Raphael E. **Hviding**

Postdoctoral Researcher | Max-Planck Institute for Astronomy | He/His

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Research Interests: Active Galactic Nuclei, Data Science, (Slitless) Spectroscopy

Appointments

Max-Planck Institute for Astronomy **Heidelberg, DE**

Postdoctoral Researcher Sep. 2023 - pres.

- *RUBIES Team under Dr. Anna de Graaff*
  - *Stastistical analyses of Little Red Dots with JWST NIRSpec.*
- *Data Science Group under Dr. Ivelina Momcheva*
  - *Slitless Spectroscopic Reduction & Analysis for (Parallel) Extragalactic Surveys*
- *Collaborations: RUBIES, OutThere, 3D-DASH, and Euclid*

Education

University of Arizona **Tucson, AZ**

Ph.D., M.Sc. in Astronomy & Astrophysics Aug. 2023, Jan. 2021

- *Seeing Red: The Present and Future of mid-IR AGN Selection with Optical Spectroscopy*
- *Advisors: Professor Kevin N. Hainline & Professor Marcia J. Rieke*

Dartmouth College **Hanover, NH**

B.A. in Physics (High Honors), Mathematics, and Astronomy (Minor) Jun. 2018

- *Senior Honors Thesis under Professor Ryan C. Hickox*

Code Development

unite **Lead Developer**

Unified Numerical Integration Tool for spEctroscopy Python

- *Joint Spectroscopic Fitting with NumPyro and JAX.*
- *Used to jointly fit multiple (NIRSpec) dispersers while accounting for undersampling.*

GELATO **Lead Developer**

Galaxy/AGN Emission Line Analysis TOol Python

- *Optical Spectroscopic Fitting package with a focus on testing for AGN contributions.*
- *In use by the DESI Collaboration, a LEGA-C Collaboration project, Dr. Mar Mezcua's group at Institute of Space Sciences in Spain, and Dr. Kohei Ichikawa's group at Tohoku University.*

Grizli **Contributor**

Grism redshift & line analysis software for space-based slitless spectroscopy Python

- *Contributions specifically to improving performance and accuracy with NIRISS WFSS data.*

Programming: Python, Linux, IRAF, SQL, ADQL, HTML/CSS, git, LaTeX, SLURM

Press

Selected Media Coverage

Feb. 2026 Scientific American, *Weird new object escalates 'black hole star' debate*
Sep. 2025 Max-Planck-Gesellscahft, *Are Black Hole Stars real?*
Feb. 2020 University of Arizona, *On Student Success, This Astronomer Walks the Walk*
Dec. 2017 Dartmouth College, *Studying the Stars in the South African Sky*

Presentations

Invited Talks

Nov. 2025 Tel Aviv University, Astro Seminar — Tel-Aviv, IL
May. 2024 MPIA, Königstuhl Colloquium — Heidelberg, DE
Jun. 2024 Durham University, Special Talk — Durham, UK

Workshops

Feb. 2026 ISSI Team 25-659 — Bern, CH
Jan. 2026 CSI: Sesto — Sexten, IT

Conference Speaking

Apr. 2026 PyCon DE & PyData 2026, Talk — Darmstadt, DE
May. 2025 Crisol 2025, Talk — Toledo, ES
Apr. 2025 PyCon DE & PyData 2025, Talk — Darmstadt, DE
Jan. 2025 Euclid GAEV Meeting, Talk — Tenerife, ES
Jan. 2023 AAS 241, Talk — Seattle, WA
Oct. 2022 SACNAS NDiSTEM 2022, Talk — San Juan, PR
Nov. 2018 Advances with SALT, Talk — Pretoria, SA
Sep. 2022 What drives the growth of black holes?, Poster — Reykjavík, IS
Jun. 2019 IAU Galaxies 2019, Poster — Viana do Castelo, PT
Nov. 2017 Ivy League Undergraduate Research Symposium, Poster — Philadelphia, PA
Aug. 2016 Hidden Monsters, Poster — Hanover, NH
Jun. 2016 Active Galactic Nuclei: What's in a name?, Poster — Garching, DE

Mentoring

MPIA Summer Internship — **Heidelberg, DE**

Summer Intership Co-Mentor — Jun. 2025 - Sep. 2025
– Co-advised a summer intern in their investigation of dwarf galaxies in NIRISS imaging.
Summer Intership Mentor — Jun. 2024 - Sep. 2024
– Advised a summer intern in their investigation of obscured AGN candidate spectra.

NOAO Astronomy Teen Café — **Tucson, AZ**

Graduate Student Guest and Discussion Leader — Oct. 2018 - May. 2022
– Worked with high school students on astronomical coding exercises and college advice.

Project ASTRO — **Tucson, AZ**

Astronomer Collaborator of a School Teacher — Sep. 2018 - May. 2018
– Worked with a primary school teacher to plan astronomical lessons for the classroom.

Workshops

AI Agents Tutorial **Jan. 2026**
– Tutorial on GAI in scientific workflows and integrations with IDEs and MPC servers.

Pixi Tutorial **Jan. 2026**
– Tutorial on cross-platform reproducible (Python) environment management.

HPC Workshop **Mar. 2024, 2025**
– Workshop covering parallelization (threading and multiprocessing), SLURM scripting, containers (Docker/Apptainer), and workflow managers (Snakemake).

Telescope Time

Principal Investigator

NOEMA W25	*Probing Exotic Dust and Gas Obscuration in a High-Redshift, X-Ray Luminous AGN* (10h; Grade A)
LBTO 2024B	*Seeing Double: A Survey of Dual and Lensed AGN at Cosmic Noon* (12h)
LBTO 2024A	*Seeing Double: A Survey of Dual and Lensed AGN at Cosmic Noon (Pilot)* (5h)
SAO 2023A	*Revealing Obscured SMBH Growth: Probing Type II AGN Candidates with MMT Binospec* with MMT Binospec (2 Nights)
SAO 2022B	*Uncovering the True Nature of the Kiloparsec-Scale Ionization in NGC 1068: Past AGN Activity or Shocks?* with MMT MMIRS and Bok BCSpec (1+3 Nights)
SAO 2021A	*MMIRS longslit follow-up of mid-IR AGN candidates with high Balmer Decrements: Obscured optical line emission?* with MMT MMIRS (1.5 Nights)
SAO 2020B	*Uncovering an Undiscovered Population of AGNs: Hectospec Follow-up of HSC-WISE-SDSS Matched Targets* with MMT Hectospec (2 Nights)

Co-Investigator

MPG 2.2m 117	*Cracking the Egg: Precision Variability of a Little Red Dot* (92h)
HST Cycle 34	*Beyond the Quasar Redshift Frontier: Uncovering Rapidly Accreting Supermassive Black Holes at $z > 8$ with HST/WFC3 and Euclid* (SNAP – 125 Orbits)
NOEMA W24	*Extremely compact galaxies at Cosmic Dawn: ultra-massive galaxies or AGN?* (16h; Grade A)

Honors & Awards

Awarded

2022	Departmental Graduate Student Award for Service	UArizona
2018 - 2023	National Science Foundation Graduate Research Fellowship	NSF
2018	College of Science Fellowship	UArizona
2018	International Travel Grant	AAS
2017 - 2018	E. E. Just Scholar	Dartmouth College

Publications

Eleven major contributing author publications: [full list]

(⋆eight as first/corresponding author)

[⋆1] **Raphael E. Hviding** et al., 2026, arXiv, arXiv:2601.09778, *The X-Ray Dot: Exotic Dust or a Late-Stage Little Red Dot?*

[2] Anna de Graaff, **Raphael E. Hviding** et al., 2025, arXiv, arXiv:2511.21820, *Little Red Dots host Black Hole Stars: A unified family of gas-reddened AGN revealed by JWST/NIRSpec spectroscopy*

[⋆3] **Raphael E. Hviding** et al., 2025, A&A, 702, A57, *RUBIES: A spectroscopic census of little red dots: All point sources with v-shaped continua have broad lines*

[⋆4] **Raphael E. Hviding** et al., 2024, AJ, 168, 220, *Improved Empirical Backgrounds for JWST NIRISS Image/Wide-field Slitless Spectroscopy Data Reduction*

[⋆5] **Raphael E. Hviding** et al., 2024, AJ, 167, 169, *Spectroscopic Confirmation of Obscured AGN Populations from Unsupervised Machine Learning*

[⋆6] **Raphael E. Hviding** et al., 2023, AJ, 166, 111, *The Kiloparsec-scale Influence of the AGN in NGC 1068 with SALT RSS Fabry-Pérot Spectroscopy*

[⋆7] **Raphael E. Hviding** et al., 2022, AJ, 163, 224, *A New Infrared Criterion for Selecting Active Galactic Nuclei to Lower Luminosities*

[8] Kevin N. Hainline, **Raphael E. Hviding** et al., 2020, ApJ, 892, 125, *Simulating JWST/NIRCam Color Selection of High-redshift Galaxies*

[9] L. Claire Gasque, Callum A. Hening, **Raphael E. Hviding** et al., 2019, AJ, 158, 156, *Two Long-period Cataclysmic Variable Stars: ASASSN-14ho and V1062 Cyg*

[⋆10] **Raphael E. Hviding** et al., 2018, ApJ, 868, 16, *Spatially Extended Low-ionization Emission Regions (LIERs) at $z \sim 0.9$*

[⋆11] **Raphael E. Hviding** et al., 2018, MNRAS, 474, 1955, *Characterizing the WISE-selected heavily obscured quasar population with optical spectroscopy from the Southern African Large Telescope*

36 total publications, twenty-five as contributing author:

[1] Bingjie Wang, ..., **Raphael E. Hviding** et al., 2026, arXiv, arXiv:2602.06024, *Water absorption confirms cool atmospheres in two little red dots*

[2] Wendy Q. Sun, ..., **Raphael E. Hviding** et al., 2026, arXiv, arXiv:2601.20929, *Little Red Dot − Host Galaxy = Black Hole Star: A Gas-Enshrouded Heart at the Center of Every Little Red Dot*

[3] Jenny E. Greene, ..., **Raphael E. Hviding** et al., 2026, ApJ, 996, 129, *What You See Is What You Get: Empirically Measured Bolometric Luminosities of Little Red Dots*

[4] Rohan P. Naidu, ..., **Raphael E. Hviding** et al., 2026, OJAp, 9, 56033, *A Cosmic Miracle: A Remarkably Luminous Galaxy at zspec = 14.44 Confirmed with JWST*

[5] Rodrigo Córdova Rosado, ..., **Raphael E. Hviding** et al., 2025, ApJ, 995, 227, *Cross-correlation of Luminous Red Galaxies with ML-selected Active Galactic Nuclei in HSC-SSP. II. AGN Classification and Clustering with DESI Spectroscopy*

[6] Anna de Graaff, ..., **Raphael E. Hviding** et al., 2025, A&A, 701, A168, *A remarkable ruby: Absorption in dense gas, rather than evolved stars, drives the extreme Balmer break of a little red dot at $z = 3.5$*

[7] Bingjie Wang, ..., **Raphael E. Hviding** et al., 2025, arXiv, arXiv:2508.18358, *The Missing Hard Photons of Little Red Dots: Their Incident Ionizing Spectra Resemble Massive Stars*

[8] Anna de Graaff, ..., **Raphael E. Hviding** et al., 2025, A&A, 697, A189, *RUBIES: A complete census of the bright and red distant Universe with JWST/NIRSpec*

[9] Olivia R. Cooper, ..., **Raphael E. Hviding** et al., 2025, ApJ, 982, 125, *RUBIES: JWST/NIRSpec Resolves Evolutionary Phases of Dusty Star-forming Galaxies at $z \sim 2$*

[10] Andrea Weibel, ..., **Raphael E. Hviding** et al., 2025, ApJ, 983, 11, *RUBIES Reveals a Massive Quiescent Galaxy at $z = 7.3$*

[11] Ragadeepika Pucha, ..., **Raphael E. Hviding** et al., 2025, ApJ, 982, 10, *Tripling the Census of Dwarf AGN Candidates Using DESI Early Data*

[12] Rohan P. Naidu, ..., **Raphael E. Hviding** et al., 2025, arXiv, arXiv:2503.16596, *A "Black Hole Star" Reveals the Remarkable Gas-Enshrouded Hearts of the Little Red Dots*

[13] Andrew J. Bunker, ..., **Raphael E. Hviding** et al., 2024, A&A, 690, A288, *JADES NIRSpec initial data release for the Hubble Ultra Deep Field: Redshifts and line fluxes of distant galaxies from the deepest JWST Cycle 1 NIRSpec multi-object spectroscopy*

[14] Charity Woodrum, ..., **Raphael E. Hviding** et al., 2024, PNAS, 121, e2317375121, *Using JADES NIRCam photometry to investigate the dependence of stellar mass inferences on the IMF in the early universe*

[15] Charity Woodrum, ..., **Raphael E. Hviding** et al., 2024, ApJ, 974, 305, *Active Galactic Nuclei in the Green Valley at $z \sim 0.7$*

[16] Morgan Fouesneau, ..., **Raphael E. Hviding** et al., 2024, arXiv, arXiv:2409.20252, *What is the Role of Large Language Models in the Evolution of Astronomy Research?*

[17] Kevin N. Hainline, ..., **Raphael E. Hviding** et al., 2024, ApJ, 964, 71, *The Cosmos in Its Infancy: JADES Galaxy Candidates at $z > 8$ in GOODS-S and GOODS-N*

[18] Kevin N. Hainline, ..., **Raphael E. Hviding** et al., 2024, ApJ, 964, 66, *Brown Dwarf Candidates in the JADES and CEERS Extragalactic Surveys*

[19] Jakob M. Helton, ..., **Raphael E. Hviding** et al., 2024, ApJ, 962, 124, *The JWST Advanced Deep Extragalactic Survey: Discovery of an Extreme Galaxy Overdensity at $z = 5.4$ with JWST/NIRCam in GOODS-S*

[20] Marcia J. Rieke, ..., **Raphael E. Hviding** et al., 2023, ApJS, 269, 16, *JADES Initial Data Release for the Hubble Ultra Deep Field: Revealing the Faint Infrared Sky with Deep JWST NIRCam Imaging*

[21] Daniel J. Eisenstein, ..., **Raphael E. Hviding** et al., 2023, arXiv, arXiv:2306.02465, *Overview of the JWST Advanced Deep Extragalactic Survey (JADES)*

[22] Emma Curtis-Lake, ..., **Raphael E. Hviding** et al., 2023, NatAs, 7, 622, *Spectroscopic confirmation of four metal-poor galaxies at $z = 10.3$-13.2*

[23] B. E. Robertson, ..., **Raphael E. Hviding** et al., 2023, NatAs, 7, 611, *Identification and properties of intense star-forming galaxies at redshifts $z > 10$*

[24] Marcia Rieke, ..., **Raphael E. Hviding** et al., 2019, BAAS, 51, 45, *JWST GTO/ERS Deep Surveys*

[25] Wei Yan, ..., **Raphael E. Hviding** et al., 2019, ApJ, 870, 33, *NuSTAR and Keck Observations of Heavily Obscured Quasars Selected by WISE*