

William O. Balmer

PHOTON HUNTER · FRINGE TRACKER · EXOPLANETEER

3400 N. Charles Street, Baltimore, MD 21218

✉ wbalmer@stsci.edu | 🏠 wbalmer.github.io | 📷 wbalmer

Research Interests

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

Appointments

Graduate Research Assistant

SPACE TELESCOPE SCIENCE INSTITUTE

Baltimore, MD

Jun. 2021 - present

Observatory Fellow

NASA MARYLAND SPACE GRANT CONSORTIUM

Baltimore, MD

Sept. 2022 - Jun. 2023

Undergraduate Research Assistant

FOLLETTE LAB, AMHERST COLLEGE

Amherst, MA

Jun. 2018 - Aug. 2021

Undergraduate Research assistant

SIOS LAB, CORNELL UNIVERSITY

Ithaca, NY

Jun. 2020 - Aug. 2020

Teaching Assistant, Grading Assistant, Observatory Operator

PHYSICS AND ASTRONOMY DEPARTMENT, AMHERST COLLEGE

Amherst, MA

Sept. 2019 - May. 2021

Education

Johns Hopkins University

PH.D CANDIDATE IN ASTRONOMY

Baltimore, MD

Aug. 2021 - present

- Thesis Advisors: Laurent Pueyo and David Sing

MASTERS IN PHYSICS

Baltimore, MD

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

B.A. cum laude IN ASTRONOMY; B.A. cum laude IN PHYSICS

Amherst, MA

Aug. 2017 - May. 2021

- Honors thesis: *The Orbit and H α 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”

JOHNS HOPKINS UNIVERSITY

Undergraduate

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

Co-I	GO 6362 JWST, <i>"Breaking the degeneracy: substellar anchors for evolutionary models,"</i> PI: E. Rickman, et al. (30.3 hours)	Cycle 3
Co-I	GO 6086 JWST, <i>"A First Detailed Exploration of Circumplanetary Disk Gas and Dust with NIRSpec and MIRI/MRS Spectroscopy,"</i> PI: K. Ward-Duong, et al. (17.4 hours)	Cycle 3
Co-I	GO 5835 JWST, <i>"Into The Spotlight: Unveiling Wide-Separation Sub-Jupiters for Future JWST Characterization,"</i> PI: A. Carter, et al. (94.9 hours)	Cycle 3
Co-I	GO 5342 JWST, <i>"Spectroscopic characterization of the lowest-mass imaged Jupiter analog,"</i> PI: J. Xuan, et al. (13.2 hours)	Cycle 3
Co-I	GO 4758 JWST, <i>"From Day to Season: Constraining the Rotation Period and Obliquity of Beta Pic b with Time-resolved High-contrast Imaging,"</i> PI: Y. Zhou, et al. (23.9 hours)	Cycle 3
*Co-PI	DD 4558 JWST, <i>"Establishing the Formation of AF Lep b with NIRCarn: The Lowest-Mass Imaged Exoplanet with a Dynamical Mass,"</i> Co-PIs: K. Franson, W. Balmer, et al. (6.4 hours)	Cycle 2
Co-I	GO 4535 JWST, <i>"Follow-up Observations of NIRCarn Sources in the Planetary System HR8799,"</i> PI: C. Beichman, et al. (4.5 hours)	Cycle 3
Co-I	GO 4534 JWST, <i>"Exoplanet search around Altair,"</i> PI: C. Beichman, et al. (7.2 hours)	Cycle 3
*PI	VLTI/GRAVITY ESO, <i>"Investigating the 25 Myr L-T transition with VLTI/GRAVITY observations of the new planet AF Lep b,"</i> PI: W. Balmer, et al. (9 hours)	P112
*Co-PI	GO 3337 JWST, <i>"Solving a Solar Neighborhood Crime Scene by Imaging 14 Her c,"</i> Co-PIs: D. Bardalez Gagliuffi, W. Balmer, et al. (7.6 hours)	Cycle 2
Co-I	GO 4050 JWST, <i>"Uncharted Worlds: Towards a Legacy of Direct Imaging of Sub-Jupiter Mass Exoplanets,"</i> PI: A. Carter, et al. (46.6 hours)	Cycle 2
*PI	VLTI/GRAVITY ESO, <i>"Monitoring 51 Eri b for a perturbing inner companion,"</i> PI: W. Balmer, et al. (15 hours)	P111-114
Co-I	SOAR 4.1m NOIRLAB, <i>"Testing planetary formation paradigms via SOAR-HST observations of an accreting planet,"</i> PI: C. Robinson 1 night	Cycle 30
*Co-PI	GO 17122 HST, <i>"Testing Planetary Formation Mechanisms through the First FUV - Optical Spectrum of a Young, Accreting Planet,"</i> Co-PIs: C. Robinson, W. Balmer, et al. (9 orbits)	Cycle 30
Co-I	GO 17092 (CAL) HST, <i>"Calibrating STIS Coronagraphic Spectroscopy for High Contrast Observations,"</i> PI: K. Ward-Duong, et al. (6 orbits)	Cycle 30
Co-I	GO 17162 HST, <i>"The HST/JWST synergy: A deep dive into the NUV with WASP-39b to answer key formation questions,"</i> PI: D. Sing, et al. (24 orbits)	Cycle 30
*PI	VLTI/GRAVITY ESO, <i>"Characterizing the target of a novel JWST Cycle 1 GO observation with VLTI/GRAVITY,"</i> PI: W. Balmer, et al. (3 hours)	P109
*PI	WIYN 3.5m NNExplore, <i>"A precision mass measurement of the most inflated hot-Saturn HAT-P-67 b,"</i> PI: W. Balmer, et al. (2.4 nights)	2022A
*PI	SOAR 4.1m NOIRLAB, <i>"Characterization of exoGRAVITY Host Stars (GHOSTS): in the Southern Hemisphere,"</i> PI: W. Balmer, et al. (2 nights)	2022A
*PI	ARC 3.5m Apache Point Observatory, <i>"Characterization of exoGRAVITY Host Stars (GHOSTS): Northern Hemisphere,"</i> 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. *VLT/GRAVITY Provides Evidence the Young, Sub-stellar Companion HD 136164 Ab Formed Like a “Failed Star”*
2. **Balmer, W. O.**, Pueyo, L., Stolker, T., et al. (2023) *ApJ*, 956, 99. *VLT/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 $H\alpha$ 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 VLT/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 3.8 μ m*
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 μ m*
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 μ m 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 NIRCcam 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 H α variability of HD 142527B”, *Coolstars 21* July 2022
- “Characterization 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 H α 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