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Center for Computational
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about

I am a postdoctoral fellow at the Center for Computational Astrophysics in New York City, working on finding novel ways to discover & characterize exoplanets. I am broadly interested in open source software, time-series analysis, astro-statistics, and general analytic techniques & algorithms for astronomy. Outside the office I love to hike, cycle, swim, craft lattes, faulty parallelism, and Oxford commas.

stats

Total Pubs	51
Refereed	45
First Author	15
Citations	2579
h-index	25

references

dan foreman-mackey

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david w. hogg

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eric agol

agol@uw.edu

education

2012–2017	PhD Astronomy and Astrobiology	University of Washington, Seattle WA
	– On the evolution, detection, and characterization of small, potentially habitable extrasolar planets (advised by Eric Agol, Rory Barnes, Victoria Meadows)	
2012–2013	MSc Astronomy and Astrobiology	University of Washington, Seattle WA
2006–2010	BA Astrophysics	Swarthmore College, Swarthmore PA
	– Minor in English Literature	

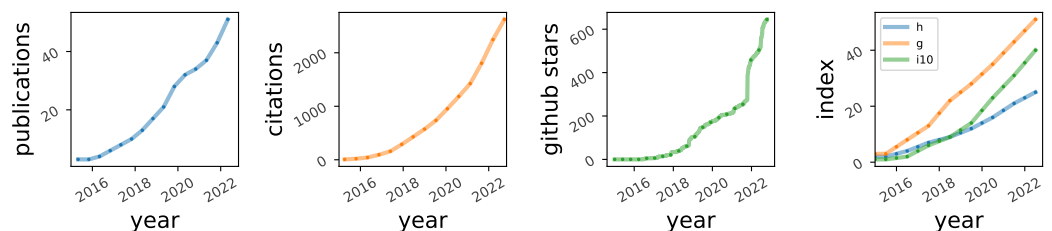
positions

2018–	Flatiron Research Fellow	Center for Computational Astrophysics, New York, NY
	– Work on hard statistical and computational data analysis problems applied to cutting edge problems in stellar and exoplanetary astrophysics	
	– Develop algorithms and open source software for timeseries analysis	
	– Expert on Gaussian processes, Bayesian inference, astrophysical imaging	
2017–2018	Postdoctoral Researcher	University of Washington
	– Developed techniques to reconstruct surface maps of extrasolar planets	
2012–2017	Research Associate	University of Washington
	– Developed signal processing methods to detect & characterize exoplanets	
	– Investigated the atmospheric evolution of Earth-like exoplanets	
2010–2012	High School Teacher	St. Luke's School, New Canaan CT
	– Created and taught a college-level elective course in astrophysics for seniors	
	– Taught junior physics, w/ a focus on critical thinking & creative problem solving	

honors

2018–2022	Flatiron Fellowship	Center for Computational Astrophysics, New York, NY
2018	Hubble Postdoctoral Fellowship	(Declined)
2018	51 Pegasi b Fellowship	(Declined)
2012–2015	ARCS Fellowship	University of Washington
2010	Bobby Berman Memorial Prize	Swarthmore College
2010	The Phi Beta Kappa Society	Swarthmore College

metrics



primary developer

secondary developer

popular software

- showyourwork** `pip install showyourwork`
 – A workflow for open source, reproducible scientific articles
- starry** `pip install starry`
 – Tools for light curve modeling & mapping stars and planets
- starry-process** `pip install starry-process`
 – Gaussian processes for modeling stellar variability
- planetplanet** `pip install planetplanet`
 – Tools for modeling planet-planet occultations
- everest** `pip install everest-pipeline`
 – Tools for de-trending K2 light curves
- exoplanet** `pip install exoplanet`
 – Tools for probabilistic modeling of exoplanet time series data
- VPLANET** `pip install vplanet`
 – Suite for simulating planetary system evolution and habitability

students

- 2022– **Sabina Sagynbayeva** Stony Brook University
 – Hierarchical Bayesian modeling of stellar surfaces
- 2020– **Shashank Dholakia** University of California, Berkeley
 – Developing analytic transit light curve models for oblate stars
- 2020– **Shishir Dholakia** University of California, Berkeley
 – Developing analytic transit light curve models for oblate stars
- 2020–2021 **Rebecca Young** Simons-NSBP Scholars Program, CCA
 – Inferring differential rotation rates from Kepler light curves
- 2020– **Fran Bartolić** Pre-doctoral Program, CCA
 – Mapping the surface of Io from Jupiter occultation data
- 2019– **Asmaa Elsayed** AstroCom Program, CUNY/CCA
 – Understand the time evolution of spotted stellar surfaces
- 2019 **Brynnner Hidalgo** AstroCom Program, CUNY/CCA
 – Understand the time evolution of spotted stellar surfaces
- 2016–2018 **Nicholas Saunders** University of Washington
 – Develop tools to mitigate systematics in K2 data

other

- 2018– **Organizer, Astronomical Data Community Meeting** CCA
 – Organize weekly meeting for NYC area graduate students, postdocs, & faculty
- 2013–2017 **IT Manager** Virtual Planet Laboratory, University of Washington
 – Managed VPL's virtual conferencing system and network
- 2010–2012 **Head Coach** St. Luke's School, New Canaan CT
 – Head coach of the JV Boys Soccer and Fencing Teams

selected research talks

📄: Downloadable

📺: Watchable

- 📄 [Statistical Approaches to the Characterization of Stars, Exoplanets, and Solar System Bodies](#), Department Colloquium, University of California, Berkeley, April 14, 2022
- [Algorithms, Statistics, and Software for Exoplanet Detection and Characterization](#), Department Colloquium, University of Toronto Mississauga, March 15, 2022
- [Algorithms, Statistics, and Software for Exoplanet Detection and Characterization](#), Department Colloquium, Carnegie Mellon University, February 03, 2022
- [Statistical Approaches to Stellar and Exoplanetary Characterization](#), Department Colloquium, University of Toronto, February 18, 2022
- [Algorithms, Statistics, and Software for Exoplanet Detection and Characterization](#), Department Colloquium, Stony Brook University, January 31, 2022
- [Algorithms, Statistics, and Software for Exoplanet Detection and Characterization](#), Department Colloquium, Pennsylvania State University, January 28, 2022
- [Stellar Variability as a Statistical Process](#), Department Colloquium, Institut für Astrophysik Göttingen, November 18, 2021
- 📄 [An Introduction to Gaussian Process Regression](#), LSSTC Data Science Fellowship Program, Online, October 05, 2021
- 📄 [Signal or Noise: My love-hate relationship with stellar variability](#), University of Michigan Astronomy Department Colloquium, Ann Arbor, MI, September 23, 2021
- 📺 [Linear Models for TESS Systematics](#), TESS Science Conference II, Online, August 05, 2021
- 📺 [A Bunch of Random Things I'm Working On \(don't worry, they're all related to spherical harmonics\)](#), Center for Computational Astrophysics Lunch Talk, New York, NY, April 29, 2021
- [Gaussian Processes for Stellar Variability](#), University of New South Wales AstroSeminar, Sydney, Australia, February 03, 2021
- 📺 [Gaussian Processes for Stellar Variability](#), Center for Computational Astrophysics Lunch Talk, New York, NY, November 05, 2020
- [Toward Maps of Exoplanet Surfaces](#), University of British Columbia Astronomy Seminar, Vancouver, Canada, April 12, 2020
- [Toward Maps of Exoplanet Surfaces](#), American Museum of Natural History Astronomy Colloquium, New York, NY, March 10, 2020
- [Lots of Fun With TRAPPIST-1](#), Stanford KIPAC Tea, Stanford, CA, February 07, 2020
- [Toward Maps of Exoplanet Surfaces](#), Stanford Astrophysics Colloquium, Stanford, CA, February 06, 2020
- 📄 [Toward Maps of Exoplanet Surfaces](#), Oxford Physics Department Seminar, Oxford, UK, January 15, 2020
- [Surface Maps of Stars and Exoplanets](#), AAS Meeting 235, 132.01, Honolulu, HI, January 2020
- 📄 [Toward Maps of Exoplanet Surfaces](#), Yale University Exoplanet Journal Club, New Haven, CT, October 08, 2019
- 📄 [Toward Maps of Exoplanet Surfaces](#), Villanova University Astronomy Department Colloquium, Villanova, PA, September 20, 2019
- 📄 [Regularization and Ridge Regression](#), LSSTC Data Science Fellowship Program, New York, NY, September 12, 2019

- 📄 [An Introduction to Gaussian Process Regression](#), LSSTC Data Science Fellowship Program, Pittsburgh, PA, June 08, 2019
- 📄 [Gradient-based Inference Techniques for Exoplanet Light Curves](#), Kepler Science Conference V, Glendale, CA, March 05, 2019
- 📄 [STARRY: Analytic Occultation and Rotation Light Curves](#), TESS Data Workshop, Baltimore, MD, February 11, 2019
- [Probing the TRAPPIST-1 System with K2, JWST, and Beyond](#), AAS Meeting 231, 410.02, National Harbor, MD, January 2018
- [Probing the TRAPPIST-1 System with Planet-Planet Occultations](#), Stars & Planets Seminar, Center for Astrophysics, Cambridge, MA, October 30, 2017
- [Probing the TRAPPIST-1 System with Planet-Planet Occultations](#), Dept. Colloquium, Penn State University, State College, PA, September 11, 2017
- 📄 [On the Evolution, Detection, and Characterization of Small Planets in the Habitable Zones of Low Mass Stars](#), Dissertation Talk, Seattle, WA, August 11, 2017
- 📄 [EVEREST Tutorial and Workshop](#), Kepler Science Conference IV, Mountain View, CA, June 21, 2017
- 📄 [TRAPPIST-1: A Seven-Planet Resonant Chain Unveiled by K2](#), Kepler Science Conference IV, Mountain View, CA, June 21, 2017
- [Evolution of the Water Content of Proxima Centauri b](#), Astrobiology Science Conference, 3534, Mesa, AZ, April 28, 2017
- [Habitable Zone Planets with K2](#), Astrobiology Science Conference, 3338, Mesa, AZ, April 26, 2017
- [Extreme Water Loss and Abiotic O₂ Buildup on Planets Throughout the Habitable Zones of M Dwarfs](#), AAS Meeting 225, 407.04, Seattle, WA, January 2015
- [Habitable Evaporated Cores: Converting Mini-Neptunes into Super-Earths in the Habitable Zone of M Dwarfs](#), AAS Meeting 223, 325.05, National Harbor, MD, January 2014

research publications

citations →
(refereed in **bold**)

- 4 **Luger, R.**, Agol, E., Bartolić, F., & Foreman-Mackey, D., 2022, [Analytic Light Curves in Reflected Light: Phase Curves, Occultations, and Non-Lambertian Scattering for Spherical Planets and Moons](#), *AJ*, **AJ accepted**, 164, 4
- 5 Johnson, M., David, T., Petigura, E., Isaacson, H., et al. (including **Luger, R.**), 2022, [An Aligned Orbit for the Young Planet V1298 Tau B](#), *AJ*, 163, 247
- 4 Wong, K., Breivik, K., Farr, W., & **Luger, R.**, 2022, [Backward Population Synthesis: Mapping the Evolutionary History of Gravitational-Wave Progenitors](#), arXiv:2206.04062
- 1 Lustig-Yaeger, J., Sotzen, K., Stevenson, K., **Luger, R.**, et al., 2022, [Hierarchical Bayesian Atmospheric Retrieval Modeling for Population Studies of Exoplanet Atmospheres: A Case Study on the Habitable Zone](#), *AJ*, 163, 140
- 2 do Amaral, L., Barnes, R., Segura, A., & **Luger, R.**, 2022, [The Contribution of M-Dwarf Flares to the Thermal Escape of Potentially Habitable Planet Atmospheres](#), *ApJ*, 928, 12
- 3 Bartolić, F., **Luger, R.**, Foreman-Mackey, D., Howell, R., & Rathbun, J., 2022, [Occultation Mapping of Io's Surface in the Near-Infrared. I. Inferring Static Maps](#), *The Planetary Science Journal*, 3, 67
- 14 Zinn, J., Stello, D., Elsworth, Y., García, R., et al. (including **Luger, R.**), 2022, [The K2 Galactic Archaeology Program Data Release 3: Age-Abundance Patterns in C1-C8 and C10-C18](#), *ApJ*, 926, 191
- 3 Dholakia, S., **Luger, R.**, & Dholakia, S., 2022, [Efficient and Precise Transit Light Curves for Rapidly Rotating, Oblate Stars](#), *ApJ*, 925, 185
- 10 Feinstein, A., Montet, B., Johnson, M., Bean, J., et al. (including **Luger, R.**), 2021, [H-Alpha and Ca II Infrared Triplet Variations During a Transit of the 23 Myr Planet V1298 Tau C](#), *AJ*, 162, 213
- 10 **Luger, R.**, Bedell, M., Foreman-Mackey, D., Crossfield, I., et al., 2021, [Mapping Stellar Surfaces III: An Efficient, Scalable, and Open-Source Doppler Imaging Model](#), arXiv:2110.06271
- 15 **Luger, R.**, Foreman-Mackey, D., & Hedges, C., 2021, [Mapping Stellar Surfaces. II. An Interpretable Gaussian Process Model for Light Curves](#), *AJ*, 162, 124
- 19 **Luger, R.**, Foreman-Mackey, D., Hedges, C., & Hogg, D., 2021, [Mapping Stellar Surfaces. I. Degeneracies in the Rotational Light-Curve Problem](#), *AJ*, 162, 123
- 3 Hedges, C., **Luger, R.**, Martinez-Palomera, J., Dotson, J., & Barentsen, G., 2021, [Linearized Field Deblending: Point-Spread Function Photometry for Impatient Astronomers](#), *AJ*, 162, 107
- 2 **Luger, R.**, Foreman-Mackey, D., & Hedges, C., 2021, [starry_process: Interpretable Gaussian Processes for Stellar Light Curves](#), *The Journal of Open Source Software*, 6, 3071
- 128 Foreman-Mackey, D., **Luger, R.**, Agol, E., Barclay, T., et al., 2021, [Exoplanet: Gradient-Based Probabilistic Inference for Exoplanet Data & Other Astronomical Time Series](#), *The Journal of Open Source Software*, 6, 3285
- 97 Agol, E., Dorn, C., Grimm, S., Turbet, M., et al. (including **Luger, R.**), 2021, [Refining the Transit-Timing and Photometric Analysis of TRAPPIST-1: Masses, Radii, Densities, Dynamics, and Ephemerides](#), *The Planetary Science Journal*, 2, 1
- 3 Hedges, C., **Luger, R.**, Dotson, J., Foreman-Mackey, D., & Barentsen, G., 2021, [Multiwavelength Photometry Derived From Monochromatic Kepler Data](#), *AJ*, 161, 95
- 16 Zinn, J., Stello, D., Elsworth, Y., García, R., et al. (including **Luger, R.**), 2020, [The K2 Galactic Archaeology Program Data Release 2: Asteroseismic Results From Campaigns 4, 6, and 7](#), *The Astrophysical Journal Supplement Series*, 251, 23

- 25 Cunningham, E., Garavito-Camargo, N., Deason, A., Johnston, K., et al. (including **Luger, R.**), 2020, [Quantifying the Stellar Halo's Response to the LMC's Infall With Spherical Harmonics](#), *ApJ*, 898, 4
- 77 Agol, E., **Luger, R.**, & Foreman-Mackey, D., 2020, [Analytic Planetary Transit Light Curves and Derivatives for Stars With Polynomial Limb Darkening](#), *AJ*, 159, 123
- 18 Montet, B., Feinstein, A., **Luger, R.**, Bedell, M., et al., 2020, [The Young Planet DS Tuc Ab Has a Low Obliquity](#), *AJ*, 159, 112
- 18 Fleming, D., Barnes, R., **Luger, R.**, & VanderPlas, J., 2020, [On the XUV Luminosity Evolution of TRAPPIST-1](#), *ApJ*, 891, 155
- 27 Barnes, R., **Luger, R.**, Deitrick, R., Driscoll, P., et al., 2020, [VPlanet: The Virtual Planet Simulator](#), *PASP*, 132, 24502
- 71 David, T., Petigura, E., **Luger, R.**, Foreman-Mackey, D., et al., 2019, [Four Newborn Planets Transiting the Young Solar Analog V1298 Tau](#), *ApJ*, 885
- 32 Bedell, M., Hogg, D., Foreman-Mackey, D., Montet, B., & **Luger, R.**, 2019, [WOBBLE: A Data-Driven Analysis Technique for Time-Series Stellar Spectra](#), *AJ*, 158, 164
- 131 Feinstein, A., Montet, B., Foreman-Mackey, D., Bedell, M., et al. (including **Luger, R.**), 2019, [Eleanor: An Open-Source Tool for Extracting Light Curves From the TESS Full-Frame Images](#), *PASP*, 131, 94502
- 38 Kruse, E., Agol, E., **Luger, R.**, & Foreman-Mackey, D., 2019, [Detection of Hundreds of New Planet Candidates and Eclipsing Binaries in K2 Campaigns 0-8](#), *The Astrophysical Journal Supplement Series*, 244, 11
- 26 Fleming, D., Barnes, R., Davenport, J., & **Luger, R.**, 2019, [Rotation Period Evolution in Low-Mass Binary Stars: The Impact of Tidal Torques and Magnetic Braking](#), *ApJ*, 881, 88
- 132 Eastman, J., Rodriguez, J., Agol, E., Stassun, K., et al. (including **Luger, R.**), 2019, [EXOFASTv2: A Public, Generalized, Publication-Quality Exoplanet Modeling Code](#), *arXiv:1907.09480*
- 2 Kislyakova, K., Fossati, L., Shulyak, D., Günther, E., et al. (including **Luger, R.**), 2019, [Detecting Volcanically Produced Tori Along Orbits of Exoplanets Using UV Spectroscopy](#), *arXiv:1907.05088*
- 38 Kreidberg, L., **Luger, R.**, & Bedell, M., 2019, [No Evidence for Lunar Transit in New Analysis of Hubble Space Telescope Observations of the Kepler-1625 System](#), *ApJ*, 877
- 3 Saunders, N., **Luger, R.**, & Barnes, R., 2019, [The Pointing Limits of Transiting Exoplanet Light Curve Characterization With Pixel Level Decorrelation](#), *AJ*, 157, 197
- 17 **Luger, R.**, Bedell, M., Vanderspek, R., & Burke, C., 2019, [TESS Photometric Mapping of a Terrestrial Planet in the Habitable Zone: Detection of Clouds, Oceans, and Continents](#), *arXiv:1903.12182*
- 140 **Luger, R.**, Agol, E., Foreman-Mackey, D., Fleming, D., et al., 2019, [Starry: Analytic Occultation Light Curves](#), *AJ*, 157, 64
- Barnes, R., **Luger, R.**, Smotherman, H., Deitrick, R., & Fleming, D., 2019, [After the Habitable Zone](#), *Memorie della Societa Astronomica Italiana*, 90, 641
- 33 Lustig-Yaeger, J., Meadows, V., Tovar Mendoza, G., Schwieterman, E., et al. (including **Luger, R.**), 2018, [Detecting Ocean Glint on Exoplanets Using Multiphase Mapping](#), *AJ*, 156, 301
- 93 Lincowski, A., Meadows, V., Crisp, D., Robinson, T., et al. (including **Luger, R.**), 2018, [Evolved Climates and Observational Discriminants for the TRAPPIST-1 Planetary System](#), *ApJ*, 867, 76
- 115 **Luger, R.**, Kruse, E., Foreman-Mackey, D., Agol, E., & Saunders, N., 2018, [An Update to the EVEREST K2 Pipeline: Short Cadence, Saturated Stars, and Kepler-Like Photometry Down to Kp = 15](#), *AJ*, 156, 99
- 24 Fleming, D., Barnes, R., Graham, D., **Luger, R.**, & Quinn, T., 2018, [On the Lack of Circumbinary](#)

- Planets Orbiting Isolated Binary Stars, *ApJ*, 858, 86
- 12 Tian, F., Güdel, M., Johnstone, C., Lammer, H., et al. (including **Luger, R.**), 2018, [Water Loss From Young Planets](#), *Space Science Reviews*, 214, 65
- 111 Meadows, V., Arney, G., Schwieterman, E., Lustig-Yaeger, J., et al. (including **Luger, R.**), 2018, [The Habitability of Proxima Centauri B: Environmental States and Observational Discriminants](#), *Astrobiology*, 18, 133
- 17 **Luger, R.**, Foreman-Mackey, D., & Hogg, D., 2017, [Linear Models for Systematics and Nuisances](#), *Research Notes of the American Astronomical Society*, 1, 7
- 29 **Luger, R.**, Lustig-Yaeger, J., & Agol, E., 2017, [Planet-Planet Occultations in TRAPPIST-1 and Other Exoplanet Systems](#), *ApJ*, 851, 94
- 229 **Luger, R.**, Sestovic, M., Kruse, E., Grimm, S., et al., 2017, [A Seven-Planet Resonant Chain in TRAPPIST-1](#), *Nature Astronomy*, 1, 129
- 27 **Luger, R.**, Lustig-Yaeger, J., Fleming, D., Tilley, M., et al., 2017, [The Pale Green Dot: A Method to Characterize Proxima Centauri B Using Exo-Aurorae](#), *ApJ*, 837, 63
- 202 **Luger, R.**, Agol, E., Kruse, E., Barnes, R., et al., 2016, [EVEREST: Pixel Level Decorrelation of K2 Light Curves](#), *AJ*, 152, 100
- 58 Barnes, R., Deitrick, R., **Luger, R.**, Driscoll, P., et al., 2016, [The Habitability of Proxima Centauri B I: Evolutionary Scenarios](#), [arXiv:1608.06919](#)
- 73 Schwieterman, E., Meadows, V., Domagal-Goldman, S., Deming, D., et al. (including **Luger, R.**), 2016, [Identifying Planetary Biosignature Impostors: Spectral Features of CO and O₄ Resulting From Abiotic O₂/O₃ Production](#), *ApJ*, 819
- 307 **Luger, R.**, & Barnes, R., 2015, [Extreme Water Loss and Abiotic O₂ Buildup on Planets Throughout the Habitable Zones of M Dwarfs](#), *Astrobiology*, 15, 119
- 96 **Luger, R.**, Barnes, R., Lopez, E., Fortney, J., et al., 2015, [Habitable Evaporated Cores: Transforming Mini-Neptunes Into Super-Earths in the Habitable Zones of M Dwarfs](#), *Astrobiology*, 15, 57
- 19 Deitrick, R., Barnes, R., McArthur, B., Quinn, T., et al. (including **Luger, R.**), 2015, [The Three-Dimensional Architecture of the \$\nu\$ Andromedae Planetary System](#), *ApJ*, 798, 46