

Sarah J. Morrison

Dept. of Physics, Astronomy & Material Science
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RESEARCH INTERESTS

planetary system formation & evolution, exoplanets, debris disks, protoplanetary disks, orbital dynamics, planet-disk interactions, influence of orbit environment on planetary surfaces, data science, science education, computational astrophysics

EDUCATION

Ph.D. in Planetary Science, minor in Astronomy, University of Arizona, Tucson, AZ: Aug. 2017
 Dissertation Topic, "The Dynamics and Implications of Gap Clearing via Planets in Planetesimal (Debris) Disks", Advisor: Kaitlin Kratter
 M.S. in Planetary Sciences, University of Arizona, Tucson, AZ: Dec. 2015
 B. A. Cum Laude in Astronomy, Cornell University, Ithaca, NY: May 2011

RESEARCH APPOINTMENTS

Missouri State University Assistant Professor in Physics, Astronomy, & Material Sciences 8/2019-
 Pennsylvania State University Center for Exoplanets & Habitable Worlds Postdoctoral Fellow 9/2017-8/2019
 Univ. of Arizona (UA) Graduate Research Associate 2013-8/2017
 NASA Earth & Space Sciences Fellow 2013-2016
 UA Graduate Research Assistant 2011-2013
 Cornell University Lunar Reconnaissance Orbiter NAC Research Assistant 2010-2011
 Cornell University Cassini Imaging Science Subsystem Research Assistant 2008-2011
 Cornell University Mars Exploration Rover Panoramic Camera Image Calibrator 2008-2011
 Northern Arizona University NSF REU SU Intern 2010
 Cornell University NSF REU SU Intern 2008
 NASA GSFC High School Student Research Intern, Planetary Geodynamics Lab 2006-2007

TEACHING/OUTREACH APPOINTMENTS

Primary Course instructor:

Missouri State SP2022: AST 317: Our Universe: The Final Frontier (enrollment: 13)
 Missouri State FA 2021: AST 313: The New Solar Systems (enrollment: 11)
 Missouri State SP2020 (co-instructor): PHY 591/692: Computational Methods and Data Analysis in Physical Sciences (enrollment: 9)
 Missouri State FA2019, SP2020, FA2020, SP2021, FA2021: AST 113: Modern Astronomy (typical enrollment: 40-100)
 Missouri State FA 2019, SP2022: PHY 409: Selected Topics in Physics (1 student)
 Penn State FA 2018: Astro 496: Independent Study (1 student)
 Penn State SP 2018: Astro 5: Sky & Planets (76 students)
 Penn State SP 2018: SC 240: Learning Assistant Experience (9 students)
 UA Lunar & Planetary Laboratory Graduate Outreach Coordinator (2015-2017)

UA Graduate Teaching Associate (SP 2017, FA 2016, SP 2014): Pys 170A1: Planet Earth: Evolution of a Habitable World, Pys 214: Astrobiology, Pys 206: The Golden Age of Space Exploration
 Participant, Pys 555 (SP 2013): Teaching College-Level Astronomy & Planetary Sciences
 UA Graduate Teaching Assistant (SP 2013, FA 2012, SP 2012): Pys 170A1: Planet Earth: Evolution of a Habitable World, Pys 170B1: The Universe and Humanity: Origin and Destiny, Pys 206: The Golden Age of Space Exploration

SELECT GRANTS, AWARDS, & OTHER HONORS

Missouri State Univ. Nontraditional Student Service Award	FA 2021
Missouri State Univ. College of Natural & Applied Sciences Internal Teaching Grant (\$3k)	
Fa2019-2020	
Missouri State Graduate College International Travel Award (~\$1410)	FA 2019
Penn State Center for Exoplanet & Habitable Worlds Small Grant Award (\$2400)	SP 2019
Co-I, "How directly investigating meteorite samples influences student learning of Solar System astronomy and methods", Scholarship of Teaching and Learning (SoTL) Grant, Penn State Schreyer Institute for Teaching Excellence (\$3K)	SP 2018
Co-I, "Assessing the Hallmarks of Migration and In Situ Formation in Multi-Exoplanet Systems", NASA Exoplanets Research Program, PI: Rebekah Dawson (\$150,410 sub-award total over 3 years)	2018-2020
UA Theoretical Astrophysics Program Small Grant Award (~\$690)	FA 2016
NASA Earth & Space Science Fellowship (\$90K total)	FA 2013-FA 2016
Title: Multiple Planet-Debris Disk Interactions: Probing Planetary System Stability and Evolution	

PUBLICATIONS (student authors denoted by *undergraduate*, *graduate*)

Morrison, S., Dawson, R. I., MacDonald, M., Chains of Planets in Mean Motion Resonances Arising from Oligarchic Growth (2020), *The Astrophysical Journal* 904 (2), 157.

MacDonald, M. G., Dawson, R. I., **Morrison, S. J.**, Lee, E. J., Khandelwal, A. (2020). Forming Diverse Super-Earth Systems in Situ. *ApJ*, 891, 20.

Dong J., Dawson S., Shannon, A., **Morrison, S.** (2020). Debris Disks in Multiplanet Systems: Are Our Inferences Compromised by Unseen Planets? *ApJ*, 889, 47.

Besla, G., Huppenkothen, D., Lloyd-Ronning, N., Schneider, E., Behroozi, P., Burkhart, B., Chan, C. K., Jacobson, S. A., **Morrison, S.**, & 4 addtl co-authors; 99 signatories (2019). Training the Future Generation of Computational Researchers. *Astro2020: Decadal Survey on Astronomy and Astrophysics*, APC white papers, no. 11; *Bulletin of the American Astronomical Society* 51 (7).

Morrison, S. J. & Kratter, K. M. (2018). Gap Formation in Planetesimal Disks Via Divergently Migrating Planets. *MNRAS*, 481, 5180.

Su, K., MacGregor, M. A., Booth, M., Wilner, D. J., Flaherty, K., Hughes, A. M., Phillips, N. M., Malhotra, R., Hales, A. S., **Morrison, S.**, Ertel, S., Matthews, B. C., Dent, W. R., Casassus, S. (2017). ALMA 1.3 millimeter map of the HD 95086 system. *AJ*, 154, 225.

Russell, A., **Morrison, S.**, Moschonas, E. H., & Papaj, D. R. (2017). Patterns of pollen and nectar foraging specialization by bumblebees over multiple timescales using RFID tracking. *Scientific Reports*, 7, 42448.

- Morrison, S. J.** & Kratter, K. M. (2016). Orbital Stability of Multi-Planet Systems: Behavior at High Masses. *ApJ*, 823, 118.
- Stanley, D., Russell, A., **Morrison, S.**, Rogers, C., & Raine, N. (2016). Investigating the impacts of field-realistic exposure to a neonicotinoid pesticide on bumblebee foraging, homing ability and colony growth. *Journal of Applied Ecology*, 53, 1440.
- Morrison, S. J.** (Jan. 24, 2016). Follow the dust to explore other solar systems. University of Arizona College of Science insert in Arizona Daily Star. **[Newspaper article]**
- Su, K. Y., **Morrison, S. J.**, Malhotra, R., Smith, P., Balog, Z., Rieke, G. (2015). Debris distribution in HD 95086-- A young analog of HR 8799. *ApJ*, 799, 146.
- Morrison, S.** & Malhotra, R. (2015). Planetary chaotic zone clearing: destinations and timescales. *ApJ*, 799, 41.
- Morrison, S.** & Hemingway, D. (2014). Grooves (irregular body). In *Encyclopedia of Planetary Landforms*, SPer Science+Business Media, 2015. **Invited Contribution**
- Yelle, R. V., Mahieux, A., **Morrison, S.**, Vuitton, V., Horst, S. M. (2014). Perturbation of the Mars atmosphere by the near-collision with Comet C/2013 A1 (Siding SP). *Icarus*, 237, 202-210.
- Thomas, P. C., Burns, J. A., Hedman, M., Helfenstein, P., **Morrison, S.**, Tiscareno, M. (2013). The inner small satellites of Saturn: A variety of worlds. *Icarus*, 226, 999-1019.
- Grundy, W., **Morrison, S. J.**, Bovyn, M. J., Tegler, S. C., Cornelison, D. (2011). Remote sensing of D/H ratios in methane ice: Temperature-dependent absorption coefficients of CH₃D in methane ice and nitrogen ice. *Icarus*, 212, 941-949.
- Morrison, S.**, Thomas, P. C., Tiscareno, M., Burns, J. A., Veverka, J. (2009). Grooves on Saturnian small satellites and other objects: Characteristics and significance. *Icarus*, 204, 262-270.

SELECT RESEARCH PRESENTATIONS

Invited talks:

- February 4, 2021. Unearthing the formation histories of the inner planets in extrasolar systems. Missouri S&T Physics Colloquium, Missouri University of Science and Technology.
- January 14, 2019. Do Planets Stay or Do They Go? Not So Simple: In situ formation of (near-) resonant chains in multi-planet systems. Center for Exoplanets & Habitable Worlds Seminar Series, Pennsylvania State University.
- November 8 & 15, 2018. Do Planets Stay or Do They Go? Investigating the role that planet migration plays in shaping planetary systems. Physics & Astronomy Colloquium, Franklin & Marshall College; Physics, Astronomy, and Material Science Colloquium, Missouri State University.
- March 5, 2018. Minding the Gap- Using Orbital Dynamics to Uncover the History of Planetary Systems Near and Far. Physics, Astronomy, and Material Science Colloquium, Missouri State University.
- Feb. 13, 2017. Minding the Gap: the Physics & Implications of Disk Clearing Via Planets. Center for Exoplanets & Habitable Worlds Seminar Series, Pennsylvania State University.
- March 28, 2016. Orbital Stability of High Mass Planets & Implications for Debris Disk Systems. Origins Seminar Series, University of Arizona.

April 30, 2015. Mind the Gap: Exploring (Exo-)Solar Systems. Presentation to the College of Science Dean's Advisory Board, University of Arizona.

October 25, 2013. Thermal effects by comet C/2013 A1 (Siding SPs) on the Martian upper atmosphere. Comet Lunch Seminar Series, Planetary Science Institute.

Select Contributed presentations (student authors denoted by *undergraduate*, graduate):

Gaibor, Y., Shoaf-Laughlin, K., & Morrison, S. J. Constraints on Warm Jupiter Formation Pathways from Planetary Companions (2021). AAS Meeting #237, 53 (1), 544.02.

Vogel, M. & Morrison, S. J. Orbit Perturbations of Habitable Zone Planets Due to Inner Planetary Companions. (2021). AAS Meeting #237, 53 (1), 544.02.

Morrison, S., Dawson, R. & MacDonald, M., Producing Close-in Super-Earths and Mini-Neptunes in Resonant Chains During In Situ Planet Formation (2020). AAS/ Division of Dynamical Astronomy Meeting, 52 (4), 403.03. (oral)

Gaibor, Y. & Morrison, S. J. Constraints on Warm Jupiter Formation and Evolution from Planetary Companions (2020). AAS/Division of Planetary Sciences Meeting Abstracts 52 (6), 309.02. (poster)

Vogel, M. & Morrison, S. J. Orbit Perturbations of Habitable Zone Planets and Implications for Habitability (2020). AAS/Division of Planetary Sciences Meeting Abstracts 52 (6), 306.01. (poster)

Dong J, Dawson S., Shannon, A., Morrison, S. (2020). Debris Disks in Multiplanet Systems: Are Our Inferences Compromised by Unseen Planets? Extreme Solar Systems #4, ID 320.03.

MacDonald, M., Morrison, S., Dawson-Rigas, R. (2019). Establishing the Diversity of Super-Earth Systems with a Continuum of Formation Conditions. Extreme Solar Systems #4, ID 317.01.

Zaidi, S. G. and Morrison, S. J. (2019). Modeling the Dynamical Evolution of Saturn's E Ring Following a Cryovolcanic Eruption on Enceladus. LPSC #50, abstract 2790.

Morrison, S. J. & Zaidi, S. G. (2019). Why So Muted? The Sources and Dynamical Mechanisms Responsible for Differing Regolith Depths on Satellites Embedded in Saturn's E Ring. LPSC #50, abstract 2788.

Morrison, S. J., Dawson, R., MacDonald, M. (2018). The Nature of Mean Motion Resonant Chains Arising From In Situ Planet Formation. DPS Meeting #50, abstract 101.04.

Morrison, S. J. & Kratter, K. M. (2017). Forming Gaps in Debris Disks with Migrating Planets. AAS Meeting #229, abstract 318.02.

Morrison, S. J. & Kratter, K. M. (2016). Forming Gaps in Debris Disks with Fewer Planets via Planet Migration. DPS Meeting #48, abstract 119.01.

Morrison, S. J. & Kratter, K. M. (2016). Orbital Stability of High Mass Planetary Systems. DDA Meeting #47, abstract 202.02.

Morrison, S. J. & Kratter, K. M. (2015). Orbital Stability of Multi-Planet Systems: Behavior at High Masses. ExSS III, abstract 201.06.

Su, K. Y., Morrison, S. J., Malhotra, R., Balog, Z., Smith, P. (2014). The debris structures of HD 95086-- A young analog of HR 8799. DPS Meeting #46, abstract 204.02.

Morrison, S. J., Malhotra, R., & Su, K. Y. L. (2014). The planetary system of HD 95086-- A young analog of HR 8799? DPS Meeting #46, abstract 204.03.

Morrison, S. & Malhotra, R. (2014). Planetary chaotic zone clearing: destinations and timescales. DDA Meeting #45, abstract 400.02.

- Morrison, S. J.** & Yelle, R. (2013). Thermal effects from Comet 2013/A1 (Siding SP) on Mars' upper atmosphere. DPS Meeting #45, abstract 313.18.
- Morrison, S.**, Helfenstein, P., Thomas, P. C., Veverka, J. (2010). Color photometry of the small Saturnian satellites: Global and regional variations on Prometheus and Calypso. DPS Meeting #42, abstract 09.05.
- Morrison, S.**, Helfenstein, P., Thomas, P., Veverka, J., Denk, T. (2009). Color variations on Saturn's small satellites: The ring connection. DPS Meeting #41, abstract 03.02.
- Thomas, P., **Morrison, S.**, Burns, J. A. (2008). Small Satellites, Asteroids, and Comets: Surface Expressions of Internal Structures. AGU FA Meeting, abstract P23A-1363.
- Morrison, S.**, Thomas, P.C., Veverka, J., Burns, J. A., Tiscareno, M. S., Porco, C. C. (2008). Grooves on Small Saturnian Satellites: Possible Evidence for Tidal Stressing. DPS Meeting #40, abstract 45.04.
- Morrison, S.** & Frey, H. V. (2007). Crater Densities in Noachis Terra: Evidence for Overlapping Ejecta from Argyre and Hellas. LPSC 38, abstract 1355.

SELECT PROFESSIONAL AND ACADEMIC SERVICE

- Member, Missouri State University Pre-Medical Committee (2021-)
- Co-chair, MSU College of Natural and Applied Sciences Diversity, Equity, and Inclusion Committee (2020-2022)
- Exoplanets and Origins Program Group Lead, Science Organizing Committee, 2019 Joint European Planetary Science Congress/AAS Division of Planetary Sciences Meeting, (2018-2019)
- Member, Penn State Eberly College of Science Climate & Diversity Committee (09/2018-07/2019)
- Elected Member, AAS Division of Dynamical Astronomy Committee (07/2018-07/2020)
- Chair, Organizing Committee for Emerging Researchers in Exoplanet Science IV (9/2017-9/2018): conference June 21-22, 2018
- Proposal Review Panelist & Executive Secretary, NASA & NSF Review Panels
- Chair (2013), Member (2012), Organizing Committee for the Lunar and Planetary Laboratory Conference: 2-day conference held annually in August

COMMUNITY ENGAGEMENT/SYNERGISTIC ACTIVITIES

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|---|-----------|
| Toward More Inclusive Introductory Astronomy Courses | 2020- |
| Developing and modifying pre-existing course content to be more inclusive such as increasing accessibility for the visually impaired, adding group dynamics primers, and including coverage of practices used in the field for combating implicit bias in the scientific review process | |
| Learning Assistant Coordinator | 2018-2019 |
| Penn State Astronomy & Astrophysics Department (Instructor: SC 240, Learning Assistant Experience) | |
| Bringing Big Data to Small Bees | 2015-2017 |
| Applied problem-solving algorithms and computational methodologies from analysis of astrophysical simulations to RFID-tracking datasets of bees in pollination ecology research. So far resulted in 2 publications (see publication list). The analysis codes I developed have been adopted by two separate pollination research groups with the potential for additional collaborations. | |

LPL Graduate Outreach Coordinator

FA 2014-2017

Managed LPL graduate student & postdoc outreach activities around the state of Arizona. Grew LPL's annual outreach audience over tenure, centralized LPL's outreach assessment+record keeping, developed new outreach activities (particularly exoplanet and orbit-related) for wider range of audiences, created LPL graduate outreach funding source through local business partnerships with Astronomy on Tap-Tucson

Co-founder, Astronomy on Tap-Tucson (Space Drafts Public Talk Series)

2015-2017

Transitioned monthly public talk series held at Borderlands Brewery in downtown Tucson to be Tucson's local flavor of the national Astronomy on Tap movement, grew average event attendance by >2x over tenure, typical audiences ~80-100 people, created an external outreach funding source for UA astronomy/planetary sciences graduate students via food and merchandise sales during these events in partnership with Borderlands Brewery and local food vendors

Select Invited Public Engagement Talks/Panels

Televised interview for KY3 at Baker Observatory regarding exoplanet science of Baker observatory 7/9/2020

Talk regarding Opportunity (longest operating Mars Exploration Rover), Astronomy on Tap-State College 5/20/2019

Talk regarding the Cassini mission, Astronomy on Tap-State College 9/18/17

Live televised interview with Phoenix 3TV meteorologist Kim Quintero 1/28/17

Invited Panelist (for expertise in orbital dynamics), Physics of Space Battles Panel, Tucson Comic-Con 11/6/2016

Invited Panelist, Lunar and Planetary Laboratory Conference Outreach & Science Communication Panel 8/20/2015

Talks about career path: Connect2Careers 1/28/17, Connect2STEM festival 1/9/16, Chess & Science Festival at Flandrau Planetarium 11/7/15

Talks about research: Westinghouse Science Honors Institute 2/23/2019, Penn State AstroNight 10/14/2017, Huachuca Astronomy Club 4/15/16, Pima Air & Space Museum 2/11/16, Southern Arizona Association for the Visually Impaired 10/22/2015, West Valley Astronomy Club 3/3/15, Sonora Astronomical Society 2/10/15

PROFESSIONAL AFFILIATIONS

Member

American Astronomical Society	
Astronomy Ambassador	2014-present
Division of Dynamical Astronomy	2012-present
Division of Planetary Science	2008-present
American Geophysical Union	2008-present