William O. **Balmer**

Photon hunter · Fringe tracker · Exoplaneteer

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Research Interests

Direct detection and characterization of exoplanets; coronagraphy; interferometry; planet formation and dynamics

Appointments

Graduate Research Assistant — *Baltimore, MD*
Space Telescope Science Institute — *Jun. 2021 - present*

Observatory Fellow — *Baltimore, MD*
NASA Maryland Space Grant Consortium — *Sept. 2022 - Jun. 2023*

Undergraduate Research Assistant — *Amherst, MA*
Follette Lab, Amherst College — *Jun. 2018 - Aug. 2021*

Undergraduate Research assistant — *Ithaca, NY*
SIOS Lab, Cornell University — *Jun. 2020 - Aug. 2020*

Teaching Assistant, Grading Assistant, Observatory Operator — *Amherst, MA*
Physics and Astronomy Department, Amherst College — *Sept. 2019 - May. 2021*

Education

Johns Hopkins University — *Baltimore, MD*
Ph.D candidate in Astronomy — *Aug. 2021 - present*

- Thesis Advisors: Laurent Pueyo and David Sing

Baltimore, MD
Masters in Physics — *Aug. 2021 - present*

- Completed Graduate Board Oral (qualifying) exam, achieving candidacy May 2nd, 2023
- Courses: *Stellar Structure and Evolution*, *Exoplanets and their Atmospheres*, *Radiative Astrophysics*, *Interstellar Medium and Astrophysical Fluid Dynamics*, *Exoplanets and Planet Formation*, *Fourier Optics and Interferometry in Astronomy*, *Astrophysical Dynamics*

Amherst College — *Amherst, MA*
B.A. *cum laude* in Astronomy; B.A. *cum laude* in Physics — *Aug. 2017 - May. 2021*

- Honors thesis: *The Orbit and Hα Variability of the Embedded Accreting Protostellar Companion HD 142527B*
  - Advisor: Katherine Follette
  - Unanimously nominated by the Department of Physics and Astronomy for *summa cum laude* honors
- Three time Amherst Memorial Fellowship awardee (2021, 2022, 2023)

Research Advising

Gavin Wang: "A Revised Density for the largest known planet from NEID and TESS" — *Undergraduate*
Johns Hopkins University — *February 2023 - present*

Grants & Awards

$170,704	**James Webb Space Telescope Program GO 3337 (Co-PI)**, NASA	*2024-2025*
$132,841	**Hubble Space Telescope Program GO 17122 (Co-PI)**, NASA	*2023-2024*
$6,000	**NASA WIYN PI Data Award 2023**, NExScI, on behalf of NASA NN-EXPLORE	*2023-2024*
$6,000	**NASA WIYN PI Data Award 2022**, NExScI, on behalf of NASA NN-EXPLORE	*2022-2023*
$18,000	**Owen Scholars Fellowship**, Krieger School of Arts and Sciences, JHU	*2021-2024*
Award	**Amherst Memorial Fellowship (x3)**, Amherst College Board of Trustees	*2021-2023*
Award	**Chambliss Student Poster Award Honorable Mention**, AAS 237th meeting	*2021*
$4,500	**Charles Hamilton Houston Award**, Charles Hamilton Houston Internship Program	*2020*
$3,500	**Gregory S. Call Student Researcher Award**, Gregory S. Call Student Research Program	*2019*
$3,500	**Sarles Fellow Award**, The Sarles Science Fund	*2018*

Observing Programs

* indicates major contribution

4534 **Co-I**	GO 6362 | JWST, *"Breaking the degeneracy: substellar anchors for evolutionary models,"* PI: E. Rickman, et al. **(30.3 hours)**	*Cycle 3*
Co-I	GO 6086 | JWST, *"A First Detailed Exploration of Circumplanetary Disk Gas and Dust with NIRSpec and MIRI/MRS Spectroscopy,"* PI: K. Ward-Duong, et al. **(17.4 hours)**	*Cycle 3*
Co-I	GO 5835 | JWST, *"Into The Spotlight: Unveiling Wide-Separation Sub-Jupiters for Future JWST Characterization,"* PI: A. Carter, et al. **(94.9 hours)**	*Cycle 3*
Co-I	GO 5342 | JWST, *"Spectroscopic characterization of the lowest-mass imaged Jupiter analog,"* PI: J. Xuan, et al. **(13.2 hours)**	*Cycle 3*
Co-I	GO 4758 | JWST, *"From Day to Season: Constraining the Rotation Period and Obliquity of Beta Pic b with Time-resolved High-contrast Imaging,"* PI: Y. Zhou, et al. **(23.9 hours)**	*Cycle 3*
***Co-PI**	DD 4558 | JWST, *"Establishing the Formation of AF Lep b with NIRCam: The Lowest-Mass Imaged Exoplanet with a Dynamical Mass,"* Co-PIs: K. Franson, W. Balmer, et al. **(6.4 hours)**	*Cycle 2*
Co-I	GO 4535 | JWST, *"Follow-up Observations of NIRCam Sources in the Planetary System HR8799,"* PI: C. Beichman, et al. **(4.5 hours)**	*Cycle 3*
Co-I	GO 4534 | JWST, *"Exoplanet search around Altair,"* PI: C. Beichman, et al. **(7.2 hours)**	*Cycle 3*
***PI**	VLTI/GRAVITY | ESO, *"Investigating the 25 Myr L-T transition with VLTI/GRAVITY observations of the new planet AF Lep b,"* PI: W. Balmer, et al. **(9 hours)**	*P112*
***Co-PI**	GO 3337 | JWST, *"Solving a Solar Neighborhood Crime Scene by Imaging 14 Her c,"* Co-PIs: D. Bardalez Gagliuffi, W. Balmer, et al. **(7.6 hours)**	*Cycle 2*
Co-I	GO 4050 | JWST, *"Uncharted Worlds: Towards a Legacy of Direct Imaging of Sub-Jupiter Mass Exoplanets,"* PI: A. Carter, et al. **(46.6 hours)**	*Cycle 2*
***PI**	VLTI/GRAVITY | ESO, *"Monitoring 51 Eri b for a perturbing inner companion,"* PI: W. Balmer, et al. **(15 hours)**	*P111-114*
Co-I	SOAR 4.1m | NOIRLAB, *"Testing planetary formation paradigms via SOAR-HST observations of an accreting planet,"* PI: C. Robinson **1 night)**	*Cycle 30*
***Co-PI**	GO 17122 | HST, *"Testing Planetary Formation Mechanisms through the First FUV - Optical Spectrum of a Young, Accreting Planet,"* Co-PIs: C. Robinson, W. Balmer, et al. **(9 orbits)**	*Cycle 30*
Co-I	GO 17092 (CAL) | HST, *"Calibrating STIS Coronagraphic Spectroscopy for High Contrast Observations,"* PI: K. Ward-Duong, et al. **(6 orbits)**	*Cycle 30*
Co-I	GO 17162 | HST, *"The HST/JWST synergy: A deep dive into the NUV with WASP-39b to answer key formation questions,"* PI: D. Sing, et al. **(24 orbits)**	*Cycle 30*
***PI**	VLTI/GRAVITY | ESO, *"Characterizing the target of a novel JWST Cycle 1 GO observation with VLTI/GRAVITY,"* PI: W. Balmer, et al. **(3 hours)**	*P109*
***PI**	WIYN 3.5m | NNExplore, *"A precision mass measurement of the most inflated hot-Saturn HAT-P-67 b,"* PI: W. Balmer, et al. **(2.4 nights)**	*2022A*
***PI**	SOAR 4.1m | NOIRLAB, *"Characterization of exoGRAVITY Host Stars (GHOSTS): in the Southern Hemisphere,"* PI: W. Balmer, et al. **(2 nights)**	*2022A*
***PI**	ARC 3.5m | Apache Point Observatory, *"Characterization of exoGRAVITY Host Stars (GHOSTS): Northern Hemisphere,"* PI: W. Balmer **(24 hrs)**	*2021, Q4*

Refereed Publications

18 refereed papers • 186 citations • h-index = 7 • i10-index = 7 • statistics from NASA ADS circa February '24

First Author

3. **Balmer, W. O.**, Pueyo, L., Lacour, S., et al. (2024) *AJ*, 167, 64. *VLTI/GRAVITY Provides Evidence the Young, Substellar Companion HD 136164 Ab Formed Like a "Failed Star"*
2. **Balmer, W. O.**, Pueyo, L., Stolker, T., et al. (2023) *ApJ*, 956, 99. *VLTI/GRAVITY Observations and Characterization of the Brown Dwarf Companion HD 72946 B*
1. **Balmer, W. O.**, Follette, K. B., Close, L. M., et al. (2022) *AJ*, 164, 29. *Improved Orbital Constraints and Hα Photometric Monitoring of the Directly Imaged Protoplanet Analog HD 142527 B*

Second- or third- author

2. Wang, G., **Balmer, W. O.**, Sing, D., et al. (in prep.) *A Revised Density for the evaporating Hot-Jupiter HAT-P-67 b from WIYN/NEID and TESS*
1. Blunt, S., **Balmer, W. O.**, Wang, J. J. et al. (2023) *First VLTI/GRAVITY Observations of HIP 65426 b: Evidence for a Low or Moderate Orbital Eccentricity*

Co-author

14. Nowak, M., Lacour, S., Abuter, R., et al. (2024) *arXiv*, arXiv:2402.05019. *A catalogue of dual-field interferometric binary calibrators*
13. Worthen, K., Chen, C. H., Law, D. R., et al. (2024) *arXiv*, arXiv:2401.16361. *MIRI MRS Observations of Beta Pictoris I. The Inner Dust, the Planet, and the Gas*
12. Petrus, S., Whiteford, N., Patapis, P., et al. (2023) *arXiv*, arXiv:2312.03852. *The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems V: Do Self-Consistent Atmospheric Models Represent JWST Spectra? A Showcase With VHS 1256 b*
11. Ray, S., Sallum, S., Hinkley, S., et al. (2023) *arXiv*, arXiv:2310.11508. *The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems III: Aperture Masking Interferometric Observations of the star HIP 65426 at 3.8μm*
10. Sallum, S., Ray, S., Kammerer, J., et al. (2023) *arXiv*, arXiv:2310.11499. *The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems IV: NIRISS Aperture Masking Interferometry Performance and Lessons Learned*
9. Grant, D., Lewis, N. K., Wakeford, H. R., et al. (2023) *ApJL*, 956, L29. *JWST-TST DREAMS: Quartz Clouds in the Atmosphere of WASP-17b*
8. Ruffio, J.-B., Perrin, M. D., Hoch, K. K. W., et al. (2023) *arXiv*, arXiv:2310.09902. *JWST-TST High Contrast: Achieving direct spectroscopy of faint substellar companions next to bright stars with the NIRSpec IFU*
7. Carter, A. L., Hinkley, S., Kammerer, J., et al. (2023) *ApJL*, 951, L20. *The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems I: High-contrast Imaging of the Exoplanet HIP 65426 b from 2 to 16 μm*
6. Follette, K. B., Close, L. M., Males, J. R., et al. (2023) *AJ*, 165, 225. *The Giant Accreting Protoplanet Survey (GAPlanetS)-Results from a 6 yr Campaign to Image Accreting Protoplanets*
5. Hinkley, S., Lacour, S., Marleau, G.-D., et al. (2023) *A&A*, 671, L5. *Direct discovery of the inner exoplanet in the HD 206893 system. Evidence for deuterium burning in a planetary-mass companion*
4. Miles, B. E., Biller, B. A., Patapis, P., et al. (2023) *ApJL*, 946, L6. *The JWST Early-release Science Program for Direct Observations of Exoplanetary Systems II: A 1 to 20 μm Spectrum of the Planetary-mass Companion VHS 1256-1257 b*
3. Adams Redai, J. I., Follette, K. B., Wang, J., et al. (2023) *AJ*, 165, 57. *The Giant Accreting Protoplanet Survey (GAPlanetS): Optimization Techniques for Robust Detections of Protoplanets*

2. Kammerer, J., Girard, J., Carter, A. L., et al. (2022) *SPIE*, 12180, 121803N. *Performance of near-infrared high-contrast imaging methods with JWST from commissioning*

1. Betti, S. K., Follette, K. B., Ward-Duong, K., et al. (2022) *ApJL*, 935, L18. *Near-infrared Accretion Signatures from the Circumbinary Planetary-mass Companion Delorme 1 (AB)b*

Presentations

Conference talks

- **"Long baseline optical interferometry of exoplanets and brown dwarfs"**, Chesapeake Bay Area Exoplanet Meeting #11 — *May 2024*
- **"Direct Detection and Characterization of Ice-line Giants with Optical Interferometry"**, Pathways to Characterizing Non-Transiting Planets, SEEC Symposium 2024 — *April 2024*
- **"The Unexpected Detection of HR8799e with NIRCam Coronagraphy and Implications for Cycle 3"**, Planetary Systems and the Origins of Life in the Era of *JWST*, STScI Spring Symposium 2023 — *May 2023*
- **"Unprecedented precision: using VLTI/GRAVITY jointly with Gaia to characterize substellar companions near and far, young and old"**, Cool Stars 21 Splinter Session — *Aug. 2022*

Colloquia & Seminars

- **ESO Garching Star and Planet Formation Seminar**, Garching, Germany — *Nov. 2023*
- **ESO Garching Stellar Coffee and Planetary Tea**, Garching, Germany — *Nov. 2023*
- **ExoGRAVITY Collaboration Workshop**, Heidelberg, Germany — *Nov. 2023*
- `petitRADTRANS` **Collaboration Workshop**, Heidelberg, Germany — *Nov. 2023*
- **American Museum of Natural History Astronomy Colloquium**, New York City, NY — *Feb. 2023*
- **STScI HotSci 2022**, Baltimore, MD — *August 17th, 2022*

Poster presentations

- **"Constraining the Atmosphere and Interior of the Directly Imaged Planet AF Leporis b with VLTI/GRAVITY"**, Extreme Solar Systems V — *March 2024*
- **"The orbit and Hα variability of HD 142527B"**, Coolstars 21 — *July 2022*
- **"Charaterization of the L-type Brown Dwarf Companion to the Nearby Solar-type Star HD 72946 with VLTI/GRAVITY, VLT/SPHERE, and RVs"**, In The Spirit of Lyot — *June 2022*
- **"The orbit and Hα variability of HD 142527B"**, STScI Spring Symposium — *April 2021*

Outreach & Service

Outreach — Observatory Open Houses and K-12 Tours (as Fellow 2022-23 & volunteer to present), *MDSGO* — *2022 - present*
Outreach — Invited talk, *North County High School* — *June 2023*
Outreach — Invited talk, *Howard Astronomical League* — *Jun. 2022*
Outreach — Invited talk, *Balticon 56* — *May 2022*
Sci-Comm — Author, *Astrobites* — *2019 - 2021*
Sci-Comm — Astronomy Editor, *The Amherst STEM Network* — *2019 - 2021*
Volunteer — Observatory Operator, *Amherst College Observatory* — *2021*
Outreach — Invited talk, *UMass Amherst Astronomy Club* — *Apr. 2021*

Code

</> Code I manage:

- `backtracks`: Relative motion of background sources with proper motion and parallax
- `stellaluna`: My own zero-age main sequence stellar structure code

Code I contribute to

- `species`: Toolkit for atmospheric characterization of directly imaged planets
- `spaceKLIP`: High contrast imaging routines for JWST data
- `petitRADTRANS`: Spectral modeling and atmospheric retrieval code