Luke G. Bouma

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RESEARCH INTERESTS

- Exoplanets: formation, evolution, and long-term fates.
- Stellar and galactic astrophysics, including the evolution of young stars & dissolution of their host clusters.
- Computational methods in large-scale astrophysical data analysis ("big data").

PROFESSIONAL APPOINTMENTS

California Institute of Technology	Pasadena, CA
Heising Simons 51 Pegasi b Fellow. Supervisor: L. Hillenbrand	09/2021-09/2024

EDUCATION

Princeton University	Princeton, NJ
Ph.D, Astrophysics. Thesis: "Origins and Fates of Close-In Giant Planets"	09/2018-08/2021
M.A, Astrophysics. Advisor: J. Winn	09/2016–08/2018
Massachusetts Institute of Technology	Cambridge, MA
Physics Ph.D. program (transferred after completing first year). Advisor: J. Winn	09/2015-08/2016
University of Southern California	Los Angeles, CA
B.Sc. Physics: B.A. Mathematics: Minor, Astronomy	09/2011-05/2015

PUBLICATION SUMMARY

Refereed publications: 67 (11 first author; 2 second author; 30 many author; 24 TESS collaboration).

Non-refereed publications: 1 (1 white paper).

Citations: 437 first & second author; 1648 many author; 6197 code. h-index: 27.

My first & second author publications are **listed here**; a full publication list is **available here**.

DISTINCTIONS

- 2021–24 Heising-Simons 51 Pegasi b Fellowship *Postdoctoral fellowship in planetary astronomy*.
- 2020–21 Charlotte Elizabeth Procter Fellowship Honorific fellowship for final-year Ph.D. students.
- 05/2015 USC Discovery Scholar *University fellowship based on research portfolio*.
- 04/2014 Goldwater Scholarship National fellowship for undergraduates pursuing careers in STEM.
- 2011–15 USC Trustee and University Scholarships Full tuition award and merit stipend.

GRANTS (The † symbol denotes active or pending awards)

- † 12/2023 PI: NASA TESS Cycle 6 GI Program G06030. A Census Of Complex Periodic Variables.
- † 02/2023 Collaborator: NASA Astrophysics Data Analysis Program (PI: K. Pardo).

 *Detecting Gravitational Waves from Supermassive Black Holes with Kepler.
 - 12/2021 PI: NASA TESS Cycle 4 GI Program G04032. Difference Imaging of Stars in Clusters.
 - 06/2020 Co-I: NASA TESS Cycle 3 GI Program G03064 (PI: J. Hartman). Cluster Difference Imaging Photometric Survey.

07/2019 Co-I: NASA TESS Cycle 2 GI Program G022117 (PI: J. Hartman).

Cluster Difference Imaging Photometric Survey.

07/2018 Co-I: NASA TESS Cycle 1 GI Program G011103 (PI: J. Hartman).

Difference Imaging of Star Clusters at Low Galactic Latitude.

ADVISING

POST-BACCALAUREATE STUDENT

Andrew Boyle (Caltech): May 2022-May 2023. Grad school, astrophysics, UNC Chapel Hill.

UNDERGRADUATE STUDENTS

Elin Stenmark (Caltech 1st-2nd year): July 2023-present. Currently at Caltech.

Elsa Palumbo (Caltech 3rd-4th year): Jan 2022-May 2023. Grad school, statistics, Carnegie Mellon.

HIGH SCHOOL STUDENTS

Thaddaeus Kiker (Sunny Hills High School, 11th grade): Jan 2022-Sep 2022. Undergrad, physics, Columbia.

Veronica Diaz (Sunny Hills High School, 11th grade): Jan 2022-Sep 2022. Undergrad, CS, Carnegie Mellon.

SERVICE & PUBLIC ENGAGEMENT

- *Prison Education Project*: Jan 2022 present. Designed and facilitated remote academic workshops in prisons. Topics have included STEM careers, astronomy, and a mix of astronomy and planetary science. 10-20 students attended each workshop per two-month term. Host institutions have been in California (Spring 2022), Scotland (Summer 2022), and Hawaii (Fall 2022, Spring 2023, Fall 2023, Spring 2024); my current focus is on an astronomy workshop at Kulani Correctional Facility on Hawaii island.
- Skype a Scientist: Oct 2020 Spring 2022. Gave 15 remote public talks in K-12 classrooms.
- Resident Graduate Student: Sept 2018 May 2021. Resident advisor to 30 undergraduate students per year. Encouraged a supportive residential environment; hosted star-gazing nights, office hours, and social events; during COVID, focused on academic support and one-on-one advising.
- Observing Outreach Organizer: Sept 2016 Sept 2019. Organized over 30 public observing events at Princeton's department telescope. Led outreach team to host groups ranging from 10 to 100 people; also hosted private groups (*e.g.*, middle and high-school classes; student clubs; university staff).
- *Princeton LGBT Center Discussion Group Co-Organizer*: Sept 2018 May 2019. Hosted a discussion group for students to speak about identity, orientation, relationships, and community.

PROFESSIONAL ACTIVITIES

Member, TESS Users Committee (2023-present).

Co-organizer for Caltech Tea Talk seminars (2023-2024).

Organizer of Caltech Star Formation and Young Stars reading group (2022-2024).

Reviewer for Caltech Optical Observatories Time Allocation Committee (2022).

Chair, Emerging Researchers in Exoplanet Science (ERES) 2021.

Active referee for AJ, ApJ, ApJL, Nature Astronomy, A&A, MNRAS, PASP (14 articles; 2019-present).

Reviewer for NASA panels (2021, 2022, 2023).

Member, American Astronomical Society (AAS). (2018-present)

Member, Division for Planetary Sciences of the AAS. (2020-present)

Member, TESS Follow-up Observing Program (TFOP; 2018-present).

Organizer, TESS Extended Mission Working Group (2015-2018).

PUBLICATION LIST [LINK TO ADS LIBRARY]

First & second author

The \dagger symbol highlights students for whom I served as the primary research mentor.

- 14. Bouma, L., Jayaraman, R., et al. *Transient Corotating Clumps Around Adolescent Low-Mass Stars From Four Years of TESS*. AJ, 167, 38 (2024).
- 13. †Boyle, A. and Bouma, L. When Does Gyrochronology Start to Work? Stellar Rotation and Structure of the α Persei Complex. AJ, 166, 14 (2023).
- 12. Bouma, L., †Palumbo, E. and Hillenbrand, L. *The Empirical Limits of Gyrochronology*. ApJL, 947, 3 (2023).
- 11. Bouma, L., Kerr, R., et al. *Kepler and the Behemoth: Three Mini-Neptunes in a 40 Million Year Old Association*. AJ, 164, 215 (2022).
- 10. Bouma, L., Curtis, J., et al. A 38 Million Year Old Neptune-Sized Planet in the Kepler Field. AJ, 163, 121 (2022).
- 9. Bouma, L., Curtis, J., et al. *Rotation and Lithium Confirmation of a 500 Parsec Halo for the Open Cluster NGC 2516*. AJ, 162, 197 (2021).
- 8. Bouma, L., Hartman, J., et al. Cluster Difference Imaging Photometric Survey. II. TOI 837: A Young Validated Planet in IC 2602. AJ, 160, 239 (2020).
- 7. Bouma, L., Winn, J., et al. PTFO 8-8695: Two Stars, Two Signals, No Planet. AJ, 160, 86 (2020).
- 6. Bouma, L., Winn, J., et al. WASP-4 is Accelerating Toward the Earth. ApJL, 893, 2 (2020).
- 5. Bouma, L., Hartman, J., et al. *Cluster Difference Imaging Photometric Survey. I. Light Curves of Stars in Open Clusters from TESS Sectors 6 & 7.* ApJS, 245, 13 (2019).
- 4. Bouma, L., Winn, J., et al. WASP-4b Arrived Early for the TESS Mission. AJ, 157, 217 (2019).
- 3. Bouma, L., Masuda, K., and Winn, J. *Biases in Planet Occurrence Caused by Unresolved Binaries in Transit Surveys*. AJ, 155, 244 (2018).
- 2. Penev, K., Bouma, L., et al. *Empirical Tidal Dissipation in Exoplanet Hosts From Tidal Spin-Up*. AJ, 155, 165 (2018).
- 1. Bouma, L., Winn, J., et al. *Planet-Detection Simulations for Several Possible TESS Extended Missions*. arXiv:1705.08891 (2017). Non-refereed white paper.

Many author

For each of these papers, I contributed key methods, data, code, and/or co-authored significant portions of the text.

- 30. Vach, S. et al., incl. Bouma, L. *The occurrence of small, short-period planets younger than 200 Myr with TESS*. AJ, 167, 210 (2024).
- 29. Hartman, J. et al., incl. Bouma, L. TOI 4201 b and TOI 5344 b: Discovery of Two Transiting Giant Planets Around M Dwarf Stars and Revised Parameters for Three Others. AJ, 166, 163 (2023).
- 28. Dai, F. et al., incl. Bouma, L. A Mini-Neptune Orbiting the Metal-poor K Dwarf BD+29 2654. AJ, 166, 49 (2023).
- 27. Blunt, S. et al., incl. Bouma, L. Overfitting Affects the Reliability of Radial Velocity Mass Estimates of the V1298 Tau Planets. AJ, 166, 62 (2023).
- 26. Wood, M. et al., incl. Bouma, L. TESS Hunt for Young and Maturing Exoplanets (THYME) VII: a 27 Myr extended population of Lower-Centarus Crux with a transiting two-planet system. AJ, 165, 85 (2023).
- 25. Yee, S. et al., incl. Bouma, L. *The TESS Grand Unified Hot Jupiter Survey. II. Twenty Hot Jupiters*. ApJS, 265, 1 (2023).

- 24. Heitzmann, A. et al., incl. Bouma, L. TOI-4562 b: A highly eccentric temperate Jupiter analog orbiting a young field star. AJ, 165, 121 (2023).
- 23. Dai, F. et al., incl. Bouma, L. TOI-1136 is a Young, Coplanar, Aligned Planetary System in a Pristine Resonant Chain. AJ, 165, 33 (2023).
- 22. Hua, X. et al., incl. Bouma, L. A Transiting Super-Earth in the Radius Valley and an Outer Planet Candidate Around HD 307842. AJ 166, 32 (2023).
- 21. Stassun, K. et al., incl. Bouma, L. A Low-Mass Pre-Main-Sequence Eclipsing Binary in Lower Centaurus Crux Discovered with TESS. AJ, 941, 125 (2022).
- 20. Kounkel, M. et al., incl. Bouma, L. Untangling the Galaxy. IV. Empirical Constraints on Angular Momentum Evolution and Gyrochronology for Young Stars in the Field. AJ, 164, 137 (2022).
- 19. Palumbo, E. et al., incl. Bouma, L. Evidence for Centrifugal Breakout around the Young M Dwarf TIC 234284556. ApJ, 925, 75 (2022).
- 18. Zhou, G. et al., incl. Bouma, L. A Mini-Neptune from TESS and CHEOPS Around the 120 Myr Old AB Dor member HIP 94235. AJ, 163, 289 (2022).
- 17. Günther, M. et al., incl. Bouma, L. Complex Modulation of Rapidly Rotating Young M Dwarfs: Adding Pieces to the Puzzle. AJ, 163, 144 (2022).
- 16. Heitzmann, A. et al., incl. Bouma, L. *The obliquity of HIP 67522 b: a 17 Myr old transiting hot Jupiter-sized planet*. ApJL, 922, 1 (2021).
- 15. Fausnaugh, M. et al., incl. Bouma, L. The TESS Mission Target Selection Procedure. PASP. 133, 1027 (2021).
- 14. Grieves, N. et al., incl. Bouma, L. Populating the brown dwarf and stellar boundary: Five stars with transiting companions near the hydrogen-burning mass limit. A&A, 652, 127 (2021)
- 13. Wirth, C. et al., incl. Bouma, L. *TOI-942b: A Prograde Neptune in a* ∼60 Myr old Multi-transiting System. ApJL, 917, 34 (2021).
- 12. Stassun, K. et al., incl. Bouma, L. Discovery and Characterization of a Rare Magnetic Hybrid β Cephei Slowly Pulsating B-type Star in an Eclipsing Binary in the Young Open Cluster NGC 6193 AJ, 910, 133 (2021).
- 11. Tofflemire, B. et al., incl. Bouma, L. TESS Hunt for Young and Maturing Exoplanets (THYME) V: A Sub-Neptune Transiting a Young Field Star. AJ, 161, 171 (2021).
- 10. Zhou, G. et al., incl. Bouma, L. Two young planetary systems around field stars with ages between 10–170 Myr from TESS. AJ, 161, 2 (2021).
- 9. Patra, K. et al., incl. Bouma, L. *The Continuing Search For Evidence of Tidal Orbital Decay For Hot Jupiters*. AJ, 159, 150 (2020).
- 8. Soares-Furtado, M. et al., incl. Bouma, L. A Catalog of Periodic Variables in Open Clusters M 35 and NGC 2158. ApJS, 246, 15 (2020).
- 7. Rodríguez Martínez, R. et al., incl. Bouma, L. *KELT-25b and KELT-26b: A Hot Jupiter and a Substellar Companion Transiting Young A-Stars Observed by TESS*. ApJS, 246, 15 (2020).
- 6. Newton, E. et al., incl. Bouma, L. TESS Hunt for Young and Maturing Exoplanets (THYME): A Planet in the 45 Myr Tucana-Horologium Association. ApJL, 880, 1, L17 (2019).
- 5. Zhan, Z. et al., incl. Bouma, L. Complex Rotational Modulation of Rapidly Rotating M Stars Observed with TESS. ApJ, 876, 127 (2019).
- 4. Rappaport, S. et al., incl. Bouma, L. *Deep long asymmetric occultation in EPIC 204376071*. MNRAS, 485, 2681 (2019).

- 3. Burt, J. et al., incl. Bouma, L. Simulating the M-R Relation From APF Followup of TESS Targets: Survey Design and Strategies for Overcoming Mass Biases. AJ, 156, 255 (2018).
- 2. Louie, D. et al., incl. Bouma, L. Simulated JWST/NIRISS Transit Spectroscopy of Anticipated TESS Planets Compared to Select Discoveries from Space-Based and Ground-Based Surveys. PASP 130d 4401 (2018).
- 1. Campante, T. et al., incl. Bouma, L. *The asteroseismic potential of TESS: Exoplanet-Host Stars*. ApJ, 830, 2 (2016).

TESS Collaboration

These are papers for which my authorship results from my contributions to mission planning and internal data analysis in the TESS collaboration. In all such instances, I provided substantive feedback on the manuscripts.

- 24. Capistrant, B. et al., incl. Bouma, L. TESS Hunt for Young and Maturing Exoplanets. XI. An Earth-sized Planet Orbiting a Nearby, Solar-like Host in the 400 Myr Ursa Major Moving Group. AJ, 167, 54 (2024).
- 23. Fairnington, T. et al., incl. Bouma, L. TOI-5126: a hot super-Neptune and warm Neptune pair discovered by TESS and CHEOPS. MNRAS, 527, 3 (2024).
- 22. Naponiello, L. et al., incl. Bouma, L. A super-massive Neptune-sized planet. Nature, 622, 255 (2023).
- 21. Osborn, A. et al., incl. Bouma, L. *TOI-332 b: a super dense Neptune found deep within the Neptunian desert.* MNRAS, 526, 548 (2023).
- 20. Sha, L. et al., incl. Bouma, L. TESS Spots a Mini-Neptune Interior to a Hot Saturn in the TOI-2000 System. MNRAS, 524, 1113 (2023).
- 19. Bozhilov, V. et al., incl. Bouma, L. A 2:1 Mean-Motion Resonance Super-Jovian pair revealed by TESS, FEROS, and HARPS . ApJL, 946, 36 (2023).
- 18. El Mufti, M. et al., incl. Bouma, L. *TOI-560: Two Transiting Planets Orbiting a K Dwarf Validated with iSHELL, PFS and HIRES RVs.* AJ, 165, 10 (2023).
- 17. Cadieux, C. et al., incl. Bouma, L. TOI-1452 b: SPIRou and TESS reveal a temperate super-Earth around a nearby M4 dwarf. AJ, 164, 96 (2022).
- 16. Hord, B. et al., incl. Bouma, L. *The Discovery of a Planetary Companion Interior to Hot Jupiter WASP-132b*. AJ, 164, 13 (2022).
- 15. Wittenmyer, R. et al., incl. Bouma, L. TOI-1842b: A Transiting Warm Saturn Undergoing Reinflation around an Evolving Subgiant, AJ, 163, 82 (2022).
- 14. Cabot, S. H. C. et al., incl. Bouma, L. *TOI-1518b: A Misaligned Ulta-hot Jupiter with Iron in Its Atmosphere*. AJ, 162, 218 (2021).
- 13. Addison, B. C. et al., incl. Bouma, L. TOI-1431b/MASCARA-5b: A Highly Irradiated Ultra-Hot Jupiter Orbiting One of the Hottest & Brightest Known Exoplanet Host Stars. AJ, 162, 292 (2021).
- 12. Hedges, C. et al., incl. Bouma, L. TOI-2076 and TOI-1807: Two Young, Comoving Planetary Systems within 50 pc Identified by TESS that are Ideal Candidates for Further Follow Up . AJ, 162, 54 (2021).
- 11. Guerrero, N. et al., incl. Bouma, L. *The TESS Objects of Interest Catalog from the TESS Prime Mission*. ApJS, 254, 39 (2021).
- 10. Dawson, B. et al., incl. Bouma, L. *Precise transit and radial-velocity characterization of a resonant pair: a warm Jupiter TOI-216c and eccentric warm Neptune TOI-216b*. AJ, 161, 161 (2021).
- 9. Daylan, T. et al., incl. Bouma, L. TESS discovery of a super-Earth and three sub-Neptunes hosted by the bright, Sun-like star HD 108236. AJ, 161, 85 (2021).
- 8. Fridlund, M., et al., incl. Bouma, L. *The TOI-763 system: sub-Neptunes orbiting a Sun-like star*. MNRAS, 498, 3 (2020).

- 7. Rowden, P., et al., incl. Bouma, L. TIC 278956474: Two Close Binaries in One Young Quadruple System Identified by TESS. AJ, 160, 2 (2020).
- 6. Jordán, A. et al., incl. Bouma, L. TOI-677 b: A Warm Jupiter (P=11.2d) on an eccentric orbit transiting a late F-type star. AJ, 159, 145 (2020).
- 5. Quinn, S. et al., incl. Bouma, L. Near-resonance in a system of sub-Neptunes from TESS. AJ, 158, 177 (2019).
- 4. Günther, M. et al., incl. Bouma, L. A Super-Earth and two sub-Neptunes transiting the bright, nearby, and quiet M-dwarf TOI-270. Nature Astronomy, 3, 1099 (2019).
- 3. Dawson, B. et al., incl. Bouma, L. *TOI-216b and TOI-216c: Two warm, large exoplanets in or slightly wide of the 2:1 orbital resonance*. AJ, 158, 65 (2019).
- 2. Shporer, A. et al., incl. Bouma, L. TESS Full Orbital Phase Curve of the WASP-18b System. AJ, 157, 178 (2019).
- 1. Rodriguez, J. et al., incl. Bouma, L. *An Eccentric Massive Jupiter Orbiting a Sub-Giant on a 9.5 Day Period Discovered in the TESS Full Frame Images*. AJ, 157, 191 (2019).

Software

- 4. Foreman-Mackey, D., et al., incl. Bouma, L. exoplanet: Gradient-based probabilistic inference for exoplanet data & other astronomical time series. JOSS, 6, 62, 3285 (2021).
- 3. Bhatti, W. Bouma, L., and Yee S. cdips-pipeline: difference-imaging photometry pipeline. Link.
- 2. Bhatti, W. Bouma, L., and Wallace J. astrobase: package for variable star astronomy. Link.
- 1. Astropy Collaboration et al., incl. Bouma, L. The Astropy Project. AJ, 156, 123 (2018).

SELECTED OBSERVING PROGRAMS

- 01/2024 PI: Keck/HIRES (2 nights), Hale/DBSP (4 nights). What are the Complex Periodic Variables?
- 07/2023 PI: Keck/HIRES (2 nights), Hale/DBSP (7 nights), Hale/TSPEC (1 night). What are the Complex Periodic Variables?
- 01/2023 PI: Keck/HIRES (2 nights). *Age-Dating the Cep-Her Complex and Reconstructing its Formation History.*
- 07/2022 PI: Keck/HIRES (1.75 nights).

 Confirming Transiting Planets Around Young Stars From TESS & Kepler.
- 01/2022 Co-I: NOAO LCOGT 1 m, 2 m, & MuSCAT3 (20, 1.2, & 1.1 nights) (PI: J. Hartman, 2022A-934009).

 Confirming and Characterizing Transiting Planets From HAT & TESS with LCO.

 (Long-term status awarded for 2022A, 2022B, 2023A.)
- 07/2022 Co-I: Keck/HIRES (1 night) (PI: L. Hillenbrand).

 Confirming a 30 Million Year Old Mini-Neptune and Measuring its Stellar Obliquity.
- 07/2021 Co-I: NOAO LCOGT 1 m & 2 m (20 & 2.5 nights) (PI: J. Hartman, 2021B-0004). Confirming and Characterizing Transiting Planets From HAT & TESS with LCO.
- 01/2021 PI: NOIRLab Minerva-Australis (2 nights).

 Confirming and Characterizing Transiting Planets Around Young Stars.
- 01/2021 Co-I: NOAO LCOGT 1 m & 2 m (20 & 2 nights) (PI: J. Hartman, 2021A-0045). Confirming and Characterizing Transiting Planets From HAT+TESS with LCO.
- 01/2021 PI: Magellan/PFS (2 nights).

 Confirming and Characterizing Transiting Planets Around Young Stars
- 10/2020 PI: TESS Director's Discretionary Time

 Complex Modulation of Rapidly Rotating Young M Dwarfs

SEMINARS & COLLOQUIA

- USC Physics & Astronomy Colloquium (Invited), February 2024
- OSU Astronomy Colloquium (Invited), February 2024
- Michigan State University Astrophysics Research Seminar (Invited), February 2024
- Caltech/IPAC Seminar (Invited), January 2024
- UH Manoa Institute for Astronomy Colloquium (Invited), January 2024
- MIT TESS Science Talks Seminar (Invited), January 2024
- Caltech Tea Talk Seminar, November 2023
- University of Geneva Exoplanets Seminar, March 2023
- Yale Exoplanets/Stars Seminar (Invited), February 2023
- Earth 2.0 Mission Science Seminar Series (Invited), October 2022
- University of Michigan Star and Planet Formation Seminar, September 2022
- MIT TESS Science Talks Seminar (Invited), March 2022
- Penn State Center for Exoplanets and Habitable Worlds (Invited), April 2021
- Harvard Exoplanet Pizza Lunch, April 2021
- JPL Astrophysics Colloquium (Invited), October 2020
- Caltech Dix Planetary Science Seminar, October 2020
- UCLA Physics and Astronomy Lunch Talk Series, September 2020
- University of Chicago Exoplanet Seminar, March 2020

TALKS & POSTERS

- TESS Sci Con 3 (Talk), MIT, Cambridge, MA, July 2024.
- Cool Stars 22 (Talk), UC San Diego, San Diego, CA, June 2024.
- Astronomy on Tap (Invited Public Talk), Pasadena, CA, November 2023.
- TASC7 (Talk), UH Manoa, Oahu, HI, July 2023.
- SPIDI23 (Invited Review), IESC, Cargèse, Corsica, France, May 2023.
- ESA ESTEC Planet-ESLAB-2023 Symposium (Talk), Noordwijk, Netherlands, March 2023.
- Flatiron Institute / CCA Thursday Lunch Talk, New York, NY, February 2023.
- 51 Pegasi Summit (Talk & Fun-Talk), San Francisco, CA, August 2022.
- ERES-VII (Poster), State College, PA, July 2022.
- AAS Meeting #240 (Talk), Pasadena, CA, June 2022.
- Exoplanets IV (Talk), Las Vegas, NV, May 2022.
- JHU-APL Exoplanet Early Career Highlight Seminar (Talk), Online, January 2022.

- TESS Science Conference II (Talk), Online, August 2021.
- AAS Meeting #238 (Talk & Press Conference), Online, July 2021
- THYME 2020 Conference (Invited Talk), Online, December 2020.
- ExSoCal 2020 (Poster), Online, September 2020.
- TESS Science Team Meeting #19 (Talk), Online, June 2020.
- Princeton Club of Chicago Alumni Meeting (Invited Public Talk), Chicago, IL, March 2020.
- TESS Science Team Meeting #18 (Talk), Cambridge, MA, December 2019.
- Extreme Solar Systems IV (Poster), Reykjavik, Iceland, August 2019.
- STScI TESS Data Workshop (Invited Talk), Baltimore, MD, February 2019.
- TESS Science Conference I (Talk & Invited Panel), Cambridge, MA, July 2019.