

William O. Balmer

PHOTON HUNTER · FRINGE TRACKER · EXOPLANETEER

3400 N. Charles Street, Baltimore, MD 21218

✉ wbalmer1@jhu.edu | 🏠 wbalmer.github.io | 📷 wbalmer

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 ASTROPHYSICS

Baltimore, MD

May 2023 - present

- Thesis: *Mapping Giant Planet Dynamics and Atmospheres on the Bleeding Edges of Detectability*
 - Advisor: Laurent Pueyo

MASTERS IN PHYSICS

Baltimore, MD

Aug. 2021 - Apr. 2023

- Completed Graduate Board Oral (qualifying) exam, achieving candidacy May 2nd, 2023
 - Advisor: Laurent Pueyo
- 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” and “Constraining Formation Models with a Young Multi-planet System”

Undergraduate

JOHNS HOPKINS UNIVERSITY, SUMMER INTERNSHIP

February 2023 - present

Gavin is leading a forthcoming first author paper as a result of his internship.

Henry Dennen: “Orbits and dynamical masses of directly imaged planets”

Undergraduate

JOHNS HOPKINS UNIVERSITY, SUMMER INTERNSHIP

June 2024 - August 2024

Henry is a contributing author on a forthcoming paper from our group as a result of his internship.

Research Interests

I am interested in the direct detection and characterization of exoplanets using optical and infrared observations. I am a specialist in the planning, execution, and analysis of coronagraphic imaging using *JWST*. I am also a “power-user” of the GRAVITY instrument at the VLTI. My work seeks to answer questions like: is our Solar System unique when compared to other systems? How can we improve our methods for directly observing planets? Can we use measurements of the orbits and atmospheres of giant planets as clues to their formation and evolution?

Refereed Publications

31 refereed papers • 411 unique refereed citations • h-index = 12 • i10-index = 14 • from NASA ADS Jan. '25

First Author

5. **Balmer, W. O.**, Kammerer, J., Pueyo, L., et al. (submitted). *JWST-TST High Contrast: Living on the Wedge, or, NIRCcam Bar Coronagraphy Reveals CO₂ in the HR 8799 and 51 Eri Exoplanets' Atmospheres*
4. **Balmer, W. O.**, Franson, K., Chomez, A., et al. (2025) *AJ*, 169, 30. *VLTI/GRAVITY Observations of AF Lep b: Preference for Circular Orbits, Cloudy Atmospheres, and a Moderately Enhanced Metallicity*
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 H α Photometric Monitoring of the Directly Imaged Protoplanet Analog HD 142527 B*

Second- or third- author (* indicates advisee first author)

4. *Wang, G., **Balmer, W. O.**, Pueyo, L., et al. (submitted). *A Revised Density Estimate for the Largest Known Exoplanet, HAT-P-67 b*
3. Maire, A.-L., Leclerc, A., **Balmer, W. O.**, et al. (2024) *A&A*, 691, A263. *Direct imaging and dynamical mass of a benchmark T-type brown dwarf companion to HD 167665*
2. Franson, K., **Balmer, W. O.**, Bowler, B. P., et al. (2024) *ApJL*, 974, L11. *JWST/NIRCcam 4–5 μ m Imaging of the Giant Planet AF Lep b*
1. Blunt, S., **Balmer, W. O.**, Wang, J. J., et al. (2023) *AJ*, 166, 257. *First VLTI/GRAVITY Observations of HIP 65426 b: Evidence for a Low or Moderate Orbital Eccentricity*

Co-author

21. Chai, Y., Chen, C. H., Worthen, K., et al. (2024) *ApJ*, 976, 167. *A JWST MIRI MRS View of the η Tel Debris Disk and Its Brown Dwarf Companion*
20. Hoch, K. K. W., Theissen, C. A., Barman, T. S., et al. (2024) *AJ*, 168, 187. *JWST-TST High Contrast: Spectroscopic Characterization of the Benchmark Brown Dwarf HD 19467 B with the NIRSspec Integral Field Spectrograph*
19. Xuan, J. W., Mérand, A., Thompson, W., et al. (2024) *Natur*, 634, 1070-1074. *The cool brown dwarf Gliese 229 B is a close binary*
18. Blunt, S., Wang, J., Hirsch, L., et al. (2024) *JOSS*, 9, 6756. *orbitize! v3: Orbit fitting for the High-contrast Imaging Community*
17. Kammerer, J., Lawson, K., Perrin, M. D., et al. (2024) *AJ*, 168, 51. *JWST-TST High Contrast: JWST/NIRCcam Observations of the Young Giant Planet β Pic b*
16. Winterhalder, T. O., Lacour, S., Mérand, A., et al. (2024) *A&A*, 688, A44. *Combining Gaia and GRAVITY: Characterising five new directly detected substellar companions*
15. Ruffio, J.-B., Perrin, M. D., Hoch, K. K. W., et al. (2024) *AJ*, 168, 73. *JWST-TST High Contrast: Achieving Direct Spectroscopy of Faint Substellar Companions Next to Bright Stars with the NIRSspec Integral Field Unit*
14. Nasedkin, E., Mollière, P., Lacour, S., et al. (2024) *A&A*, 687, A298. *Four-of-a-kind? Comprehensive atmospheric characterisation of the HR 8799 planets with VLTI/GRAVITY*
13. Nowak, M., Lacour, S., Abuter, R., et al. (2024) *A&A*, 687, A248. *Catalogue of dual-field interferometric binary calibrators*
12. Pourré, N., Winterhalder, T. O., Le Bouquin, J.-B., et al. (2024) *A&A*, 686, A258. *High contrast at short separation with VLTI/GRAVITY: Bringing Gaia companions to light*

11. Petrus, S., Whiteford, N., Patapis, P., et al. (2024) *ApJL*, 966, L11. *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 1256–1257 b*
10. Worthen, K., Chen, C. H., Law, D. R., et al. (2024) *ApJ*, 964, 168. *MIRI MRS Observations of β Pictoris. I. The Inner Dust, the Planet, and the Gas*
9. Sallum, S., Ray, S., Kammerer, J., et al. (2024) *ApJL*, 963, L2. *The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems. IV. NIRISS Aperture Masking Interferometry Performance and Lessons Learned*
8. Grant, D., Lewis, N. K., Wakeford, H. R., et al. (2023) *ApJL*, 956, L32. *JWST-TST DREAMS: Quartz Clouds in the Atmosphere of WASP-17b*
7. 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*
6. 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*
5. 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*
4. 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*
3. 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*
2. 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*
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*

Grants & Awards

\$50,000	James Webb Space Telescope Program DD 4558 (Co-PI), NASA	2024
\$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

Presentations

Conference talks

- “The Bleeding Edges of Direct Imaging with JWST”, NASA ExoPAG 31 Jan. 2025
- “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

- MPIA/APEX ExoCoffee, Heidelberg, Germany Jan. 2025
- STScI-JHU ExoJamboree, Baltimore, MD Nov. 2024
- Carnegie EPL Astronomy Seminar, Washington DC Oct. 2024
- OCA Protoplanets Group Meeting, Nice, France Jun. 2024
- 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

Observing Programs

* indicates PI contribution



*Co-PI	MINERVA-A NN-EXPLORE, “Unlocking the periods and masses of two young long-period planets,” Co-PIs: G. Wang, W. Balmer. (23.0 hours)	2025A
*PI	VLTI/GRAVITY ESO, “The ExoGRAVITY+ Orbital Refinery,” PI: W. Balmer, et al. (7 hours)	P114
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 NIRCarn: 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 NIRCarn 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 NN-EXPLORE, “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

Outreach & Service




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

Code

</> Code I manage:

-  **backtracks**: Relative motion of background sources with proper motion and parallax
-  **stellaluna**: My own pedagogical 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