Edward W. Schwieterman

CURRICULUM VITAE

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Current Position: NASA Postdoctoral Program Fellow
University of California, Riverside (UCR)
NAI Alternative Earths Team, Department of Earth Sciences
Supervisor/PI: Timothy Lyons

Education: UNIVERSITY OF WASHINGTON (UW)
Ph.D., Astronomy & Astrobiology, August 2016
Thesis Advisor: Dr. Victoria Meadows
Master of Science, Astronomy, August 2011

FLORIDA INSTITUTE OF TECHNOLOGY (FIT)
B.Sc., Astronomy & Astrophysics, *Magna Cum Laude,* May 2010
B.Sc., Physics, *Magna Cum Laude*, May 2010

Other Professional Experience

2015-Present. Research Scientist, Blue Marble Space Institute of Science (BMSIS)

2010-2016. Graduate Research & Teaching Assistant, University of Washington

2009-2010. Research Assistant, Lowell Observatory

Grants and Awards

2018. NASA Exobiology, Assessing Earth's Biosignatures (Co-I; **$467K**)

2018. NASA NExSS Virtual Planetary Laboratory (Co-I; ~**$11M**)

2016-2019. NASA Postdoctoral Program Fellowship (~**$210K**)

2018. NAI Scholarship for the Astrobiology Grand Tour, Western Australia ($**1K**)

2016. NASA Astrobiology Institute Director's Discretionary Fund (PI; **$46K**)

2015. Kenilworth Foundation Grant for the UW Pre-Major in Astronomy Program **($16.5K**)

2015. Wildcard Award, NASA Famelab Contest, Chicago/AbSciCon Regional Heat

2015. UW Student Technology Fee (STF) Grant, Planetarium Upgrade (Co-I; **$47K**)

2015. UW STF Grant, Manastash Ridge Observatory Imaging Camera (Co-I; **$37K**)

2011-2015. UW GPSS grants for graduate student improvements ($**1.5K** total)

2013. American Philosophical Society Lewis and Clark Fund for Research (PI; **$4K**)

2013. NAI Scholar, International Summer School in Astrobiology

2012. NAI Scholar, Nordic-NASA Summer School, 2012

Selected Academic Service and Synergistic Activities

2019. Session convener, Astrobiology Science Conference 2019 (Bellevue, WA)

2018. NASA Grant Review Panelist

2018. Session convener, Goldschmidt geochemistry conference (Boston, MA)

2016 - present. Peer reviewer for the journals *Astrobiology*, *Astronomical Journal* (AJ), *Monthly Notices of the Royal Astronomical Society* (MNRAS), and *Journal of Astronomical Telescopes, Instruments, and Systems* (JATIS)

2017. Session convener, Astrobiology Science Conference, Mesa, AZ

2016-2018. NExSS Workshop on Exoplanet Biosignatures, Review Paper Lead

2017. Reviewer, Lewis & Clark Fund for Field Research in Astrobiology

2015-2016. Student Technology Fee Committee (UW; $5 million/year fund)

2015. Executive Secretary, NASA Solar System Workings Panel

2010-2015. Senator, Graduate and Professional Student Senate (GPSS)

GPSS Committees: Executive (2014-2015), Finance & Budget (2012-2014; Chair: 2012-2013), Elections (2014, 2015), STF Oversight (2015), Judiciary (2010-2011)

2015. Student Representative, Academic Grievance Hearing Panel

Selected Scientific Talks

2019. "A Limited Habitable Zone for Complex Life: A Tutorial" Florida Institute of Technology. Physics & Space Science colloquium. Melbourne, FL. March 22, 2019. [Invited]

2018. "Earth as a Laboratory for Exoplanet Biosignatures" California State Polytechnic University, Pomona. Physics seminar. Pomona, CA. October 25, 2018. [Invited]

2018. "Characterizing Ozone Detectability and Seasonality on Weakly Oxygenated Terrestrial Exoplanets" The LUVOIR Seminar Series, Goddard Space Flight Center. Greenbelt, MD, April 4, 2018. [Invited, Remote]

2017. "An Introduction to Planetary Habitability and its Connection to the Search for Life Beyond Earth." The Early History of Planetary Systems and Habitable Planets. Tartu, Estonia, Aug 8-10, 2017. [Invited]

2017. "Characterizing N_2O as an Exoplanet Biosignature: Early Earth as a Template" Goldschmidt conference, Paris, France, Aug 12-18, 2017.

2017. "A Phase-dependent Spectral Earth Database with Applications For Directly Imaged Earth-like Exoplanets." The Astrobiology Science Conference 2017, held April 24–28, 2017 in Mesa, Arizona. No. 1965, id. 3515.

2017. "VPL Stellar and Planetary Spectra. Identifying Habitable Planets of Nearby M Dwarfs: The Virtual Planetary Laboratory Tools Workshop". The 229th American Astronomical Meeting, held January 2-7 in Grapevine, TX.

2016. "Spectral identification of abiotic O_2 buildup from early runaways and rarefied atmospheres." American Astronomical Society Meeting #227, #211.04.

2015. "Using Dimers to Constrain Planetary Habitability and Discriminate Against False Positives for Life." Astrobiology Science Conference 2015 held in Chicago, IL talk #7486.

2015. "Distinguishing True and False Positive Oxygen Signatures with Models and Observations. American Astronomical Society Meeting #225, #224.02.

Selected Education and Outreach Talks and Events

2019. "Alien Worlds: The Future of Exoplanet Science and the Search for Life Elsewhere." Florida Institute of Technology on March 22, 2019. Approximately 110 attendees.

2017. "Alien Planets: Are Other Earths Lurking in our Galaxy?" UCR Palm Desert Campus on April 6, 2017. Approximately 350 members of the public attended.

2017. Demonstrated cloud chamber to interested audience members during "Sensing the Universe" activity following "Are We Alone?" science lecture on February 1, 2017 at UCR.

2016. "Measuring Exoplanet Atmospheres for Signs of Life." Night Sky Network webinar held on November 16, 2016. 111 audience members attended virtually.

2016. "Life Beyond the Solar System: The hunt for habitable worlds and biosignatures in the 2020s and beyond", public talk to the Seattle Astronomical Society (Seattle, April 20, 2016).

2016. "Biosignatures and Technosignatures: Finding life outside of the solar system", the Pacific Science Center's Science and a Movie Night (Seattle, March 23-24, 2016).

2016. "Promoting Inclusivity in STEM through Active Recruiting and Mentoring: The Pre-Major in Astronomy Program (Pre-MAP) at the University of Washington." AAS 227, #313.04.

2015. "An Astrobiologist in the Land of Eternal Sunsets", NASA Famelab (Chicago, 2015).

2015. "Lifesigns and Biosignatures: How we'll find life outside the solar system", Astronomy on Tap science outreach talk (Seattle, October 28, 2015).

2015. "Bridging the Skill Gap from High School to Student Researcher: The Pre-Major in Astronomy Program (Pre-MAP) at the University of Washington." Northwest Astronomy Teaching Exchange (NATE), Center for Astronomy Education (CAE).

Teaching and Advising Experience and Relevant Professional Development

2017-2019. Lead Organizer. Astrobiology Seminar (weekly), UC Riverside

2018. Guest Lecture. "Exoplanet Biosignatures" Geo 280, UC Riverside (12/4)

2018. How to Teach Students Problem Solving Skills (CAE/AAS) (participant, 06/05)

2018. Using Anchored Inquiry to Teach Astronomy /Physics (BSCS/AAS) (participant, 06/03)

2018. Guest Lecture. "Spectral Signs of Habitability" Astro 630, University of Hawaii (04/25)

2016-2018. Co-advisor to Stephanie Olson, PhD student at UCR (6 papers)

2016-2019. Postdoc collaborator to Jacob Lustig-Yaeger, PhD Student at UW (1 paper,1 in prep.)

2017. Co-advisor to Spandan Dash, student in BMSIS Young Scientist Summer Program

2016. Guest Lecturer, Astronomy 150 "The Planets" (UW)

2015. Facilitator, "Being an RA in the Physical Sciences" workshop, TA/RA Conference (UW)

2014. Instructor of Record, ASTR 192 "Pre-Major in Astronomy seminar" (UW)

2013. Teaching Assistant, ASTBIO 115 "Introduction to Astrobiology" (UW)

2012-2013. Physics/Astronomy Tutor, Student Athlete Academic Services (UW)

2011. Teaching Assistant, ASTR 101 "Introduction to Astronomy" (UW)

2010-2011. Teaching Assistant, ASTR 150 "The Planets" (UW)

2011, 2014. Astronomy Tutor, CLUE program (UW)

Education and Outreach Service

2010-2016. UW Planetarium and Mobile Planetarium Show Presenter (min 1/qrt)

2010-2016. Staff Member & Events Organizer, Pre-Major in Astronomy Program (UW)

2009. NASA International Year of Astronomy Student Ambassador, Florida

2006-2008. Coach, Brevard County (FL) Collaborative High School Science Bowl Team

Peer-Reviewed Papers and Book Chapters

(Google Scholar h-index=16; N_{cite}=776; *includes a (co-)advised student (co-)author)

***Schwieterman, E. W.,** Reinhard, C. T., Olson, S. L., Harman, C.E., Lyons, T.W. 2019b. A limited habitable zone for complex life. *The Astrophysical Journal*, in review, arXiv: 1902.04720.

***Schwieterman, E.W**., Reinhard, C.T., Olson, S., et al. 2019a. Rethinking CO antibiosignatures in the search for life beyond the solar system. *The Astrophysical Journal*, 874, 9.

Glenar, D.A., Stubbs, T.J., **Schwieterman, E.W.**, Robinson, T.D., Livengood, T.A., 2019. Earthshine as an illumination source at the Moon. Icarus 321, 841–856.

*Lustig-Yaeger, J., Meadows, V., Tovar, G., **Schwieterman, E.,** et al. 2018. Detecting Ocean Glint on Exoplanets by Phase-Dependent Mapping. The *Astronomical Journal*, 156, 301.

DasSarma, S.D. & **Schwieterman, E. W.** 2018. Early Evolution of Purple Retinal Pigments on Earth and Implications for Exoplanet Biosignatures. *International Journal of Astrobiology*, 1-10, doi: 10.1017/S1473550418000423

***Schwieterman, E.W.** et al. 2018. Exoplanet Biosignatures: A Review of Remotely Detectable Signs of Life. *Astrobiology*, 18(6), 663-708. doi: 10.1089/ast.2017.1729

*Olson, S.L., **Schwieterman, E.W.,** Reinhard, C.T., Ridgwell, A., Kane, S.R., Meadows, V.S., and Lyons, T.W., 2018, Atmospheric seasonality as an exoplanet biosignature: *The Astrophysical Journal Letters*, 858, L14. doi.org/10.3847/2041-8213/aac171.

Schwieterman E.W. (2018) Surface and Temporal Biosignatures. In: Deeg H., Belmonte J. (eds) Handbook of Exoplanets. Springer, Cham. doi: 10.1007/978-3-319-30648-3_69-1

*Olson S.L., **Schwieterman E.W.,** Reinhard C.T., Lyons T.W. (2018) Earth: Atmospheric Evolution of a Habitable Planet. In: Deeg H., Belmonte J. (eds) Handbook of Exoplanets. Springer, Cham. doi: 10.1007/978-3-319-55333-7_189

Meadows, V.S., Arney, G.N., **Schwieterman, E.W.** et al. 2018. The Habitability of Proxima Centauri b: Environmental States and Observational Discriminants *Astrobiology*, 18(2). doi: 10.1089/ast.2016.1589

*Reinhard, C.T., Olson, S.L., **Schwieterman, E.W.**, Lyons, T.W., 2017. False Negatives for Remote Life Detection on Ocean-Bearing Planets: Lessons from the Early Earth. Astrobiology 17, 287–297.

Schwieterman, E.W., Meadows, V.S., et al. 2016. Identifying Planetary Biosignature Impostors: Spectral Features of CO and O_4 Resulting from Abiotic O_2/O_3 Production. *The Astrophysical Journal Letters*, 819: L13

Krissansen-Totton, J., **Schwieterman, E.W.,** et al., 2016. Is the Pale Blue Dot Unique? Optimized Photometric Bands for Identifying Earth-Like Exoplanets. *The Astrophysical Journal* 817, 31.

Schwieterman, E.W., Robinson, T.D., Meadows, V.S., Misra, A., Domagal-Goldman, S., 2015. Detecting and Constraining N_2 Abundances in Planetary Atmospheres Using Collisional Pairs. *The Astrophysical Journal* 810, 57.

Harman, C.E., **Schwieterman, E.W.,** Schottelkotte, J.C., Kasting, J.F., 2015. Abiotic O_2 Levels on Planets Around F, G, K, and M Stars: Possible False Positives for Life? *The Astrophysical Journal* 812, 137.

Schwieterman, E.W., Cockell, C.S., Meadows, V.S., 2015. Nonphotosynthetic Pigments as Potential Biosignatures. *Astrobiology* 15, 341–361.

Schwieterman, E. W., et al. 2010. Time-Series Photometry of GW Librae One Year after Outburst. *Journal of the Southeastern Association for Research in Astronomy*, Vol 3.

Meadows, V.S., Reinhard, C.T., Arney, G.N., Parenteau, M.N., **Schwieterman, E.W.** et al., 2018. Exoplanet Biosignatures: Understanding Oxygen as a Biosignature in the Context of Its Environment. *Astrobiology*, 18(6), 630-662. doi: 10.1089/ast.2017.1727

Walker, S.I., et al. (including **Schwieterman, E.W.**) 2018. Exoplanet Biosignatures: Future Directions. *Astrobiology* 18(6), 779-824. doi: 10.1089/ast.2017.1738

Kiang, N.Y., Domagal-Goldman, S., Parenteau, M.N., Catling, D.C., Fujii, Y., Meadows, V.S., **Schwieterman, E.W**., Walker, S.I., 2018. Exoplanet Biosignatures: At the Dawn of a New Era of Planetary Observations. *Astrobiology* 18(6). doi:10.1089/ast.2018.1862

Arney, G.N., et al. (including **Schwieterman, E.**) 2017. Pale Orange Dots: The Impact of Organic Haze on the Habitability and Detectability of Earthlike Exoplanets. *The Astrophysical Journal* 836, 49.

Gentry, D.M., et al. (including **Schwieterman, E.W**.) 2017. Correlations Between Life-Detection Techniques and Implications for Sampling Site Selection in Planetary Analog Missions. *Astrobiology* 17, 1009–1021.

Stüeken, E.E., Kipp, M.A., Koehler, M.C., **Schwieterman, E.W.**, Johnson, B., Buick. R. 2016. Modeling pN_2 through Geological Time: Implications for Planetary Climates and Biosignatures. *Astrobiology* 16, 949–963.

Arney, G., Domagal-Goldman, S., Meadows, S., Wolf, E., **Schwieterman, E.**, et al. 2016. The Pale Orange Dot: The Spectrum and Habitability of Hazy Archean Earth. *Astrobiology* 16, 873–899.

Amador, E.S., et al. (incl. **Schwieterman, E.**). 2015. Synchronous in-field application of life-detection techniques in planetary analog missions. *Planetary and Space Sciences*,106:1-10.

Robinson, T.D., et al. (incl. **Schwieterman, E.W.**). 2014. Detection of Ocean Glint and Ozone Absorption Using LCROSS Earth Observations. *The Astrophysical* Journal 787, 171.

Knight, M.M., et al. (incl. **Schwieterman, E.W.**) 2012. A Quarter-Century of Observations of Comet 10P/Tempel 2 at Lowell Observatory: Continued Spin-Down, Coma Morphology, Production Rates, and Numerical Modeling. *The Astronomical Journal*, 144:153.

Meech, K.J., et al. (incl. **Schwieterman, E.W.**) 2011. EPOXI: Observations from a Worldwide Earth-Based Campaign. *The Astrophysical Journal Letters*, 734:L1.

Knight, M.M., Farnam, T.L, Schleicher, D., **Schwieterman, E.W.** 2011. The Increasing Rotation Period of Comet 10P/Tempel 2. *The Astronomical Journal*, 141:2.

Addison, B., Durrance, S.T., **Schwieterman, E.** 2010. Modeling and Observing Extrasolar Planetary Transits. *Journal of the Southeastern Association for Research in Astronomy*, Vol 3.

Piwowar, D., Wood, M.A., **Schwieterman, E.W.**, et al. 2010. Time-Series Photometry of the Cataclysmic Variable Systems VY Aquarii and V2491 Cygni. *Journal of the Southeastern Association for Research in Astronomy*, Vol 3.

White Papers and Other Non-Refereed Articles (*includes a student author)

*Reinhard, C.T., **Schwieterman, E.W.,** et al. (2019) The remote detectability of Earth's biosphere through time and the importance of UV capability for characterizing habitable exoplanets. A white paper submitted in response to the 2020 Astronomy & Astrophysics Decadal Survey call. arXiv preprint 1903.05611.

*Checlair, J.H., Abbot, D.S., Webber, R.J., Feng, Y.K., Bean, J.L., **Schwieterman, E.W.** et al. (2019) A Statistical Comparative Planetology Approach to Maximize the Scientific Return of Future Exoplanet Characterization Efforts. A white paper submitted in response to the 2020 Astronomy & Astrophysics Decadal Survey call. arXiv preprint 1903.05211.

Schwieterman, E.W., Lyons, T.W., Reinhard, C.T. (2018) 'Signs of life on a global scale: Earth as a laboratory for exoplanet biosignatures.' *The Biochemist*. Vol. 40. No. 6, pp. 22-27.

Schwieterman, E. W. (2018) 'Distant worlds beckon' (book review of *One of Ten Billion Earths* by Karel Schrijver), *Nature Astronomy*. Springer US, 2(11), pp. 849–850. doi: 10.1038/s41550-018-0624-8.

***Schwieterman, E.**, Reinhard, C., Olson, S., Lyons, T., 2018. *The Importance of UV Capabilities for Identifying Inhabited Exoplanets with Next Generation Space Telescopes*. A white paper submitted in response to the National Academies of Sciences Astrobiology Science Strategy and Exoplanet Science Strategy calls. arXiv preprint 1801.02744.

Domagal-Goldman, S., et al. (including **Schwieterman, E.W.**) 2018. *Life Beyond the Solar System: Remotely Detectable Biosignatures.* A white paper submitted in response to the National Academies of Sciences Study: Astrobiology Science Strategy and Exoplanet Strategy Calls. arXiv preprint 1801.06714.

Trainer, M., et al. (including **Schwieterman, E.W.)** 2018. *"Pale Orange Dot": Titan As An Analog For Early Earth And Hazy Exoplanets.* A white paper submitted in response to the National Academies of Sciences Study: Astrobiology Science Strategy for the Search for Life in the Universe.

Haqq-Misra, J., Som, S., Mullan, B., Loureiro, R., **Schwieterman, E.**, et al. 2018. *The Astrobiology of the Anthropocene.* A white paper submitted in response to the National Academies of Sciences Study: Astrobiology Science Strategy for the Search for Life in the Universe. arXiv preprint 1801.00052.

Henning, W.G., et al. (including **E.W. Schwieterman**). 2018. Exoplanet Science Priorities from the Perspective of Internal and Surface Processes for Silicate and Ice Dominated Worlds. A white paper submitted in response to the National Academies of Sciences Exoplanet Science Strategy call. arXiv preprint 1804.05094

Kopparapu, R., et al. (including **E.W. Schwieterman**). 2018. Exoplanet Diversity in the Era of Space-based Direct Imaging Missions. A white paper submitted in response to the National Academies of Sciences Exoplanet Science Strategy call. arXiv preprint 1803.03812

Fischer et al. (**E.W. Schwieterman** contributing author). 2018. National Aeronautics and Space Agency. The Large Ultraviolet Optical Infrared Surveyor (LUVOIR) Interim Report. Greenbelt, MD.

Knight, M., **Schwieterman, E.,** Schleicher, D. 2010. Comet 103P/Hartley. IAU Circ. 9163.

Press Releases & Selected Media

2019. "Why this poisonous gas could be a sign of alien life." Mike Wall, Space.com. https://www.space.com/carbon-monoxide-indicator-alien-life.html

2019. "Carbon monoxide detectors could warn of extraterrestrial life." Sarah Simpson, UCR News. https://news.ucr.edu/articles/2019/03/18/carbon-monoxide-detectors-could-warn-extraterrestrial-life

2018. "Purple reign: life on Earth might once have been dominated by purple microorganisms." CBC "Quirks & Quarks" Article and Radio Interview with Dr. Edward Schwieterman.

2018. "Was Life on the Early Earth Purple?" Keith Cooper, Astrobiology Magazine: https://www.astrobio.net/news-exclusive/was-life-on-the-early-earth-purple/

2018. "UCR Team Among Scientists Developing Guidebook for Finding Life Beyond Earth" Sarah Nightingale, *UCR Today*: https://ucrtoday.ucr.edu/54211

2018. "Atmospheric Seasons Could Signal Alien Life" Sarah Nightingale, *UCR Today:* https://ucrtoday.ucr.edu/53416

2018. "False Positives, False Negatives; The World of Distant Biosignatures Attracts and Confounds." Marc Kauffman, *Many Worlds/ NASA Astrobiology Newsletter: https://astrobiology.nasa.gov/news/false-positives-false-negatives-the-world-of-distant-biosignatures-attracts-and-confounds/*

2017. "A new atmosphere in astronomy: UW alumni and Virtual Planetary Laboratory featured for exoplanet modeling." Alan Brazelton, *The UW Daily*: http://www.dailyuw.com/features/article_fc7ca23e-021f-11e7-9e7e-1f7266f313ac.html

2016. "Planet Hunters Seek New Ways to Detect Alien Life." Alexandra Witze, *Nature News.* doi:10.1038/535474a

2016. "False Positives in the Search for Extraterrestrial Life." Paul Glister, *Centauri Dreams. https://www.centauri-dreams.org/2016/03/02/false-positives-in-the-search-for-extraterrestrial-life/*

2016. "Life or an illusion? Avoiding 'false positives' in the search for living worlds." Peter Kelley – *UW Today*. https://www.washington.edu/news/2016/02/29/life-or-illusion-avoiding-false-positives-in-the-search-for-living-worlds/

2016. "Nitrogen may be a sign of habitability." Elizabeth Howell, *Astrobiology Magazine*. https://www.astrobio.net/news-exclusive/nitrogen-may-be-a-sign-of-habitability/

2015. "Earth observations show how nitrogen may be detected on exoplanets, aiding search for life." Peter Kelley, *UW Today*. https://www.washington.edu/news/2015/09/03/earth-observations-show-how-nitrogen-may-be-detected-on-exoplanets-aiding-search-for-life/

2015. "Spectrum of life: Nonphotosynthetic pigments could be biosignatures of life on other worlds." Peter Kelley, *UW Today*. https://www.washington.edu/news/2015/06/22/spectrum-of-life-nonphotosynthetic-pigments-could-be-biosignatures-of-life-on-other-worlds/

Memberships in Professional Societies

American Astronomical Society, Division of Planetary Sciences, American Physical Society, American Geophysical Union, European Association of Geochemistry