

# 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

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### Max-Planck Institute for Astronomy

Heidelberg, DE

Postdoctoral Researcher

Sep. 2023 - pres.

- *RUBIES Team under Dr. Anna de Graaff*
  - *Statistical 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

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### 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

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### 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, L<sup>A</sup>T<sub>E</sub>X, SLURM

## PRESS

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### Selected Media Coverage .....

- Feb. 2026 [Scientific American](#), *Weird new object escalates ‘black hole star’ debate*  
Sep. 2025 [Max-Planck-Gesellschaft](#), *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

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### 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

### Conferences .....

- 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

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### [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

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**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

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**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

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**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

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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] 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*
- [3] Rohan P. Naidu, ..., **Raphael E. Hviding** et al., 2026, OJAp, 9, 56033, *A Cosmic Miracle: A Remarkably Luminous Galaxy at  $z_{\text{spec}} = 14.44$  Confirmed with JWST*
- [4] 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*
- [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] 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*
- [12] Ragadeepika Pucha, ..., **Raphael E. Hviding** et al., 2025, [ApJ](#), 982, 10, *Tripling the Census of Dwarf AGN Candidates Using DESI Early Data*
- [13] Charity Woodrum, ..., **Raphael E. Hviding** et al., 2024, [PNAS](#), 121, e2317375121, *Using JADES NIRCам photometry to investigate the dependence of stellar mass inferences on the IMF in the early universe*
- [14] Charity Woodrum, ..., **Raphael E. Hviding** et al., 2024, [ApJ](#), 974, 305, *Active Galactic Nuclei in the Green Valley at  $z \sim 0.7$*
- [15] 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*
- [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, 66, *Brown Dwarf Candidates in the JADES and CEERS Extragalactic Surveys*
- [18] 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*
- [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/NIRCам 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 NIRCам 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] B. E. Robertson, ..., **Raphael E. Hviding** et al., 2023, [NatAs](#), 7, 611, *Identification and properties of intense star-forming galaxies at redshifts  $z > 10$*
- [23] Emma Curtis-Lake, ..., **Raphael E. Hviding** et al., 2023, [NatAs](#), 7, 622, *Spectroscopic confirmation of four metal-poor galaxies at  $z = 10.3\text{--}13.2$*
- [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*

