.iop.org/article/10.3847/2041-8213/abee6a>
6. Event Horizon Telescope Collaboration et al., “First M87 Event Horizon Telescope Results. VIII. Magnetic Field Structure near The Event Horizon,” *ApJL*, **910**, 13, (2021). https://iopscience.iop.org/journal/2041-8205/page/Focus_on_EHT
7. Event Horizon Telescope Collaboration et al., “First M87 Event Horizon Telescope Results. VII. Polarization of the Ring,” *ApJL*, **910**, 12, (2021). https://iopscience.iop.org/journal/2041-8205/page/Focus_on_EHT
8. Wielgus, M., Akiyama, K., Blackburn, L., Chan, C.-K., Dexter, J., Doeleman, S., et al. "Monitoring the Morphology of M87* in 2009-2017 with the Event Horizon Telescope," *ApJ*, **901**, 67, (2020).
9. Kim, J-Y., Krichbaum, T. P., Broderick, A. E., et al. "Event Horizon Telescope imaging of the archetypal blazar 3C 279 at an extreme 20 microarcsecond resolution," *A&A*, **640**, A69, (2020).

10. Gold, R., Broderick, A. E., Younsi, Z., et al. "Verification of Radiative Transfer Schemes for the EHT," *ApJ*, **897**, 148, (2020).
11. Broderick, A. E., Gold, R., Karami, M., et al. "THEMIS: A Parameter Estimation Framework for the Event Horizon Telescope," *ApJ*, **897**, 139, (2020).
12. Blackburn, L., Pesce, D. W., Johnson, M. D., Wielgus, M., Chael, A. A., Christian, P., & Doeleman, S. S., "Closure Statistics in Interferometric Data," *ApJ*, **894**, 31, (2020).
13. Roelofs, F., Janssen, M., Natarajan, I., et al. "SYMBA: An end-to-end VLBI synthetic data generation pipeline. Simulating Event Horizon Telescope observations of M 87," *A&A*, **636**, A5, (2020).
14. Johnson, M. D., Lupsasca, A., Strominger, A., et al. "Universal interferometric signatures of a black hole's photon ring," *Science Advances*, **6**, eaaz1310, (2020).
15. Doeleman, S., Blackburn, L., et al., "Studying Black Holes on Horizon Scales with VLBI Ground Arrays," *BAAS*, **51**, 256, (2019). <https://ui.adsabs.harvard.edu/abs/2019BAAS...51g.256D/abstract>
16. Johnson, M. et al., "Studying black holes on horizon scales with space-VLBI," *BAAS*, **51**, 235, (2019). <https://ui.adsabs.harvard.edu/abs/2019BAAS...51g.235J/abstract>
17. Liu, K. et al., "Detection of Pulses from the Vela Pulsar at Millimeter Wavelengths with Phased ALMA," *ApJL*, **885**, 10, (2019).
18. Gill, A., Blackburn, L., Roshanineshat, A., Chan, C-K., Doeleman, S., Johnson, M., Raymond, A. & Weintraub, J., "Prospects for Wideband VLBI Correlation in the Cloud," *PASP*, **131**, 124501, (2019).
19. Palumbo, D., Doeleman, S., Johnson, M., Bouman, K. & Chael, A., "Metrics and Motivations for Earth-Space VLBI: Time-Resolving SgrA* with the Event Horizon Telescope," *ApJ*, **881**, 62, (2019). <https://arxiv.org/pdf/1906.08828.pdf>
20. Blackburn, L. et al., "EHT-HOPS pipeline for millimeter VLBI data reduction," *ApJ*, **882**, 23, (2019). <https://arxiv.org/abs/1903.08832>
21. Doeleman, S. et al., "Black Hole Physics on Horizon Scales," *BAAS*, **51**, 537, (2019). https://baas.aas.org/wp-content/uploads/2019/05/537_doeleman.pdf
22. Event Horizon Telescope Collaboration et al., "First M87 Event Horizon Telescope Results. VI. The Shadow and Mass of the Central Black Hole," *ApJL*, **875**, 6, (2019).
23. Event Horizon Telescope Collaboration et al., "First M87 Event Horizon Telescope Results. V. Physical Origin of the Asymmetric Ring," *ApJL*, **875**, 5, (2019).
24. Event Horizon Telescope Collaboration et al., "First M87 Event Horizon Telescope Results. IV. Imaging the Central Supermassive Black Hole," *ApJL*, **875**, 4, (2019).
25. Event Horizon Telescope Collaboration et al., "First M87 Event Horizon Telescope Results. III. Data Processing and Calibration," *ApJL*, **875**, 3, (2019).
26. Event Horizon Telescope Collaboration et al., "First M87 Event Horizon Telescope Results. II. Array and Instrumentation," *ApJL*, **875**, 2, (2019).
27. Event Horizon Telescope Collaboration et al., "First M87 Event Horizon Telescope Results. I. The Shadow of the Supermassive Black Hole," *ApJL*, **875**, 1, (2019).
28. Doeleman, S. et al., "Focus on the First Event Horizon Telescope Results," *ApJL Focus Issue*, https://iopscience.iop.org/journal/2041-8205/page/Focus_on_EHT
29. Issaoun, S. et al., "The Size, Shape and Scattering of Sagittarius A* at 86GHz: First VLBI with ALMA," *ApJ*, **871**, 30, (2019). <https://arxiv.org/abs/1901.06226>
30. Brinkerink, C. et al, "Micro-arcsecond structure of Sagittarius A* revealed by high-sensitivity 86GHz VLBI observations," *A&A*, **621**, A119, (2019). <https://arxiv.org/abs/1811.08394>
31. Bower, G. et al, "ALMA Polarimetry of SgrA*: Probing the Accretion Flow from the Event Horizon to the Bondi Radius," *ApJ*, **868**, 101, (2018). <https://arxiv.org/abs/1810.07317>

32. Kim, J. et al, "A VLBI receiving system for the South Pole Telescope," *Proc. SPIE*, **10708**, 19, (2018). DOI: [10.1117/12.2301005](https://doi.org/10.1117/12.2301005)
33. Kubo, D. et al, "Electronics instrumentation for the Greenland Telescope," *Proc. SPIE*, **10708**, 19, (2018). DOI: [10.1117/12.2312241](https://doi.org/10.1117/12.2312241)
34. Nishioka, H. et al, "Control and monitoring system for the Greenland Telescope: computers, network and software," *Proc. SPIE*, **10700**, 11, (2018). DOI: [10.1117/12.2313104](https://doi.org/10.1117/12.2313104)
35. Matsushita, S. et al, "Commissioning status of the Greenland Telescope (GLT)," *Proc. SPIE*, **10700**, 10, (2018). DOI: [10.1117/12.2310046](https://doi.org/10.1117/12.2310046)
36. Chen, M-T. et al, "The Greenland telescope: Thule operations," *Proc. SPIE*, **10700**, 12, (2018). DOI: [10.1117/12.2313378](https://doi.org/10.1117/12.2313378)
37. Kim, J. et al, "The 1.4mm Core of Centaurus A: First VLBI Results with the South Pole Telescope," *ApJ*, **861**, 129, (2018). <https://arxiv.org/abs/1805.09344>
38. Lu, R-S., Krichbaum, T., Roy, A., Fish, V., Doeleman, S. et al, "Detection of Intrinsic Source Structure at ~ 3 Schwarzschild Radii with Millimeter-VLBI Observations of Sagittarius A*," *ApJ*, **859**, 60, (2018). <https://arxiv.org/abs/1805.09223>
39. Matthews, L., Crew, G., Doeleman, S. et al, "The ALMA Phasing System: A Beamforming Capability for Ultra-high-resolution Science at (Sub)Millimeter Wavelengths," *PASP*, **130**, 015002, (2018). <https://arxiv.org/abs/1711.06770>
40. Bouman, K. et al, "Reconstructing Video from Interferometric Measurements of Time-Varying Sources," in *IEEE Transactions on Computational Imaging*, **4**, 512, (2018). <https://arxiv.org/abs/1711.01357>
41. Johnson, M. et al, "Dynamical Imaging with Interferometry," *ApJ*, **850**, 172, (2017). <https://arxiv.org/abs/1711.01286>
42. Doeleman, S., "Seeing the Unseeable," *NatAs*, **1**, 646, (2017). <https://arxiv.org/abs/1710.03104>
43. Roelofs, F., Johnson, M., Shiokawa, H., Doeleman, S. & Falcke, H., "Quantifying Intrinsic Variability of Sagittarius A* Using Closure Phase Measurements of the Event Horizon Telescope," *ApJ*, **847**, 55, (2017). <https://arxiv.org/abs/1708.01056>
44. Shiokawa, H., Gammie, C. & Doeleman, S., "Time Domain Filtering of Resolved Images of SgrA*," *ApJ*, **846**, 29, (2017). <https://arxiv.org/abs/1708.02577>
45. Akiyama, K. et al, "Superresolution Full-polarimetric Imaging for Radio Interferometry with Sparse Modeling," *AJ*, **153**, 159, (2017). <https://arxiv.org/abs/1702.00424>
46. Akiyama, K. et al, "Imaging the Schwarzschild-radius-scale Structure of M87 with the Event Horizon Telescope Using Sparse Modeling," *ApJ*, **838**, 1, (2017). <https://arxiv.org/abs/1702.07361>
47. Gold, R., McKinney, J., Johnson, M.D. & Doeleman, S.S., "Probing the magnetic field structure in Sgr A* on Black Hole Horizon Scales with Polarized Radiative Transfer Simulations," *ApJ*, **837**, 180, (2017). <http://arxiv.org/abs/1601.05550>
48. Brinkerink, C. et al, "Asymmetric structure in SgrA* at 3mm from closure phase measurements with VLBA, GBT and LMT," *MNRAS*, **462**, 1382, (2016). <https://arxiv.org/abs/1608.06515>
49. Fish, V. et al, "Observing – and Imaging – Active Galactic Nuclei with the Event Horizon Telescope," *Galaxies*, **4**, 54, (2016). <https://arxiv.org/abs/1607.03034>
50. Chael, A., Johnson, M., Narayan, R., Doeleman, S., Wardle, J. & Bouman, K., "High-resolution Linear Polarimetric Imaging for the Event Horizon Telescope," *ApJ*, **829**, 11, (2016). <https://arxiv.org/abs/1605.06156>
51. Ortiz-Leon, G., Johnson, M.D., Doeleman, S.S., et al, "The Intrinsic Shape of Sagittarius A* at 3.5mm Wavelength," *ApJ*, **824**, 40, (2016). <http://arxiv.org/abs/1601.06571>
52. Johannsen, T., Wang, C., Broderick, A., Doeleman, S., et al, "Testing General Relativity with Accretion-Flow Imaging of SgrA*," *PhRvL*, **116**, 091101, (2016).

53. Bouman, K.L., Johnson, M.D., Zoran, D., Fish, V.L., Doeleman, S.S. & Freeman, W.T., “Computational Imaging for VLBI Image Reconstruction,” *The IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, p. 913-922, (2016). <http://arxiv.org/abs/1512.01413>
54. Broderick, A.E., Fish, V.L., Johnson, M., Rosenfeld, K., Wang, C., Doeleman, S.S., et al, “Modeling Seven Years of Event Horizon Telescope Observations with Radiatively Inefficient Accretion Flow Models,” *ApJ*, **820**, 137, (2016).
55. Fish, V.L., Johnson, M.J., Doeleman, S.S., et al, “Persistent Asymmetric Structure of Sagittarius A* on Event Horizon Scales,” *ApJ*, **820**, 90, (2016).
56. Lu, R., Roelofs, F., Fish, V., Shiokawa, H., Doeleman, S.S., et al, “Imaging an Event Horizon: Mitigation of Source Variability of Sagittarius A*,” *ApJ*, **817**, 173, (2016).
57. Johannsen, T., Broderick, A.E., Plewa, P.M., Chatzopoulos, S., Doeleman, S.S., et al, “Testing general relativity with the shadow size of SgrA*,” *Phys Rev. Lett.*, **116**, 031101, (2016).
58. Vertatschitsch, L., et al, “R2DBE: A Wideband Digital Backend for the Event Horizon Telescope,” *PASP*, **127**, 1226, (2015).
59. Johnson, M., Fish, V., Doeleman, S., et al, “Resolved Magnetic-Field Structure and Variability Near the Event Horizon of Sagittarius A*,” *Science*, **350**, 1242, (2015).
60. Johnson, M., Loeb, A., Shiokawa, H., Chael, A. & Doeleman, S.S., “Measuring the Direction and Angular Velocity of a Black Hole Accretion Disk via Lagged Interferometric Covariance,” *ApJ*, **813**, 132, (2015).
61. Wagner, J., et al “First 230 GHz VLBI Fringes on 3C 279 using the APEX Telescope,” *A&A*, **581**, 32, (2015).
62. Akiyama, K., Ru-Sen, L., Fish, V., Doeleman, S.S., et al, “230 GHz VLBI observations of M87: event-horizon-scale structure at the enhanced very-high-energy gamma-ray state in 2012,” *ApJ*, **807**, 150, (2015).
63. Broderick, A., Narayan, R., Kormendy, J., Perlman, E., Rieke, M. & Doeleman, S.S., “The Event Horizon of M87,” *ApJ*, **805**, 179, (2015).
64. Bower, G.C., et al “The Proper Motion of the Galactic Center Pulsar Relative to Sagittarius A*,” *ApJ*, **798**, 120, (2015).
65. Psaltis, D., Narayan, R., Fish, V.L., Broderick, A., Loeb, A. & Doeleman, S.S., “Event Horizon Telescope Evidence for Alignment of the Black Hole in the Center of the Milky Way with the Inner Stellar Disk,” *ApJ*, **798**, 15, (2015).
66. Plambeck, R., Bower, G.C., Rao, R., Marrone, D., Jorstad, S.G., Marcher, A., Doeleman, S.S., Fish, V.L. & Johnson, M.D., “Probing the Parsec-scale Accretion Flow of 3C 84 with Millimeter Wavelength Polarimetry,” *ApJ*, **797**, 66, (2014).
67. Inoue, M. et al, “Greenland telescope project: Direct confirmation of black hole with sub-millimeter VLBI,” *Radio Science*, **49**, 564, (2014). <https://arxiv.org/abs/1407.2450>
68. Fish, V.L., Johnson, M.D., Lu, R.-S., Doeleman, S.S., Bouman, K., Zoran, D., Freeman, W., Psaltis, D., Narayan, R., Pankratius, V., Broderick, A., Gwinn, C. & Vertatschitsch, L., “Imaging an Event Horizon: Mitigation of Scattering toward Sagittarius A*,” *ApJ*, **795**, 134, (2014).
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