Rohan Dahale

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Research Interests

I am interested on understanding black hole accretion, spin and perform tests of General Relativity through direct imaging/modeling of supermassive black holes. I am also keen to understand how relativistic jets are launched and how the accretion disk connects to the relativistic jets. To understand these problems, I am interested in developing and using tools that use machine learning and Bayesian inference, reconstruct images, videos and velocity profiles through radio interferometric observations.

Previous and current work: 1) Led the work on Bayesian imaging algorithm `Comrade.jl` in the EHTC paper on imaging of the black hole shadow of M87. 2) Submitted a first-author paper on measuring M87*'s ring ellipticity which provides insights into its turbulent accretion flow. 3) Leading a paper on validating and evaluating the first video reconstructions of the black hole SgrA*. 4) Leading a paper on Bayesian full Stokes geometric snapshot modeling of the dynamics of SgrA*.

Education

Instituto de Astrofísica de Andalucía (IAA-CSIC) Sep 2022–Aug 2025 (expected)
Doctoral Programme in Physics and Space Sciences *Granada, Spain*
PhD Thesis: Bayesian Imaging of Supermassive Black Holes with the Event Horizon Telescope
Supervisor: Dr. José L. Gómez

Indian Institute of Science Education and Research Kolkata 1 Aug 2017–14 Jul 2022
Bachelor and Master of Science in Physical Sciences *GPA: 9.52/10.0*
MS Thesis: Magnetic Fields of Relativistic Jets of Supermassive Black Holes
Supervisor: Dr. José L. Gómez

Experience

PhD Candidate, Instituto de Astrofísica de Andalucía (IAA-CSIC) Sep 2022–Aug 2025
Granada, Spain
- Supervisor: Dr. José L. Gómez
- "la Caixa" Doctoral Fellow
- Event Horizon Telescope Collaboration Member
- Thesis on "Bayesian Imaging of Supermassive Black Holes with the Event Horizon Telescope"

Visiting Scholar Jul–Aug 2024
Black Hole Initiative, Harvard University (Supervisor: Dr. Paul Tiede) *Cambridge, USA*
MIT Haystack Observatory (Supervisor: Dr. Kazu Akiyama) *Westford, USA*
- Project: Time and frequency resolved Bayesian imaging with `Comrade.jl`
- Added auto-differentiable NFFT for images at different times and/or frequency
- Optimized the code for time ($\mathcal{O}(N)$ but can be parallelized) and memory allocations
- Added unit tests for the new code and had a code review
- Working on adding a spatio-temporal Gaussian Random Field (GRF) prior
- GRF will be a solution of a stochastic PDE which outputs video and the velocity profile

Research Intern, University of California, Santa Barbara May–Jul 2019
Santa Barbara, USA
- Supervisors: Dr. Emilia Järvelä, Prof. Robert Antonucci
- Extended Radio Emission in Narrow-line Seyfert 1 Galaxies with JVLA
- QSO PG 1630+377 Lyman Edge Polarisation using Hubble

Selected Publications

[1] **R. Dahale** and the Event Horizon Telescope Collaboration, "Measuring the ring the ellipticity of M87* using 2018 Event Horizon Telescope Data," *Astronomy & Astrophysics (submited)*, 2024.

[2] **R. Dahale** and the Event Horizon Telescope Collaboration, "Validation and evaluation of the first video reconstructions of the black hole SgrA* with the Event Horizon Telescope," *(in prep)*, 2024.

[3] **R. Dahale** and the Event Horizon Telescope Collaboration, "Bayesian full Stokes geometric snapshot modeling of the black hole SgrA* with the Event Horizon Telescope," *(in prep)*, 2024.

[4] Event Horizon Telescope Collaboration, **(including R. Dahale)**, K. Akiyama, *et al.*, "The persistent shadow of the supermassive black hole of M 87. I. Observations, calibration, imaging, and analysis," *Astronomy & Astrophysics*, vol. 681, A79, Jan. 2024. DOI: 10.1051/0004-6361/202347932.

[5] E. Järvelä, **R. Dahale**, L. Crepaldi, *et al.*, "Unravelling the origin of extended radio emission in narrow-line Seyfert 1 galaxies with the JVLA,", vol. 658, A12, A12, Feb. 2022. DOI: 10.1051/0004-6361/202141698.

Other Publications

[1] A. W. Raymond, Event Horizon Telescope Collaboration, **(including R. Dahale)**, *et al.*, "First Very Long Baseline Interferometry Detections at 870 μm,", vol. 168, no. 3, 130, p. 130, Sep. 2024. DOI: 10.3847/1538-3881/ad5bdb.

[2] Event Horizon Telescope Collaboration, **(including R. Dahale)**, K. Akiyama, *et al.*, "First Sagittarius A* Event Horizon Telescope Results. VIII. Physical Interpretation of the Polarized Ring,", vol. 964, no. 2, L26, p. L26, Apr. 2024. DOI: 10.3847/2041-8213/ad2df1.

[3] Event Horizon Telescope Collaboration, **(including R. Dahale)**, K. Akiyama, *et al.*, "First Sagittarius A* Event Horizon Telescope Results. VII. Polarization of the Ring,", vol. 964, no. 2, L25, p. L25, Apr. 2024. DOI: 10.3847/2041-8213/ad2df0.

[4] G. F. Paraschos, Event Horizon Telescope Collaboration, **(including R. Dahale)**, *et al.*, "Ordered magnetic fields around the 3C 84 central black hole,", vol. 682, L3, p. L3, Feb. 2024. DOI: 10.1051/0004-6361/202348308.

[5] E. Traianou, T. P. Krichbaum, **(including R. Dahale)**, *et al.*, "Lost in the curve: Investigating the disappearing knots in blazar 3C 454.3,", vol. 682, A154, A154, Feb. 2024. DOI: 10.1051/0004-6361/202347267.

[6] P. Torne, Event Horizon Telescope Collaboration, **(including R. Dahale)**, *et al.*, "A Search for Pulsars around Sgr A* in the First Event Horizon Telescope Data Set,", vol. 959, no. 1, 14, p. 14, Dec. 2023. DOI: 10.3847/1538-4357/acf4f2.

[7] A. Fuentes, J. L. Gómez, **(including R. Dahale)**, *et al.*, "Filamentary structures as the origin of blazar jet radio variability," *Nature Astronomy*, vol. 7, pp. 1359–1367, Nov. 2023. DOI: 10.1038/s41550-023-02105-7.

[8] F. Roelofs, Event Horizon Telescope Collaboration, **(including R. Dahale)**, *et al.*, "Polarimetric Geometric Modeling for mm-VLBI Observations of Black Holes,", vol. 957, no. 2, L21, p. L21, Nov. 2023. DOI: 10.3847/2041-8213/acff6f.

[9] Event Horizon Telescope Collaboration, **(including R. Dahale)**, K. Akiyama, *et al.*, "First M87 Event Horizon Telescope Results. IX. Detection of Near-horizon Circular Polarization,", vol. 957, no. 2, L20, p. L20, Nov. 2023. DOI: 10.3847/2041-8213/acff70.

[10] G.-Y. Zhao, J. L. Gómez, **(including R. Dahale)**, *et al.*, "Unraveling the Innermost Jet Structure of OJ 287 with the First GMVA + ALMA Observations,", vol. 932, no. 1, 72, p. 72, Jun. 2022. DOI: 10.3847/1538-4357/ac6b9c.

Honors and Awards

"la Caixa" Doctoral INPhINIT Fellowship Sep 2022 - Aug 2025

Fundación "la Caixa" - Instituto de Astrofísica de Andalucía (IAA-CSIC)

- 35 fellowships (from $\sim$ 1000 candidates) are awarded to pursue PhD studies in research centres accredited with the Spanish Seal of Excellence Severo Ochoa in STEM disciplines
- Duration: 3 years and Total grant: €122,592

JAE Intro 2021 Scholarship Oct 2021 - Jun 2022

Consejo Superior de Investigaciones Científicas (CSIC), Spain

- 250 scholarships (from $\sim$ 3000 candidates) offered to undergraduate students
- Total grant: €3,000 for five months. Used for the Master Thesis at IAA-CSIC
- Extension of 4 months with €2,400 is awarded to top 100 beneficiaries

INSPIRE Scholarship Aug 2017 - Jul 2022

Department of Science and Technology (DST), India

- Offered to top 1% students in 12th grade exams, undertaking Bachelor and Masters level education in the Natural Sciences. The scholarship amounts to 400,000 INR ($\sim$ €4,500) for 5 years

Invited & Contributed Talks

Invited Talks

[1] Full Stokes Radio Interferometric Imaging and Instrument Modeling with `Comrade.jl` — 1-2 Oct 2024
European Radio Interferometry School 2024, Granada, Spain

[2] New EHT Results of the M87* Shadow: Observations, Imaging, and Analysis from Multiple Years — 1 Jul 2024 Presentation
European Astronomical Society Annual Meeting 2024, Padova, Italy

[3] 2018 M87* Ring Ellipticity — 12 Dec 2023
2023 EHT Virtual Collaboration Meeting Presentation

Contributed Talks

[1] Full Stokes Bayesian Modeling and Imaging of VLBI data with `Comrade.jl` — 2 Jul 2024
European Astronomical Society Annual Meeting 2024, Padova, Italy Presentation

[2] Measuring the Ring Ellipticity of M87* using 2018 the EHT data — 24 May 2024
EHT Collaboration Meeting Summer 2024, Mexico City, Mexico Presentation

[3] Full Stokes Snapshot Modeling with `Comrade.jl` — 27 Feb 2024
SgrA Dynamics Workshop, Granada, Spain* Presentation

[4] Measuring the Ring Ellipticity of M87* using 2018 the EHT data — 27 Jun 2023
EHT Collaboration Meeting 2023 Summer, Taichung, Taiwan Presentation

[5] A Bayesian Approach to Imaging Supermassive Black Holes and Relativistic Jets — 17 May 2023
Doctoral Conferences (Jornadas de Doctorado), IAA-CSIC Presentation

[6] Accelerating Bayesian Imaging with `Comrade.jl` — 15 Dec 2022
2022 EHT Winter (Virtual) Collaboration Meeting Presentation

[7] Accelerating Bayesian Imaging with `Comrade.jl` — 26 Oct 2022
Resolve Workshop 2022, MPIfR, Bonn, Germany Presentation

Accepted Proposals & Observations

2023.1.01244.V: The Multi-frequency Horizon-scale View of M87 Apr 2024

Led the Event Horizon Telescope ALMA Cycle 10 Proposal

Observed at the IRAM-30m Telescope for the 2024 EHT Observation Campaign

Outreach

Official Press Release of the EHT for the 2018 M87* Paper I 18 Jan 2024
M87 One Year Later: Proof of a persistent black hole shadow*

Official Press Release of IAA-CSIC for the 2018 M87* Paper I 18 Jan 2024
English version: M87 One Year Later: Proof of a persistent black hole shadow*

Managing Social Media and Website of VLBI Group at IAA-CSIC May 2022 - present
X.com, Instagram, Threads, Website

Teaching

Spring 2021: PH1201: Electricity and Magnetism Apr - Jul 2021
Level: First Year BS-MS, IISER Kolkata

Autumn 2020: PH1101: Mechanics I Dec 2020 - Mar 2021
Level: First Year BS-MS, IISER Kolkata

Autumn 2020: PH3103: Mathematical Methods for Physics Aug - Dec 2020
Level: Third Year BS-MS, IISER Kolkata

Skills

Imaging: `Comrade.jl`, `eht-imaging`
Programming: Julia, Python, Git, Bash
Languages: English (native), Hindi (native), Marathi (native), Spanish (A2)

References

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Last updated: November 5, 2024