Dr. Sachin Vaidya

Postdoctoral Associate, MIT

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Education

Pennsylvania State University *2017 – 2023*
Ph.D., Physics

- Thesis: Topological photonic crystals in one, two, and three dimensions

University of Hyderabad *2012 – 2017*
M.Sc., Physics (Integrated Bachelors+Masters program)

- Thesis: A stochastic approach to simulating the complex modulus of viscoelastic fluids
- Specialization: Quantum optics and photonics

Academic Experience

Massachusetts Institute of Technology *2023 – present*
Postdoctoral Associate

- Affiliations: Department of Physics and Research Laboratory of Electronics (RLE)
- Research interests:
  - AI and robotics
  - Nanophotonics
  - Topological matter
- Advisor: Prof. Marin Soljačić

NSF AI Institute for Artificial Intelligence and Fundamental Interactions *2023 – present*
IAIFI Junior Investigator

Pennsylvania State University *2019 – 2023*
Graduate Research Assistant

- Research interests:
  - Topological photonics
  - Photonic crystals
  - Bound states in the continuum
- Advisor: Prof. Mikael C. Rechtsman
- Thesis committee: Prof. Chao-xing Liu, Prof. Eric Hudson, Prof. Chris Giebink

Pennsylvania State University *2017 – 2019*
Graduate Teaching Assistant

- Teaching assistant for five undergraduate physics courses over four semesters
- Received the Graduate Teaching Assistant Award for Teaching Excellence in Physics

National Center for Radio Astrophysics, Pune, India *2016*
Visiting Student

- Project: Towards understanding radio mode feedback in galaxy clusters

National Physical Laboratory, New Delhi, India *2015*
Research Fellow

- Project: Designing, modeling, and testing an effusive Ytterbium atomic oven.

Awards, Honors and Fellowships

Awards and Honors

- **David H. Rank Memorial Physics Award, Penn State (2018)**
  Awarded to excellent students based on their academic performance in graduate school.
- **Graduate Teaching Assistant Award, Penn State (2018)**
  Awarded for teaching excellence based on the feedback of hundreds of students.
- **University Medal in Physics, University of Hyderabad (2017)**
  Honor equivalent to summa cum laude.

Fellowships

- **David C. Duncan Graduate Fellowship in Physics, Penn State (2022)**
  Awarded for excellence in research and coursework.
- **Downsbrough Graduate Fellowship in Physics, Penn State (2022 and 2021)**
  Recognizes the accomplishments of outstanding graduate students.
- **Troxell Scholarship in Physics, Penn State (2017)**
  Awarded to exceptional incoming Ph.D. candidates based on their graduate school application.
- **Homer F. Braddock Fellowship, Penn State (2017)**
  Awarded to exceptional incoming Ph.D. candidates based on their graduate school application.
- **CSIR-NET Junior Research Fellowship, All-India rank: 42 (2016)**
  Awarded based on a nationwide competitive exam; Rank indicates top 1% standing.
- **Indian Academy of Sciences Summer Research Fellowship (2015)**
  Awarded to conduct research at a prominent research institution in India over one summer period.

Grants and Funding

Co-wrote multiple funded proposals securing over $1M across DARPA, ONR, AFOSR, NSF, and industry initiatives. Managed strategic aspects for several grants, including review meeting presentations, budgeting, deliverables, and progress reports.

- Co-wrote grant with Prof. Marin Soljačić (and other PIs) titled *"Agentic AI for scientific co-pilots in materials"* – Shell MITEI proposal 2025 (funded, $280k)
- Co-wrote grant with Prof. Marin Soljačić, and Prof. Pulkit Agrawal titled *"Generative AI for Automated Experimental Setup and Alignment in Optics and Beyond"* – MIT Generative AI Impact Consortium (MGAIC) 2025 (funded, $100k)
- Co-wrote grant with Prof. Marin Soljačić titled *"Bridging Statistical Physics and Generative AI: Scaling Laws, Robustness, and Spectral Control"* – MIT Generative AI Impact Consortium (MGAIC) 2025 (funded, $150k)
- Co-wrote grant with Prof. Marin Soljačić and Prof. Riccardo Comin titled *"Enhanced superconductivity via bound-states-in-the-continuum"* – DARPA QUAMELEON 2024 (funded, $150k)
- Co-wrote grant with Prof. Marin Soljačić titled *"Quantum light and nanophotonic scintillation"* – DARPA PhENOM 2024 (funded, $325k)
- Co-wrote grant with Prof. Mikael Rechtsman titled *"Limitations on disorder and leveraging aperiodicity in topological photonics and beyond"* – ONR regular program 2022 (funded, $758k)
- Wrote a white paper with Prof. Marin Soljačić titled *"OptoMate: AI- and Robotics-Driven Automation for Optical Setup Assembly and Alignment"*.
- Managed aspects of ongoing grants in Prof. Marin Soljačić's group (review meeting presentations, progress reports) – ONR MURI on photonic higher order topology and AFOSR MURI on topological plasmas (2023–2025).
- Contributed significantly to several other grants spanning NSF, NIH, DOD, and industry opportunities currently in submission.

Publications

Links

Google Scholar | arXiv | ORCiD (*equal contribution, ■ lead/co-lead, †corresponding author)

In Preparation

Draft available upon request

1. Yichen Li*, **Sachin Vaidya***†, André Grossi Fonseca, Marin Soljačić, *Hinge skin effect in strained Weyl semimetals* (2025)
2. Seou Choi*, **Sachin Vaidya***†, Charles Roques-Carmes, and Marin Soljačić, *Supercollimating photonic crystal scintillators* (2025)
3. Kyle Linn, Jonas Karcher, **Sachin Vaidya**, Christina Jörg, Jaeuk Kim, Paul Steinhardt, Salvatore Torquato, and Mikael C. Rechtsman, *Transparency in a one-dimensional disordered stealthy-hyperuniform photonic medium* (2025)
4. Manxi Shi*, **Sachin Vaidya***†, Ali Ghorashi, Steven G. Johnson, Marin Soljačić, *Three-dimensional confinement of light in photonic crystals without bandgaps* (2025)

Preprints under submission

1. André Grossi Fonseca*, Oriol Mayne i Comas*, **Sachin Vaidya**†, Marin Soljačić, *Refining Heuristic Predictors of Fractional Chern Insulators using Machine Learning* arXiv:2512.01873 (2025)
2. André Grossi Fonseca*, Eric Wang*, **Sachin Vaidya**, Patrick J. Ledwith, Ashvin Vishwanath, Marin Soljačić, *Gradient-based search of quantum phases: discovering unconventional fractional Chern insulators*, arXiv:2509.10438 (2025)
3. Shiekh Zia Uddin*, **Sachin Vaidya***†, Shrish Choudhary, Zhuo Chen, Raafat K. Salib, Luke Huang, Dirk R. Englund, Marin Soljačić, *AI-driven robotics for free-space optics*, arXiv:2505.17985 (2025)
4. Ali Ghorashi*, **Sachin Vaidya***†, Ziming Liu, Charlotte Loh, Thomas Christensen, Max Tegmark, Marin Soljačić, *Interpretable Artificial Intelligence for Topological Photonics*, arXiv:2505.10485 (2025)
5. Jamison Sloan*, **Sachin Vaidya***†, Nicholas Rivera, Marin Soljačić, *Noise immunity in quantum optical systems through non-Hermitian topology*, arXiv:2503.11620 (2025)
6. J. Lukas K. König*, Kang Yang*, André Grossi Fonseca, **Sachin Vaidya**, Marin Soljačić, Emil J. Bergholtz, *Exceptional Topology on Nonorientable Manifolds*, arXiv:2503.04889 (2025)

Peer-Reviewed Publications

1. **Sachin Vaidya***†, André Grossi Fonseca*, Mark R. Hirsbrunner, Taylor L. Hughes, Marin Soljačić, *Quantized electromagnetic-crystalline responses in insulators*, Physical Review Letters (2025) — accepted – Editors' Suggestion
2. Yannick Salamin, Gaojie Yang, Brian Mills, André Grossi Fonseca, Charles Roques-Carmes, Quansan Yang, Justin Beroz, Steven Kooi, Marc de Miguel Comella, Kiran Mak, **Sachin Vaidya**, Daniel Oran, Corban Swain, Yi Sun, Shai Maayani, Jamison Sloan, Amel Amin Elfadil Elawad, Josue Lopez, Edward Boyden, and Marin Soljačić, *Three-Dimensional Nanophotonics with Spatially Modulated Optical Properties*, Light: Science & Applications (2025) — accepted.
3. Ki Young Lee, Stephan Wong, **Sachin Vaidya**, Terry A. Loring, Alexander Cerjan, *Classification of Fragile Topology Enabled by Matrix Homotopy*, Physical Review Research (2025)
4. Sahil Pontula, **Sachin Vaidya**, Charles Roques-Carmes, Shiekh Zia Uddin, Marin Soljačić, Yannick Salamin, *Non-reciprocal frequency conversion in a multimode nonlinear system*, Nature Communications (2025)
5. Ahmet Kemal Demir*, Luca Nessi*, **Sachin Vaidya**, Connor Occhialini, Marin Soljačić, Riccardo Comin, *Tunable Nanophotonic Devices and Cavities based on a 2D Magnet*, Nature Photonics (2025) – Phys.org, MIT News, MRL Newsletter
6. Louis Martin-Monier*, Simo Pajovic*, Muluneh G. Abebe*, Joshua Chen, **Sachin Vaidya**, Seokhwan Min, Seou Choi, Steven E. Kooi, Bjorn Maes, Juejun Hu, Marin Soljačić, Charles Roques-Carmes, *Large-scale self-assembled nanophotonic scintillators for X-ray imaging*, Nature Communications (2025)

7. Seokhwan Min, Seou Choi, Simo Pajovic, **Sachin Vaidya**, Nicholas Rivera, Shanhui Fan, Marin Soljačić, Charles Roques-Carmes, *End-to-end design of multicolor scintillators for enhanced energy resolution in X-ray imaging*, Light: Science & Applications 14, 158 (2025)
8. Ziming Liu, Yixuan Wang, **Sachin Vaidya**, Fabian Ruehle, James Halverson, Marin Soljačić, Thomas Y. Hou, Max Tegmark, *KAN: Kolmogorov-Arnold networks*, ICLR (2025) – Scientific American, Quanta Magazine, MIT Technology Review, IEEE Spectrum
9. Ali Ghorashi, **Sachin Vaidya**, Mikael Rechtsman, Wladimir Benalcazar, Marin Soljačić, Thomas Christensen, *Prevalence of two-dimensional photonic topology*, Phys. Rev. Lett. 133, 056602 (2024)
10. André Grossi Fonseca*, **Sachin Vaidya*†**, Thomas Christensen, Mikael C. Rechtsman, Taylor L. Hughes, Marin Soljačić, *Weyl points on non-orientable manifolds*, Phys. Rev. Lett. 132, 266601 (2024)
11. Maria Barsukova*, Fabien Grisé*, Zeyu Zhang*, **Sachin Vaidya**, Jonathan Guglielmon, Michael I. Weinstein, Li He, Bo Zhen, Randall McEntaffer, Mikael C. Rechtsman, *Direct observation of Landau levels in silicon photonic crystals*, Nature Photonics 18, 580–585 (2024) – Phys.org, News & Views, Penn State News
12. **Sachin Vaidya**†, Mikael C. Rechtsman, Wladimir A. Benalcazar, *Polarization and weak topology in Chern insulators*, Phys. Rev. Lett. 132, 116602 (2024)
13. **Sachin Vaidya*†**, Christina Jörg*, Kyle Linn, Megan Goh, Mikael C. Rechtsman, *Reentrant delocalization transition in one-dimensional photonic quasicrystals*, Phys. Rev. Research 5, 033170 (2023)
14. **Sachin Vaidya**†, Ali Ghorashi, Thomas Christensen, Mikael C. Rechtsman, Wladimir A. Benalcazar, *Topological phases of photonic crystals under crystalline symmetries*, Phys. Rev. B 108, 085116 (2023)
15. Christina Jörg*, **Sachin Vaidya***, Jiho Noh, Alexander Cerjan, Shyam Augustine, Georg von Freymann, Mikael C. Rechtsman, *Observation of quadratic (charge-2) Weyl point splitting in near-infrared photonic crystals*, Laser & Photonics Reviews 16, 2100452 (2022) – Featured on the cover
16. Alexander Cerjan*, Christina Jörg*, **Sachin Vaidya**, Shyam Augustine, Wladimir A. Benalcazar, Chia Wei Hsu, Georg von Freymann, Mikael C. Rechtsman, *Observation of bound states in the continuum embedded in symmetry bandgaps*, Science Advances 7, eabk1117 (2021)
17. Julian Schulz, **Sachin Vaidya**, Christina Jörg, *Topological photonics in 3D micro-printed systems*, APL Photonics 6, 080901 (2021) – Editor's pick
18. **Sachin Vaidya**†, Wladimir A. Benalcazar, Alexander Cerjan, Mikael C. Rechtsman, *Point-defect-localized bound states in the continuum in photonic crystals and structured fibers*, Phys. Rev. Lett. 127, 023605 (2021)
19. **Sachin Vaidya*†**, Jiho Noh*, Alexander Cerjan, Christina Jörg, Georg von Freymann, Mikael C. Rechtsman, *Observation of a charge-2 photonic Weyl point in the infrared*, Phys. Rev. Lett. 125, 253902 (2020) – Editors' Suggestion

Patents

1. *Automated robotic system for the assembly, fine-alignment, and characterization of optical setups*, U.S. provisional patent application No. 63/745,115, MIT (2025)

Service and Outreach

Peer Review

Referee for: Springer Nature (Nature Physics, Nature Communications, Communications Physics), APS (Physical Review Letters, Physical Review X, Physical Review A, Physical Review B, Physical Review Applied, Physical Review Research), AAAS (Science Advances), Optica (Optica, Photonics Research, Optics Express), AIP (APL Photonics, Applied Physics Letters, Journal of Applied Physics), Wiley (Advanced Optical Materials, Laser & Photonics Reviews), Oxford (National Science Review), IOPScience (Journal of Physics: Photonics), ACM (ACM Computing Surveys)

External Review

Reviewer for user proposals submitted to the Center for Integrated Nanotechnologies (CINT) at Sandia National Laboratories (2023–present).

Conference Organization

- MRS Fall Meeting 2026 (*upcoming*) – Session organizer (Topology Beyond Periodicity: From Aperiodic to Interacting Systems) with Dr. Alexander Cerjan, Prof. Terry Loring and Prof. Wladimir Benalcazar
- APS March Meeting 2024 – session chair (Topological Crystalline Insulators: Theory and Experiment)
- CLEO 2024 – session chair (Optoelectronic Nanodevices)

Outreach

- Invited by MIT News and New Scientist magazine to provide expert commentary on a published paper.
- NSF IAIFI Talent Forum Board Member (2025–present)
- MIT Undergraduate Research Opportunities Program (UROP) mentor (2023–present)
- Penn State Research Experience for Undergraduates (REU) mentor (2019-2022)
- NSF MRSEC outreach team member, Penn State (2019–2020)
- Co-founder of the science club "ETHER" (Engaging Talks on Highly Exciting Research) University of Hyderabad (2015–2017)

Teaching and Mentoring

Teaching Assistant

Conducted ten one-hour recitation sessions per week throughout the semester for the following undergraduate courses. Received the Graduate Teaching Assistant Award based on student evaluations.

- Wave Motion and Quantum Mechanics, Penn State, Fall 2018
- Fluids and Thermal Physics, Penn State, Fall 2018
- Mechanics and Intro Physics Laboratory, Penn State, Summer 2018
- Mechanics, Penn State, Spring 2018
- Introductory Physics, Penn State, Fall 2017

Graduate Mentoring

1. Ryan Lopez (MIT Graduate Student, 2025–present), Visual reasoning for optical laboratories using multimodal language models
2. Victoria Zhang (MIT Graduate Student, 2025–present), Anderson localization of quantum noise
3. Joshua Chen (MIT Graduate Student, 2024–present), Focusing phase masks for scintillation
4. Seou Choi (MIT Graduate Student, 2024–present), Super-collimating photonic crystal scintillators
5. Ali Ghorashi (MIT Graduate Student, 2023–present), Interpretable AI for topological photonics
6. André Grossi Fonseca (MIT Graduate Student, 2023–present), Weyl points on non-orientable manifolds
7. Maria Barsukova (Penn State Graduate Student, 2022–2023), Landau levels in photonic crystals
8. Zeyu Zhang (Penn State Graduate Student, 2022–2023), Landau levels in photonic crystals

Undergraduate Mentoring

1. Caio Silva (MIT Undergraduate Research Opportunities Program, Fall 2025–present), Robotics for automated construction of optical cavities
2. Luka Protulipac (Exchange student at MIT, Summer 2025), Benchmarking and comparison of symbolic regression methods
3. Amelie Chan (MIT Undergraduate Research Opportunities Program, Fall 2024–present), Enhancements in surface-roughened scintillators
4. Yichen (Sophie) Li (MIT Undergraduate Research Opportunities Program, Fall 2024–Summer 2025), Non-Hermitian skin effect in strained Weyl semimetals

5. Taohan Lin (MIT Undergraduate Research Opportunities Program, Fall 2024–present), Neural wave functions using Kolmogorov-Arnold Networks
6. Eric Wang (MIT Undergraduate Research Opportunities Program, Fall 2024–Summer 2025), Gradient-based search of quantum phases
7. Luke Huang (MIT Undergraduate Research Opportunities Program, Fall 2024–Spring 2025), AI-driven robotics for free-space optics
8. Oriol Mayne i Comas (Erasmus Intern, Fall 2024–Summer 2025), Refining Heuristic Predictors of Fractional Chern Insulators using Machine Learning
9. Raafat Salib (MIT Undergraduate Research Opportunities Program, Spring 2024–Summer 2025), AI-driven robotics for free-space optics
10. Shrish Choudhary (MIT Undergraduate Research Opportunities Program, Spring 2024–Summer 2025), AI-driven robotics for free-space optics
11. Manxi (Maggie) Shi (MIT Undergraduate Research Opportunities Program, Fall 2023–Summer 2025), Confinement of light in three-dimensions without photonic bandgaps
12. Kyle Linn (Penn State Research Experience for Undergraduates, Summer 2022), Reentrant delocalization transition in 1D photonic quasicrystals
13. Megan Goh (Penn State Research Experience for Undergraduates, Summer 2022), Hofstadter butterfly and chiral edge states in 1D photonic crystals
14. Alison Weiss (Penn State Research Experience for Undergraduates, Summer 2020 and 2021), Searching for near-IR Fermi arcs in a photonic chiral woodpile

Conference Presentations, Seminars, Posters

Invited Talks

- *Title TBD* – Noncommutative Topology and Quantum Materials at University of New Mexico (March 2026), Albuquerque, New Mexico (*upcoming*)
- *Overcoming the experimental bottleneck with AI and robotics* – AMOS Seminar at Lawrence Berkeley National Laboratory (January 2026), Berkeley, California (*upcoming*)
- *Interpretable AI and robotics for photonics* – Emerging Directions in Optical Computing and Information Processing at CUNY (June 2025), Virtual
- *Interpretable AI and robotics for photonics* – Quantum computing for artificial intelligence (QC-AI) Seminar at RPTU Kaiserslautern-Landau (June 2025), Virtual
- *Interpretable AI and robotics for physics and photonics applications* – SPIE Photonics West (January 2025), San Francisco, California
- *Topological treks through non-orientable spaces and noisy landscapes* – Condensed matter physics seminar at Emory University (November 2024), Atlanta, Georgia
- *Frontiers in nanophotonics, quantum optics, and interpretable AI for physics* – CINT colloquium at Sandia National Laboratories (October 2024), Albuquerque, New Mexico

Invited Group Meeting Talks

- *Interpretable AI and robotics for photonics* – University of Maryland (May 2025), College Park, Maryland (Host: Prof. Mohammad Hafezi)
- *Interpretable AI and robotics for physics* – UCLA (March 2025), LA, California (Host: Prof. Di Luo)
- *Emerging paradigms in nanophotonics* – University of California, Berkeley (October 2024), Berkeley, California (Hosts: Prof. Boubacar Kante and Prof. Eli Yablonovitch)
- *Advances in topological insulators and semimetals* – Stanford University (June 2024), Stanford, California (Host: Prof. Shanhui Fan)
- *Weyl points in photonic crystals* – virtual (December 2022) (Host: Prof. Adolfo Grushin)
- *Topological photonic crystals in one, two and three dimensions* – MIT (October 2022), Cambridge, Massachusetts (Host: Prof. Marin Soljačić)

Contributed Conference Talks

- *Supercollimating photonic crystal scintillators* – SPIE Photonics West (January 2026), San Francisco, California (*upcoming*)
- *AI-driven robotics for physics* – NSF IAIFI Summer Workshop at Harvard University (2025), Cambridge, Massachusetts
- *Volumetrically-patterned nanophotonic scintillators* – CLEO (2025), Long Beach, California
- *Unidirectional flow of quantum noise through non-reciprocity* – APS Global Summit (2025), Anaheim, California
- *Weyl points on non-orientable manifolds* – MRS Fall Meeting (2024), Boston, Massachusetts
- *Photonic Weyl points on non-orientable Brillouin zones* – CLEO (2024), Charlotte, North Carolina
- *Localization and reentrant delocalization transitions in one-dimensional photonic quasicrystals* – APS March Meeting (2024), Minneapolis, Minnesota
- *Polarization-induced topological edge and corner states in Chern photonic crystals* – CLEO (2023), San Jose, California
- *Photonic Chern and Weyl systems in multilayer structures via dimensional extension* – CLEO (2023), San Jose, California
- *Polarization and corner charge in Chern insulators* – APS March Meeting (2023), Las Vegas, Nevada
- *Point-defect localized photonic bound states in the continuum* – DAMOP (2021), Virtual Conference
- *Observation of charge-2 photonic Weyl point* – CLEO (2020), Virtual Conference

Grant Review Presentations

- *New developments in topological matter and photonics* – ONR MURI Review (2025), University of Maryland, College Park, Maryland
- *Robustly controlling quantum noise & development of nanophotonic scintillators* – DARPA PhENOM phase 1 program review (2025), Virtual
- *Non-reciprocal topological control of quantum noise* – DARPA PhENOM quarterly program review (QPR) (2024), Virtual
- *Development of advanced nanophotonic scintillators* – DARPA PhENOM Kickoff Meeting (2024), Virtual
- *Advances in topological band theory* – ONR MURI Review (2024), Philadelphia, Pennsylvania
- *Novel topological phases in photonic crystals* – ONR MURI Review (2023), Los Angeles, California
- *Observation of quadratic Weyl point splitting in 3D micro-printed photonic crystals* – ONR MURI Review (2021), Virtual

Other Talks and Posters

- *Overcoming the experimental bottleneck with AI and robotics* – NSF IAIFI Journal Club at MIT (2026), Cambridge, Massachusetts
- *Volumetric photonic crystal scintillators* (poster) – MRS Fall Meeting (2024), Boston, Massachusetts
- *Topological phases on the real projective plane* (poster) – APS March Meeting (2024), Minneapolis, Minnesota
- *Symmetry-indicator invariants: bridging the gap in topological band theory* – MIT CMT Journal Club (2023), Cambridge, Massachusetts
- *Weyl points in 3D photonic crystals* – Peter Eklund Award Finalist at Penn State (2023)
- *Quantized polarization and fractional corner charge in Chern insulators* – Office of Naval Research (ONR) MURI Seminar (2022), Virtual
- *Weyl points and BICs in 3D micro-printed photonic crystals* – Nanoscribe User Meeting (2021), Virtual
- *Point-defect localized photonic bound states in the continuum* (poster) – Office of Naval Research (ONR) MURI Poster Session (2021), Virtual
- *Towards understanding radio mode feedback in galaxy clusters: catalogue of radio sources and their properties* – Visiting Students' Research program (VSRP) seminar, NCRA-TIFR (2016), Pune, Maharashtra

References

Prof. Marin Soljačić
Cecil and Ida Green Professor of Physics
Massachusetts Institute of Technology
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Prof. Mikael C. Rechtsman
Professor of Physics and Associate Head for Research
Pennsylvania State University
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University of Illinois Urbana-Champaign
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Prof. Riccardo Comin
Associate Professor of Physics
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Prof. Terry Loring
Distinguished Professor of Mathematics and Statistics
University of New Mexico
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