BRETT M. MORRIS

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http://brettmorr.is

Interests

I develop and maintain open source software in Python, often in the pursuit of characterizing exoplanets and their host stars with observations from the ground and from space.

Employment

Senior Software Engineer — September 2022 – present
Space Telescope Science Institute, MD, USA

NCCR PlanetS Postdoctoral Research Fellow — July 2019 – August 2022
Universität Bern, Bern, Switzerland

Education

University of Washington, Seattle, WA, USA
PhD in Astronomy and Astrobiology — June 2014 – April 2019
M.Sci. in Astronomy — Sep 2013 – June 2014
Dissertation: "The Effects of Stellar Magnetic Activity and Variability on Observations of Exoplanets"

University of Maryland, College Park, MD, USA — Aug 2009 – Dec 2012
B.Sci. with High Honors in Astronomy
B.Sci. in Physics (double degree)

Open-Source Software

Leadership Roles:

- astropy Team roles: Workshops Coordinator (2019-present) and NDData module maintainer (2023-present), core team and voting member
- OpenAstronomy Steering Committee member (2018-present)
- Former manager of the Exoclime Simulation Platform (2020-2022)

Selected projects:

- **Maintainer and contributor** of astropy (in the top 50 of >400 contributors, 2015-present)
- **Co-creator and maintainer** of astroplan: an astropy-affiliated package for astronomical observation planning (top contributor, 2015-present)
- **Contributor and former maintainer** to Exoclimes Simulation Platform (2019-2022)
- **Creator** of pedagogical statistics tutorials for data science on Markov Chain Monte Carlo, Gaussian Process regression, and Approximate Bayesian Computation
- **Creator** of shampoo: numerical reconstruction toolkit for digital holographic microscopy for microbiology and astrobiology (top contributor, 2015-present)

Software Workshops

- **Leader**: jdaviz Workshop, Carnegie Observatories, California, 2024 April 11
- **Instructor**: Astropy Workshop, 243rd Meeting of the American Astronomical Society, 2024 January 6
- **Instructor**: Introduction to jdaviz, .Astronomy, Center for Computational Astrophysics, New York, NY, 2023 October 2
- **Leader**: Astropy Workshop, 242nd Meeting of the American Astronomical Society, Albequerque, NM, 2023 June 5
- **Leader**: astropy and jdaviz Workshops, Université de Montréal, Canada, 2023 April 5
- **Instructor**: Astropy Workshop, 241st Meeting of the American Astronomical Society, Seattle, WA, 2023 January 8
- **Leader**: Astropy For Heliophysicists, Python in Heliophysics Summer School, ESAC, Madrid, Spain, 2022 May 30

- **Instructor**: Astropy Workshop, 238th Meeting of the American Astronomical Society, Online, 2021 June 4
- **Instructor**: Astropy Workshop, 237th Meeting of the American Astronomical Society, Online, 2021 January 7-8
- **Leader**: Queens University Belfast, 2019 November 21 (resources/debrief)
- **Leader**: Geneva Observatory, 2019 November 14 (resources/debrief)
- **Leader**: University of Bern, 2019 October 28 (resources/debrief)
- **Certified** Software Carpentry Instructor (2019-present)

Publications

Summary:
18 peer-reviewed first-author articles, five short publications (RNAAS, JOSS) as lead author, one sole-author article. h-index = 29 (Google Scholar). $>$2800 citations (excluding astropy papers).

First author works:

18. Observations of scattered light from exoplanet atmospheres
Morris, B.M.; Heng, K.; Kitzmann, D. A&A (2024)
17. Physically-motivated basis functions for temperature maps of exoplanets
Morris, B.M.; Heng, K.; Jones, K; Piaulet, C; Demory, B.-O.; Kitzmann, D.; Hoeijmakers, H.J. A&A (2022)
16. CHEOPS Precision Phase Curve of the Super-Earth 55 Cnc e
Morris, B.M.; Delrez, L.; Brandeker, A.; Cameron, A. C.; et al. A&A (2021)
15. A CHEOPS White Dwarf Transit Search
Morris, B.M.; Heng, K.; Brandeker, A.; Swan, A.; Lendl, M. A&A (2021)
14. Hunt for Starspots in HARPS Spectra of G and K Stars
Morris, B.M.; Hoeijmakers, H.J.; Kitzmann, D.; Demory, B.-O. ApJ (2020)
13. A Relationship Between Stellar Age and Spot Coverage
Morris, B.M. ApJ (2020)
12. The Stellar Variability Noise Floor for Transiting Exoplanet Photometry with PLATO
Morris, B.M.; Bobra, M.G.; Agol, E.; Lee, Y.J.; Hawley, S.L., MNRAS (2020)
11. Stellar Properties of Active G and K Stars: Exploring the Connection between Starspots and Chromospheric Activity
Morris, B.M.; Curtis, J.L.; Sakari, C.; Hawley, S.L.; Agol, E., AJ (2019)
10. The Solar Benchmark: Rotational Modulation of the Sun Reconstructed from Archival Sunspot Records
Morris, B.M.; Davenport, J.R.A.; Giles, H.A.C.; Hebb, L.; Hawley, S.L; Angus, R.; Gilman, P.; Agol, E., MNRAS (2019)
9. Are Starspots and Plages Co-Located on Active G and K Stars?
Morris, B.M.; Curtis, J.L.; Douglas, S.T.; Hawley, S.L.; Agüeros, M.A.; Bobra, M.G.; Agol, E. ApJL (2018)
8. Non-detection of Contamination by Stellar Activity in the Spitzer Transit Light Curves of TRAPPIST-1
Morris, B.M., Agol E., Hebb L., Hawley S.L., Gillon M., Ducrot E., Delrez L., Ingalls J., Demory B-O. ApJL 863, L32 (2018)
7. Robust Transiting Exoplanet Radii in the Presence of Starspots from Ingress and Egress Durations
Morris, B.M., Agol E., Hebb, L., Hawley, S.L., AJ 156, 91 (2018)
6. Possible Bright Starspots on TRAPPIST-1
Morris, B.M., Agol, E., Davenport, J.R.A., Hawley, S.L. ApJ 857, 1 (2018)
5. Spotting stellar activity cycles in Gaia astrometry
Morris, B.M., Agol, E; Davenport, J.R.A., Hawley, S.L. MNRAS 476 4 (2018)
4. astroplan: An Open Source Observation Planning Package in Python
Morris, B.M., Tollerud E., Sipocz B., Deil C., Douglas S.T., Medina J.B., Vyhmeister K., Smith T.R., Littlefair S., Price-Whelan A.M., Gee W.T., Jeschke E. AJ 155, 128 (2018)

3. Chromospheric Activity of HAT-P-11: an Unusually Active Planet-Hosting K Star
Morris, B.M., Hawley S.L., Hebb L., Saraki C., Davenport J.R.A., Isaacson H., Howard A.W., Montet B.T., Agol E., ApJ, 846, 99 (2017)
2. The Starspots of HAT-P-11: Evidence for a Solar-like Dynamo
Morris, B.M., Hebb L., Davenport J.R.A., Rohn G., Hawley S.L., ApJ, 846, 2 (2017)
1. Kepler's Optical Secondary Eclipse of HAT-P-7b and Probable Detection of Planet-induced Stellar Gravity Darkening.
Morris, B.M., Mandell, A.M., & Deming, D. ApJL, 764, L22 (2013)

Contributed significantly to:

16. Investigating the visible phase curve variability of 55 Cnc e
Meier Valdés, E.A.; **Morris, B.M.**, et al. A&A (2023)
15. The stable climate of KELT-9b
Jones, K.; **Morris, B.M.**, et al. A&A (2022)
14. Weak evidence for variable occultation depth of 55 Cnc e with TESS
Meier Valdés, E.A.; **Morris, B.M.**, et al. A&A (2022)
13. Spi-OPS: Spitzer and CHEOPS confirm the near-polar orbit of MASCARA-1 b and reveal a hint of dayside reflection
Hooton, M.J., Hoyer, S., Kitzmann, D., **Morris, B.M.**, et al. A&A (2021)
12. Closed-form ab initio solutions of geometric albedos and reflected light phase curves of exoplanets
Heng, K., **Morris, B.M.**, and Kitzmann, D., NatAs (2021)
11. Monitoring precipitable water vapour in near real-time to correct near-infrared observations using satellite remote sensing
Meier Valdés, E.A., **Morris, B.M.**, and Demory, B.-O., A&A (2021)
10. Refining the Transit-timing and Photometric Analysis of TRAPPIST-1: Masses, Radii, Densities, Dynamics, and Ephemerides
Agol, E., Dorn, C., Grimm, S.L., Turbet, M., Ducrot, E., Delrez, L., Gillon, M., Demory, B.-O., Burdanov, A., Barkaoui, K., Benkhaldoun, Z., Bolmont, E., Burgasser, A., Carey, S., de Wit, J., Fabrycky, D., Foreman-Mackey, D., Haldemann, J., Hernandez, D.M., Ingalls, J., Jehin, E., Langford, Z., Leconte, J., Lederer, S.M., Luger, R., Malhotra, R., Meadows, V.S., **Morris, B.M.**, Pozuelos, F.J., Queloz, D., Raymond, S.N., Selsis, F., Sestovic, M., Triaud, A.H.M.J., and Van Grootel, V., PSJ (2021)
9. RotNet: Fast and Scalable Estimation of Stellar Rotation Periods Using Convolutional Neural Networks
Johnson, J.E., Sundaresan, S., Daylan, T., Gavilan, L., Giles, D.K., Ishitani Silva, S., Jungbluth, A., **Morris, B.**, and Muñoz-Jaramillo, A., NeurIPS (2020)
8. Exploring the Atmospheric Dynamics of the Extreme Ultrahot Jupiter KELT-9b Using TESS Photometry
Wong, I., Shporer, A., Kitzmann, D., **Morris, B.M.**, et al. AJ (2020)
7. Kepler Object of Interest Network. III. Kepler-82f: a new non-transiting 21 $M_{\oplus}$ planet from photodynamical modelling
Freudenthal, J., von Essen, C., Ofir, A., Dreizler, S., Agol, E., Wedemeyer, S., **Morris, B.M.**, Becker, A.C., Deeg, H.J., Hoyer, S., Mallonn, M., Poppenhaeger, K., Herrero, E., Ribas, I., Boumis, P., and Liakos, A., A&A (2019)
6. Diffuser-assisted Photometric Follow-up Observations of the Neptune-sized Planets K2-28b and K2-100b
Stefansson, G., Li, Y., Mahadevan, S., Wisniewski, J., Hebb, L., **Morris, B.M.**, Huehnerhoff, J., and Hawley, S., AJ (2018)
5. The 0.8-4.5 μm Broadband Transmission Spectra of TRAPPIST-1 Planets
Ducrot, E., Sestovic, M., **Morris, B.M.**, et al. AJ (2018)
4. Kepler Object of Interest Network. II. Photodynamical modelling of Kepler-9 over 8 years of transit observations

Freudenthal, J., von Essen, C., Dreizler, S., Wedemeyer, S., Agol, E., **Morris, B.M.** et al., A&A (2018)

3. Extreme precision photometry from the ground with beam-shaping diffusers for K2, TESS, and beyond
Stefansson, G., Mahadevan, S., Wisniewski, J., Li, Y., Hebb, L., **Morris, B.M.**, Halverson, S., Monson, A., and Robertson, P., SPIE (2018)
2. Kepler Object of Interest Network. I. First results combining ground- and space-based observations of Kepler systems with transit timing variations
von Essen, C., Ofir, A., Dreizler, S., Agol, E., Freudenthal, J., Hernández, J., Wedemeyer, S., Parkash, V., Deeg, H.J., Hoyer, S., **Morris, B.M.** et al., A&A (2018)
1. Toward Space-like Photometric Precision from the Ground with Beam-shaping Diffusers
Stefansson, G., Mahadevan, S., Hebb, L., Wisniewski, J., Huehnerhoff, J., **Morris, B.M.** et al., ApJ (2017)

Short works:

- fleck: Fast approximate light curves for starspot rotational modulation
Morris, B.M. Journal of Open Source Software (2020)
- arcesetc: ARC Echelle Spectrograph Exposure Time Calculator
Morris, B.M., Dorn-Wallenstein T., Levesque E., Sakari C., Gies D., Lester K., Notsu Y., Youngblood A., McMillan, R. Journal of Open Source Software (2019)
- aesop: ARC Echelle Spectroscopic Observation Pipeline
Morris, B.M. & Dorn-Wallenstein T. Journal of Open Source Software (2018)
- Pre-MAP Search for Transiting Objects Orbiting White Dwarfs
Wallach, A, **Morris, B.M.**, et al. RNAAS 2 1 (2018)
- Large Starspot Groups on HAT-P-11 in Activity Cycle 1
Morris, B.M., Hawley, S.L., Hebb, L. RNAAS 2 1 (2018)
- Photometric Analysis and Transit Times of TRAPPIST-1 b and c
Morris, B.M., Agol, E., Hawley S.L. RNAAS, 2, 1 (2018)

Funded Projects

- (PI): Spin doctor: unwinding stellar contamination from TRAPPIST-1, James Webb Space Telescope General Observer Program, Cycle 3, 2024
- $38k (PI): A forward model for time series observations of stellar oscillations and granulation, Space Telescope Science Institute (DRF), 2023
- $25k (co-I): Self consistent atmospheres and radiative transfer models for high resolution Bayesian retrieval frameworks, Crafoord Foundation, 2023
- $19k (PI): Probing Giant Planet Formation with MOSFIRE Exoplanet Transmission Spectroscopy, Keck Observatory, 2014 (N132M)

Observing Experience

- **Principal investigator** of James Webb Space Telescope Cycle 3 Archival Research General Observer program Spin doctor: unwinding stellar contamination from TRAPPIST-1 (2024)
- **Principal investigator** of an 84 orbit Guest Observer program on the CHEOPS space telescope (2020)
- **Principal investigator** on $>$200 half-nights on the Astrophysical Research Consortium (ARC) 3.5 m Telescope at Apache Point Observatory (APO, 2013-present), with experience using many instruments including: ARCES (echelle spectrograph), ARCTIC (optical imager), Agile (frame-transfer imager), NICFPS (IR imager)
- **Principal investigator** on Keck Observatory/MOSFIRE program: "Probing Giant Planet Formation with MOSFIRE Exoplanet Transmission Spectroscopy", awarded 2 nights (2014)

– **Principal investigator** on University of Maryland Observatory, 152 mm campaign: >100 hours collecting photometry of transiting exoplanets and asteroids (2010-2013)

Honors And Awards

– University of Washington Distinguished Dissertation Award in Math, Physical Sciences & Engineering (2019)
– University of Washington Astronomy Department Graduate Student Research Prize (2018)
– Poster competition winner at the NASA Kepler Science Conference IV (earned prize talk)
– Astrobiology Fellow, University of Washington, 2013-2014.

Past Employment

Software Engineer in Digital Holographic Microscopy November 2016 – 2019
Software consultant position in the UW Department of Oceanography under Prof. Jody Deming and Dr. J. Kent Wallace.
– Developed and maintained the shampoo digital holographic microscopy numerical reconstruction toolkit in Python.
– This software enables efficient reconstruction of holograms for bacterial motility studies, with applications in life-detection for astrobiology.

Consultant for Center for Inquiry Science at the Institute for Systems Biology 2014-2015
STEM curriculum consulting for middle school science teachers
– Worked with school science teachers in Renton School District to adapt their curriculum to comply with new state standards as part of the Partnership in Science and Engineering Practices project.
– Collaborated with science teachers at Meeker Middle School (Tacoma, WA) to update a Sun-Moon-Earth system lab as part of the Observing for Evidence of Learning professional development model.

Research Assistant at NASA's Goddard Space Flight Center Jan 2013 – Aug 2013
Post-baccalaureate research assistantship with advisor Dr. Avi Mandell at the Goddard Center for Astrobiology.
– Prepared a Python data reduction pipeline for near-infrared differential spectrophotometric observations with Keck/MOSFIRE and Keck/NIRSPEC of transiting exoplanet atmospheres.

Selected Professional Presentations

– **Plenary talk**: "The Activity Cycle of HAT-P-11." Cool Stars 20. Boston, MA. July 31, 2018.
– **Prize talk**: "The Active Latitudes of HAT-P-11" Kepler & K2 Science Conference IV, Mountain View, CA. June 19, 2017 (poster competition prize winner)
– Contributed talk: "astroplan: Observation Planning for Astronomers." Python in Astronomy Conference 2016. Seattle, WA. March 25, 2016.

Invited Presentations

– **Seminar**, "Are these frying pans hot, or red-colored, or both?," Carnegie Observatories, California, April 2024
– **Seminar**, "Phase Curves of Giant Exoplanets," Université de Montréal, Canada, April 2023
– **WE-Heraeus Seminar**, "Fading Memories of Magnetic Youths," Physikzentrum Bad Honnef, Germany, January 2023
– **Colloquium**, "Phase curves of giant exoplanets: clear or cloudy?" University of Washington, Seattle, WA, Nov 2022
– **ISSI Plenary**, "New and old benchmarks for stellar magnetic activity," ISSI Workshop on "Solar and stellar dynamos", Bern, Switzerland, June 2022
– **Colloquium**, "Phase curves of giant exoplanets: clear or cloudy?" Ludwig Maximilian University of Munich (LMU), Germany, April 2022

- **Seminar**, "A practical introduction to leave-one-out cross-validation," ORIGINS Data Science Lab, Munich, Germany, March 2022
- **ISSI Plenary**, "The Stellar Variability Noise Floor," ISSI Workshop on "Getting Ultra-Precise Planetary Radii with PLATO: The Impact of Limb Darkening and Stellar Activity on Transit Light Curves," Bern, Switzerland, September 2021
- **Seminar**, "Issues of Replicability in Astrophysics," Philosophy of Science Cafe, Bern, Switzerland, August 2019
- **Seminar**, "The Effects of Stellar Magnetic Activity and Variability on Observations of Exoplanets," University of Exeter, England, October 2019

Teaching Experience

- Course instructor (full teaching responsibilities): ASTR192 Pre-Major in Astronomy Program (Pre-MAP) in Fall 2016, developed open-source Python curriculum
- Academic mentor ASTR192 Pre-Major in Astronomy Program (Pre-MAP) in Fall 2015
- Instructor of UW Astro/Phys Python Bootcamp, 2016 (and co-instructor in 2015)
- Teaching assistant for ASTR150 The Planets (three quarters) ASTR101 Intro Astronomy (one quarter), Intro to Observational Astronomy (one semester)

Mentorship

- **Team Domain Lead** for the Frontier Development Lab's Starspots Challenge (2020), providing domain expertise for a team of eight collaborators who built supervised machine learning techniques for measuring stellar rotation of 100,000+ stars in Kepler photometry
- Primary day-to-day supervisor to PhD student Kathryn Jones (Bern, 2020-2022)
- **Lead mentor** in the Google Summer of Code program for improvements to astropy-affiliated packages (mentees: Karl Vyhmeister 2016, Tiffany Jansen 2019)
- 2014-2019: Founded the Search for Planets Around post-Main Sequence stars (SPAMS) research group with five undergraduates in the University of Washington's Pre-Major in Astronomy Program (Pre-MAP), which searches for transiting planetary material orbiting white dwarfs

Public Outreach

- Co-founder and co-host of over forty events of the Seattle satellite branch of Astronomy on Tap (2015-2019).
- Science Communication Fellow at the Pacific Science Center (2016-2019)

Press

- Feature article: "Counting Starspots", Astronomy Magazine. January 17, 2018.
- Science outreach TwitterBots that I created and maintain have been featured by *Popular Mechanics*
- Press release: "NASA-funded Program Helps Amateur Astronomers Detect Alien Worlds". NASA Goddard Space Flight Center, Greenbelt, Md. September 4, 2013.

Service

- Reviewer: ApJ, AJ, MNRAS, A&A, JOSS
- Telescope Allocation Committees: University of Washington/Apache Point Observatory