

Sarah C. Millholland

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RESEARCH INTERESTS	Exoplanet detection and characterization; planetary dynamics and orbital architectures	
CURRENT POSITION	NASA Sagan Fellow Department of Astrophysical Sciences Princeton University, Princeton, NJ	2020 - present
EDUCATION	Yale University, New Haven, CT Ph.D. in Astronomy, May 2020 <i>Thesis: Data-Driven Dynamics of Planetary Systems</i> <i>Advisor: Prof. Greg Laughlin</i> M.S., M.Phil. in Astronomy, May 2018	July 2016 – May 2020
	UC Santa Cruz, Santa Cruz, CA Pursuit of Ph.D. in Astronomy & Astrophysics (transferred after completing first year)	Sept. 2015 – June 2016
	University of Saint Thomas, Saint Paul, MN B.S. in Physics; B.A. in Mathematics, May 2015 <i>Summa Cum Laude</i> , GPA: 4.00	Sept. 2011 – May 2015
AWARDS	<ul style="list-style-type: none">- Lyman Spitzer Jr. Postdoctoral Fellowship, Princeton University- NASA Hubble Fellowship Program (NHFP) Sagan Fellowship- Tinsley Award for the Best Paper by a Yale Astronomy Graduate Student (for Millholland & Laughlin 2017b)- DDA/AAS Raynor L. Duncombe Prize for Student Research- Yale Conference Travel Fellowship- NSF Graduate Research Fellowship- Summer Sagan Workshop Travel Award- UCSC Regents Fellowship- NSF Graduate Research Fellowship Honorable Mention- Barry M. Goldwater Scholarship (national science scholarship)- Smith Academic Scholarship- Danger Mathematics Scholarship- UST Collaborative Inquiry Research Scholarship- Walczak Mathematics Scholarship- B. John Barry Academic Scholarship- UST Endowed Scholarship	<ul style="list-style-type: none">2023-20252020-20232018201820172017 – 20202016201520152014 – 20152014 – 20152013 – 2014, 2014 – 201520142013 – 20142012 – 20132011 – 2015
TEACHING EXPERIENCE	<ul style="list-style-type: none">- Teaching Fellow, Planets and Stars, Yale University- Teaching Fellow, Physics of Planetary Systems, UCSC- Teaching Fellow, Overview of the Universe, UCSC- Teaching Assistant, Modern Physics, UST- Observatory Lab Instructor, Introduction to Astronomy, UST and the UST Observatory	<ul style="list-style-type: none">Spring 2017Spring 2016Fall 2016Springs 2014, 2015Fall 2012 – Spring 2015
MENTORING EXPERIENCE	<ul style="list-style-type: none">- David Jensen, Princeton University undergraduate student, 2020 – present- Samantha Berek, Yale University undergraduate student (mentored through the “Astro Sib” program), 2018 – 2020	

- Adrian Kulesza, Yale University undergraduate student (research project in “Astrophysics Research Methods”), Spring 2019
- Rachel Cohen, Yale University undergraduate student (research project in “Astrophysics Research Methods”), Spring 2019
- Marguerite Epstein-Martin, Yale University undergraduate student (co-advised with Greg Laughlin), 2017 – 2018

1ST AUTHOR
PAPERS

11. **Millholland, S.** & Spalding, C. “Formation of Ultra-Short-Period Planets by Obliquity-Driven Tidal Runaway.” 2020, submitted to AAS Journals
10. **Millholland, S.**, Petigura, E., & Batygin, K. “Tidal Inflation Reconciles Low-Density Sub-Saturns with Core Accretion.” 2020, ApJ, 897, 7
9. **Millholland, S.** “Tidally Induced Radius Inflation of Sub-Neptunes.” 2019, ApJ, 886, 72
8. **Millholland, S.** & Batygin, K. “Excitation of Planetary Obliquities Through Planet-Disk Interactions.” 2019, ApJ, 876, 119
7. **Millholland, S.** & Laughlin, G. “Obliquity-Driven Sculpting of Exoplanetary Systems.” 2019, Nature Astronomy, 3, 424, arXiv: 1903.01386
6. **Millholland, S.** & Laughlin, G. “Obliquity Tides May Drive WASP-12b’s Rapid Orbital Decay.” 2018, ApJL, 869, L15
5. **Millholland, S.**, Laughlin, G., Teske, J., et al. “New Constraints on Gliese 876 – Exemplar of Mean-Motion Resonance.” 2018, AJ, 155, 106
4. **Millholland, S.**, Wang, S., & Laughlin, G. “*Kepler* Multi-Planet Systems Exhibit Unexpected Intra-system Uniformity in Mass and Radius.” 2017, ApJL, 849, L33
3. **Millholland, S.** & Laughlin, G. “Supervised Learning Detection of Sixty Non-Transiting Hot Jupiter Candidates.” 2017, AJ, 154, 83
2. **Millholland, S.** & Laughlin, G. “Constraints on Planet Nine’s Orbit and Sky Position within a Framework of Mean-motion Resonances.” 2017, AJ, 153, 91
1. **Millholland, S.**, Wang, S., & Laughlin, G. “On the Detection of Non-Transiting Hot Jupiters in Multiple Planet Systems.” 2016, ApJL, 823, L7

2ND AUTHOR
PAPERS

2. Spalding, C. & **Millholland, S.** “Stellar Oblateness versus Distant Giants in Exciting *Kepler* Planet Mutual Inclinations.” 2020, AJ, 160, 105
1. Adams, A. D., **Millholland, S.**, & Laughlin, G. “Signatures of Obliquity in Thermal Phase Curves of Hot Jupiters.” 2019, AJ, 158, 3

OTHER
CO-AUTHOR
PAPERS

5. Davis, A., Wang, S., Jones, M., Eastman, J., Günther, M., Stassun, K., et al. including **Millholland, S.** [51 total] “TOI 564 b and TOI 905 b: Grazing and Fully Transiting Hot Jupiters Discovered by TESS.” 2020, AJ, in press
4. Bryan, M., Chiang, E., Bowler, B. P., Morley, C. V., **Millholland, S.**, Blunt, S., Ashok, K. B., Nielsen, E., Ngo, H., Mawet, D., Knutson, H. A. “Obliquity Constraints on an Extrasolar Planetary-Mass Companion.” 2020, AJ, 159, 181

3. Wang, S., Jones, M., Shporer, A., Fulton, B. J., Paredes, L. A., Trifonov, T., Kossakowski, D., Eastman, J., Redfield, S., Günther, M. N., Kreidberg, L., Huang, C. X., **Millholland, S.**, et al. [60 total] “HD 202772Ab: A Transiting Hot Jupiter Around a Bright, Mildly Evolved Star in a Visual Binary Discovered by TESS.” 2019, AJ, 157, 51
2. Becker, J. C., Khain, T., Hamilton, S. J., Adams, F. C., Gerdes, D. W., Zullo, L., Franson, K., **Millholland, S.**, et al. [66 total] “Discovery and Dynamical Analysis of an Extreme Trans-Neptunian Object with a High Orbital Inclination.” 2018, AJ, 156, 81
1. Janvier, M., Savcheva, A., Pariat, E., Tassev, S., **Millholland, S.**, Bommier, V., McCauley, P., McKillop, S., Dougan, F. “Evolution of Flare Ribbons, Electric Currents and Quasi-separatrix Layers During an X-class Flare.” 2016, A&A, 591, A141

OBSERVING PROGRAMS

1. Keck I, HIRESr, “Non-Transiting Hot Jupiters: Hidden Companions to Known Exoplanets”, 2020B, 2 nights, Co-I (PI: Malena Rice)
2. ORM, STELLA/SES, “Radial velocity confirmation of non-transiting planets from Kepler” 2020B, 40 hrs, Co-I (PI: Jorge Lillo-Box)
3. Keck I, HIRESr, “Non-Transiting Hot Jupiters: Hidden Companions to Known Exoplanets”, 2020A, 2 nights, Co-I (PI: Songhu Wang)
4. Keck I, HIRESr, “Are Hot Jupiters Dynamically Hot?”, 2020A, 2 nights, Co-I (PI: Songhu Wang)
5. Keck I, HIRESr, “Non-Transiting Hot Jupiters: Hidden Companions to Known Exoplanets”, 2019B, 4 nights, Co-I (PI: Songhu Wang)
6. CAHA, CAFE, “Radial velocity confirmation of non-transiting planets from Kepler” 2019B, 5 nights, Co-I (PI: Jorge Lillo-Box)
7. Keck I, HIRESr, “Do Multi-planet Systems Share Alignment with Their Parent Stars?”, 2018A, 1 night, Co-I (PI: Songhu Wang)

CONFERENCE TALKS

1. “Formation of Ultra-Short-Period Planets by Obliquity-Driven Tidal Runaway.” Division of Dynamical Astronomy Meeting, virtual conference, August 2020
2. “The Role of Tidal Inflation in Explaining Sub-Saturn Structures.” Boston Area Exoplanet Science Meeting #7, virtual conference, April 2020
3. “Tidally-Induced Radius Inflation of Sub-Neptunes.” Extreme Solar Systems IV, Reykjavik, Iceland, August 2019
4. “Tidally-Induced Radius Inflation of Sub-Neptunes.” Emerging Researchers in Exoplanet Science (ERES) V, Cornell University, Ithaca, NY, June 2019
5. “Excitation of Planetary Obliquities Through Planet-Disk Interactions.” Division of Dynamical Astronomy Meeting, Boulder, CO, June 2019
6. “Obliquity Tides and their Role in Understanding the Kepler Planet Period Ratio Distribution.” Kepler & K2 Science Conference V, Glendale, CA, March 2019
7. “The Surprising Role of Obliquity Tides in Short-Period Exoplanets.” Boston Area Exoplanet Science Meeting #5, Boston University, Boston, MA, January 2019

8. “Consequences of Large Planetary Obliquities in Extrasolar Systems.” 2018 Connecticut Exoplanets Meeting, Wesleyan University, Middletown, CT, July 2018
9. “Obliquity-Driven Sculpting of Exoplanetary Systems.” Emerging Researchers in Exoplanet Science (ERES) IV, Pennsylvania State University, State College, PA, June 2018
10. “On f for 9.” Planet Nine Workshop, California Institute of Technology, Pasadena, CA, May 2018
11. “On the Obliquities of Planets in Close-in, Coplanar Systems.” Division of Dynamical Astronomy Meeting, San Jose, CA, April 2018
12. “New Constraints on the Multi-Resonant Planetary System, Gliese 876.” Numerical Integration Methods in Planetary Science, University of Toronto at Scarborough, Toronto, Ontario, August 2017
13. “Constraints on Planet Nine in a Mean-Motion Resonant Framework.” Numerical Integration Methods in Planetary Science, University of Toronto at Scarborough, Toronto, Ontario, August 2017
14. “Supervised Learning Detection of Sixty Non-Transiting Hot Jupiter Candidates.” Kepler & K2 Science Conference IV, NASA Ames Research Center, Moffett Field, CA, June 2017
15. “Supervised Learning Detection of Sixty Non-Transiting Hot Jupiter Candidates.” Emerging Researchers in Exoplanet Science (ERES) III, Yale University, New Haven, CT, June 2017
16. “Supervised Learning Detection of Sixty Non-Transiting Hot Jupiter Candidates.” 2017 Connecticut Exoplanets Meeting, Wesleyan University, Middletown, CT, May 2017
17. “Constraints on Planet Nine in a Mean-Motion Resonant Framework.” 2017 Aspen Winter Conference, Formation and Dynamical Evolution of Exoplanets, Aspen, CO, March 2017

SEMINARS &
COLLOQUIA
(* = INVITED)

1. * JPL Exoplanet Journal Club Talk, NASA Jet Propulsion Laboratory, August 2020
2. * Special Seminar, Climate and Space Sciences and Engineering, University of Michigan, February 2020
3. * Cosmos Seminar, The University of Texas at Austin, October 2019
4. * Institute for Theory and Computation Seminar, Harvard University, October 2019
5. Friday Lunch Time Astrophysics Seminar, University of California Santa Cruz, October 2019
6. Tuesday Lunch Talk, University of California Los Angeles, October 2019
7. Astronomy Tea Talk, California Institute of Technology, October 2019
8. Exoplanet Tea Talk, Massachusetts Institute of Technology, September 2019
9. * Planetary Lunch Seminar, Cornell University, September 2019
10. Astronomy Seminar, Columbia University, September 2019

11. Star and Planet Formation Seminar, University of Michigan, March 2019
12. Princeton Extrasolar Planet Discussion Group, Princeton University, February 2019
13. * Penn State Center for Exoplanets & Habitable Worlds Seminar, Penn State University, February 2019
14. * Extrasolar Planets Seminar, NASA Goddard Space Flight Center, April 2018
15. * Planetary Science Seminar, California Institute of Technology, December 2017
16. * Stars & Planets Seminar, Harvard-Smithsonian Center for Astrophysics, November 2017
17. Exoplanet Pizza Lunch, Harvard-Smithsonian Center for Astrophysics, March 2017

POSTER
PRESENTATIONS

1. **Millholland, S.**, Petigura, E., & Batygin, K. “Tidal Inflation Reconciles Low-Density Sub-Saturns with Core Accretion.” Exoplanets III Conference, virtual conference, July 2020
2. Adams, A., **Millholland, S.** & Laughlin, G. “Detecting Planet Obliquity in Thermal Phase Curves.” Summer Sagan Workshop, Pasadena, CA, July 2018
3. **Millholland, S.** & Laughlin, G. “Obliquity-Driven Sculpting of Exoplanetary Systems.” Exoplanets II Conference, Cambridge, UK, July 2018
4. **Millholland, S.**, Laughlin, G., Butler, P., et al. “New Dynamical Constraints on the Multi-Resonant System, GJ 876.” Summer Sagan Workshop, Pasadena, CA, July 2016
5. **Millholland, S.**, Laughlin, G., Burt, J., et al. “A Search for Non-Transiting Hot Jupiters with Transiting Super-Earth Companions.” Exoplanets I Conference, Davos, Switzerland, July 2016
6. **Millholland, S.** & Ruch, G. “An Analysis of the Fixed Star Approximation in Transit Light Curve Models.” IAU General Assembly, Meeting #29, id.2255909, Honolulu, HI, August 2015
7. **Millholland, S.**, Savcheva, A. & DeLuca, E., “Magnetic Field Modeling of Complex, Flare Producing Active Regions.” American Geophysical Union Fall Meeting, abstract #SH13A-4079, San Francisco, CA, December 2014
8. **Millholland, S.**, Maruyama, N., Maute, A., et al. “Modeling Sudden Stratospheric Warming Events Using the Ionosphere-Plasmasphere Electrodynamics Model.” American Geophysical Union Fall Meeting, abstract #SA23A-2034, San Francisco, CA, December 2013
9. **Millholland, S.** & Ruch, G., “Modeling and Fitting Exoplanet Transit Light Curves.” AAS Meeting #221, id.343.10, Long Beach, CA, January 2013

INVITED BLOG POSTS - “Tilting Planets and Sculpting Orbits”, guest post by S. Millholland at *Nature Research Behind the Paper*, March 2019. (Click here to follow link.)

OUTREACH
TALKS AND
PUBLICATIONS

1. Exploring Science, Yale University, New Haven, CT, August 2020 (virtual talk)
2. Yale Young Global Scholars Research Showcase (<http://globalscholars.yale.edu>), Yale University, New Haven, CT, July 2019 (talk)
3. Institute for Learning in Retirement, Albertus Magnus College, New Haven, CT, October 2018 (talk)
4. Yale Young Global Scholars Research Showcase (<http://globalscholars.yale.edu>), Yale University, New Haven, CT, June & July 2018 (talks)
5. Leitner Family Observatory & Planetarium, New Haven, CT, February 2018 (talk)
6. Pathways Summer Scholars Program Science Café (<http://pathwayssummerscholars.yale.edu>), Yale University, New Haven, CT, July 2017 (talk)
7. Yale Young Global Scholars Research Showcase (<http://globalscholars.yale.edu>), Yale University, New Haven, CT, July 2017 (talk)
8. Pathways Summer Scholars Enrichment Workshop (<http://pathwayssummerscholars.yale.edu>), Yale University, New Haven, CT, July 2017 (talk & workshop)
9. Yale Open Labs Science Café (<http://theopenlabs.org>), Yale University, New Haven, CT, April 2017 (talk)
10. 9th Annual Women in Leadership Conference, Yale University, New Haven, CT, February 2017 (invited panel member)
11. “The Search for Planet Nine”, a publication for the Hartford Courant News in Education series, *Science Matters!*, Hartford, CT, January 2017 (article)
12. LAMAT REU Program, UCSC, Santa Cruz, CA, July 2016 (talk)
13. “Reading Scientific Literature”, LAMAT REU Program, UCSC, Santa Cruz, CA, June 2016 (workshop)
14. Public Observing Night, University of St. Thomas Observatory, St. Paul, MN, March 2013 (talk & public observing)
15. Minnesota Optical Society Meeting, St. Paul, MN, March 2013 (talk)

TUTORING
EXPERIENCE

- Head Tutor (i.e. tutor and supervisor of other student tutors), Mathematics Resource Center, UST 2015
- Tutor of Mathematics and Physics, Mathematics Resource Center, UST 2012 – 2015
- Private Tutor of Mathematics and Physics 2013 – 2015

PROFESSIONAL
ACTIVITIES &
SERVICE

- Referee for AJ, ApJ, MNRAS, Nature Astronomy 2017 – present
- Scientific Organizing Committee Member, Emerging Researchers in Exoplanet Science (ERES) Conference III (Yale) and V (Cornell) 2017, 2019
- External reviewer for the OPTICON trans-national telescope access program 2019
- Featured subject for a University of St. Thomas television commercial and advertising campaign 2018
- Organizing committee of the UCSC astronomy prospective student visit 2015

- SELECTED
OUTREACH &
LEADERSHIP
- Organizer of ERES V Panel: “Diversity & Inclusion in Astronomy” 2019
 - Yale Open Labs (<http://theopenlabs.org>) 2016 – 2018
 - Committee chair for Science Café Talk Series 2017 – 2018
 - Executive board member 2016 – 2017
 - Organizer of Yale Young Global Scholars Program visits 2017, 2018
 - to the Astro. Department (<http://globalscholars.yale.edu>)
 - Public Night Volunteer, Lick Observatory Summer 2016
 - Astronomy Public Night Leader, UST Observatory 2012 – 2015
 - UST Math Club Vice President 2014 – 2015
 - UST Math Club Communications Administrator 2013 – 2014
 - UST Physics Club President 2012 – 2013
 - UST Student Alumni Council Member 2012 – 2013
 - UST Women’s Choir Board Member 2012 – 2013
 - UST Volunteers in Action weekly volunteer 2011 – 2013
- SELECTED
MEDIA
COVERAGE
- **Tilted planets** (Millholland & Laughlin 2019) featured in Scientific American, Sky & Telescope, Popular Science, Science Daily, Live Science, Space.com, Yale News.
 - **Intra-system uniformity** (Millholland et al. 2017) featured in AAS Nova, Nature Research Highlights.
 - **Machine learning detection of hot Jupiters** (Millholland & Laughlin 2017b) featured in National Geographic, Sky & Telescope, FOX 61 Connecticut News (television), University of St. Thomas News, Yale News.