

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*
 - *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

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*

MENTORING

MPIA Summer Internship

Heidelberg, DE

Summer Internship Co-Mentor

Jun. 2025 - Sep. 2025

- Co-advised a summer intern in their investigation of dwarf galaxies in NIRISS imaging.

Summer Internship 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.

TEACHING

ASTR 400B: Theoretical Astrophysics: Galaxies and Cosmology

UArizona

Teaching Assistant with Professor Dan Stark

Spring 2021

- Led office hours, graded, and taught a lecture for an advanced undergraduate course.

ASTR 170B: Exploring our Universe

UArizona

Teaching Assistant with Professor Ed Prather

Spring 2023

- Participated in lesson activities and led office hours for a general-education course.

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).

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*

Jan. 2026 [Astrobites](#), *A Potential New Piece of the "Little Red Dot" Puzzle*

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

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

TELESCOPE TIME

Principal Investigator

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

Co-Investigator

MPG 2.2m 117	<i>Cracking the Egg: Precision Variability of a Little Red Dot</i> (92h)
HST Cycle 34	<i>Beyond the Quasar Redshift Frontier: Uncovering Rapidly Accreting Supermassive Black Holes at $z > 8$ with HST/WFC3 and Euclid (SNAP – 125 Orbits)</i>
NOEMA W24	<i>Extremely compact galaxies at Cosmic Dawn: ultra-massive galaxies or AGN?</i> (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] 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] 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*
- [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] Andrea Weibel, ..., **Raphael E. Hviding** et al., 2025, *ApJ*, 983, 11, *RUBIES Reveals a Massive Quiescent Galaxy at $z = 7.3$*
- [10] Olivia R. Cooper, ..., **Raphael E. Hviding** et al., 2025, *ApJ*, 982, 125, *RUBIES: JWST/NIRSpec Resolves Evolutionary Phases of Dusty Star-forming Galaxies at $z \sim 2$*
- [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] 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 $z = 10.3$ -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*