

## Samantha K. Trumbo

51 Pegasi b Postdoctoral Fellow, Cornell University  
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<b>EDUCATION</b>	<b>Ph.D. Planetary Science</b> , California Institute of Technology Dissertation: <i>Views of an Ocean World: The Signatures of Internal and External Processes on the Surface of Europa</i>	<b>Spring 2021</b>
	<b>M.S. Oceanography</b> , Scripps Institution of Oceanography, UCSD Thesis: <i>Marine Export Productivity and the Demise of the Central American Seaway</i>	<b>Fall 2015</b>
	<b>B.A. Astronomy, Biology</b> (double major), Cornell University Magna Cum Laude, Distinction in All Subjects	<b>Spring 2013</b>

**RESEARCH INTERESTS** Surface processes and composition of icy satellites and dwarf planets; Spacecraft exploration of ocean worlds and the outer Solar System; Coupling between remote-sensing observations and laboratory experiments

<b>RESEARCH POSITIONS</b>	<b>51 Pegasi b Postdoctoral Fellow</b> , Cornell University	<b>July 2021–present</b>
	<b>Postdoctoral Scholar</b> , Caltech	<b>Dec. 2020–June 2021</b>
	<b>NASA Earth and Space Science Graduate Fellow</b> , Caltech	<b>2017–2020</b>
	<b>Graduate Student Researcher</b> , Caltech	<b>2015–2017</b>
	<b>Graduate Student Researcher</b> , Scripps Institution of Oceanography, UCSD	<b>2013–2015</b>
	<b>Undergraduate Researcher</b> , Cornell University	<b>2011–2013</b>
	<b>NASA Airborne Science Intern</b> , Student Airborne Research Program (SARP)	<b>Summer 2012</b>

### SELECTED

**PUBLICATIONS (full list to follow)** **Trumbo, S.K.** and Brown, M.E. (2023) The distribution of CO<sub>2</sub> on Europa indicates an internal source of carbon. *Science*, 381, 1308, doi:10.1126/science.adg4155.

**Trumbo, S.K.**, Brown, M.E., Bockelée-Morvan, D., de Pater, I., Fouchet, T., Wong, M.H., Fletcher, L.N., de Kleer, K., Lellouch, E., Mura, A., Poch, O., Quirico, E., Rodriguez-Ovalle, P., Showalter, M.R., Tiscareno, M.S., and Tosi, F. (2023) Hydrogen peroxide at the poles of Ganymede. *Science Advances*, 9, 29, doi:10.1126/sciadv.adg3724.

**Trumbo, S.K.**, Davis, M.R., Cassese, B., and Brown, M.E. (2022) Spectroscopic mapping of Io's surface with HST/STIS: SO<sub>2</sub> frost, sulfur allotropes, and large-scale compositional patterns. *PSJ*, 3, 272, doi:10.3847/PSJ/aca46d.

**Trumbo, S.K.**, Becker, T.M., Brown, M.E., Denman, W.T.P., Molyneux, P., Hendrix, A., Retherford, K.D., Roth, L., and Alday, J. (2022) A new UV spectral feature on Europa: Confirmation of NaCl in leading-hemisphere chaos terrain. *PSJ*, 3, 27, doi:10.3847/PSJ/ac4580.

**Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2019) H<sub>2</sub>O<sub>2</sub> within chaos terrain on Europa's leading hemisphere. *AJ*, 158, 127, doi:10.3847/1538-3881/ab380c.

**Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2019) Sodium chloride on the surface of Europa. *Science Advances*, 5, 6, doi: 10.1126/sciadv.aaw7123.

**Trumbo, S.K.**, Brown, M.E., and Butler, B.J. (2017) ALMA thermal observations of a proposed plume source region on Europa. *AJ*, 154, 148, doi:10.3847/1538-3881/aa8769.

### GRANT FUNDING

**Space Telescope Science Institute (PI, HST-GO)**, *Targeted observations of Ceres' Occator crater with HST/STIS*, \$74,748 (awarded 2022, 3-year period).

**Space Telescope Science Institute (PI, HST-GO)**, *Europa's UV absorptions: oceanic or exogenic origins?* \$154,020 (awarded 2022, 3-year period).

**Heising-Simons Foundation (51 Pegasi b Fellowship)**, *The surfaces of icy worlds: Windows to the oceans below*, \$375,000 (awarded 2021, 3-year period).

**Space Telescope Science Institute (Co-I, HST-GO)**, *Complete spectral maps of the Galilean satellites from 200-1000 nm: salts, radiolytic cycles, and O<sub>2</sub> production*, \$175,842 (awarded 2019).

**Space Telescope Science Institute (Co-I, HST-AR)**, *Complete spectral maps of the Galilean satellites from 200-1000 nm: salts, radiolytic cycles, and O<sub>2</sub> production*, \$76,677 (awarded 2019).

**NASA (Earth and Space Science Graduate Fellowship),** *The Signatures of Exogenous and Endogenous Processes on the Surface of Europa*, \$135,000 (awarded 2017).

**PI & SCIENCE-  
PI OBSERVING  
PROGRAMS**  
*(Facility and  
instrument listed)*

**JWST:** 1 program as PI, Cycle 2 GO (2023–2024), NIRSpec, 6 hours.  
**Hubble Space Telescope (HST):** 2 programs as PI, Cycle 30 (2022–2023), STIS, 9 total orbits.  
**Gemini Observatory:** 2 programs as PI (2019–2021), GMOS-S, 6.6 total hours.  
**W.M. Keck Observatory:** 3 programs as Science PI (2018–2021), NIRSPEC, 9 total half nights.  
**The Atacama Large Millimeter Array (ALMA):** 1 program as PI, Cycle 6 (2018–2019), 2.5 hours.  
**NASA Infrared Telescope Facility (IRTF):** 2 programs as PI (2018–2019), SpeX, 28.5 total hours.

**CO-I  
OBSERVING  
PROGRAMS**

**JWST:** 2 programs, Cycle 2 GO+GTO (2023–2024), NIRSpec+MIRI, 33 total hours.  
**Hubble Space Telescope (HST):** 3 programs, Cycles 24, 27, 31 (2016–2023), 151 total orbits.  
**The Atacama Large Millimeter Array (ALMA):** 1 program, Cycle 5 (2017–2018), 4 hours.

**ADVISING &  
MENTORING**

**Research Supervisor & Thesis Committee Member,** Peiyu Wu, Ph.D. student, Cornell **2021–present**  
**NASA AMP-UP Mentor,** Astronomy Mentorship Program for Upcoming Postdocs **2023–present**  
**Career Mentor,** Pasadena City College Natural Sciences Mentoring Program **2021**  
**Research Mentor,** Sherry Liang, undergraduate student, Caltech **Fall 2019**  
**Research Mentor,** Yiluo Li, Visiting undergraduate student, Caltech **Summer 2018**

**TEACHING**

**Physics Tutor,** Volunteer Physics Tutoring Pilot Program, Pasadena City College **2020–2021**  
**Math Tutor,** Caltech Rise Program for the Pasadena Unified School District **2020–2021**  
**Teaching Assistant,** Caltech **2017–2019**  
    Ge 108: Applications of Physics to the Earth Sciences (graduate-level course; guest lectured)  
    Ge 157c: Remote Sensing (senior undergraduate/graduate-level course with lab and field component)  
    Ge 131: Planetary Interiors (senior undergraduate/graduate-level course)  
**Teaching Assistant,** Scripps Institution of Oceanography, UCSD **2014–2015**  
    SIO 1: The Planets (large undergraduate course; designed and led discussion sections)  
    SIO 104/255: Paleobiology and the History of Life (undergraduate course with lab component)  
**Undergraduate Teaching Assistant,** Physics Learning Center, Cornell University **2011**  
    PHYS 1102: General Physics II (large undergraduate course with lab component)

**PROFESSIONAL  
DEVELOPMENT**

**Alda Center for Science Communications Workshop,** two-part workshop run by the Alan Alda Center for Science Communication. Summer 2023.  
**GET-SET Course Design Institute,** series of workshops through the Cornell Center for Teaching Innovation on the development of learning outcomes and student-centered courses. March 2023.  
**Teaching and Learning in the Diverse Classroom,** month-long course through the Cornell Center for Teaching Innovation on inclusive teaching strategies and best practices. June 2022.  
**Culturally Mindful Mentoring Workshop,** three-part workshop led by Dr. Kelly Mack on effective mentorship of marginalized students. Winter 2022.

**SPACECRAFT  
MISSION  
INVOLVEMNT**

**NASA Europa Clipper Composition Working Group Co-Chair** **Starting Nov. 2023**  
**NASA Europa Clipper Science Team,** Postdoctoral Affiliate (MISE) **2021–present**  
**NASA Europa Clipper Science Team,** Graduate-student Affiliate (Europa-UVS) **2019–2021**

**PROFESSIONAL  
AFFILIATIONS  
& SERVICE**

**Review Panelist** for NSF, STScI  
**Referee,** *AGU Journals*, *AAS Journals*, *Icarus*  
**AAS Division of Planetary Sciences (DPS),** DPS Meeting session co-chair (2020, 2021)  
**American Geophysical Union (AGU)**

**PUBLIC  
OUTREACH  
& SCI. COMM.**

**California Academy of Sciences Benjamin Dean Astronomy Lecture,** Sep. 2023  
**NPR Morning Edition Radio Appearance,** Sep. 2023  
**BBC Newsroom Radio Appearance,** Sep. 2023  
**Cornell REU Program Guest Lecture,** June 2023  
**NASA Community College Network,** Subject Matter Expert, 2022–present  
**Cornell Friends of Astronomy Lecture,** March 2022  
**Cornell Astronomical Society Lecture,** March 2022  
**W.M. Keck Observatory Donor Talk,** Dec. 2020  
**Science Magazine Podcast Appearance,** June 2019  
**L.A. Public Radio Appearance,** June 2019

NASA SARP Guest Lecture, July 2017

Public Education Volunteer, The Birch Aquarium at Scripps Institution of Oceanography, 2008

**SELECTED  
AWARDS**

CCAPS Research Innovation Award, Cornell University **2023**  
Heising-Simons Foundation 51 Pegasi b Fellowship in Planetary Astronomy **2021**  
NASA Earth and Space Sciences Fellowship **2017**  
E.W. Scripps Fellowship, Scripps Institution of Oceanography **2013**  
Outstanding Student Paper Award (OSPA), AGU Fall Meeting **2012**

**SELECTED  
PRESS**

NASA Press Release, NASA's Webb Finds Carbon Source on Surface of Jupiter's Moon Europa, Sep. 2023  
Scientific American, Jupiter's Moon Europa May Hide Tantalizing Carbon in Mysterious Ocean, Sep. 2023  
(and many other outlets, including Forbes, NPR, Newsweek)  
Gizmodo, Webb Space Telescope Unlocks Secrets of Jupiter's Moons, Aug. 2023  
Cornell Press Release, James Webb Space Telescope sees Jupiter moons in a new light, Aug. 2023  
The Atlantic, There's Hope for Life on Europa, a Distant Moon, Oct. 2022  
Caltech/JPL Press Release, Table Salt Compound Spotted on Europa, June 2019  
Scientific American, Water on Europa—with a Pinch of Salt, June 2019 (and many other outlets, including  
Gizmodo, EOS, CNN)  
NRAO Press Release, ALMA Maps Europa's Temperature, Oct. 2018  
EOS, How Hot is Europa? There's a Map for That, Sep. 2018  
New Scientist, One of Europa's Plumes May Not Exist, Making Hunt for Life Hard, Aug. 2017

**INVITED  
SEMINARS &  
COLLOQUIA**

Cornell University, Earth and Atmospheric Sciences Seminar, Sep. 29, 2023  
Europa Clipper Team, Composition Working Group Meeting, July 11, 2023  
Boston University, Space Physics Seminar, April 20, 2023  
UC Santa Cruz, EPS/IGPP Seminar, May 13, 2022  
Cornell University, Planetary Lunch Seminar, Oct. 19, 2020  
UC Berkeley and UCLA, Joint CIPS and EPSS Seminar, Sep. 30, 2020  
CU Boulder, Laboratory for Atmospheric and Space Physics Seminar, Sep. 3, 2020  
JPL, Europa Clipper Lecture Series, Jan. 10, 2020  
Europa Clipper Team, Habitability Working Group Meeting, June 13, 2019  
JPL, Icy Worlds Seminar, April 18, 2019  
University of Copenhagen, Centre for Star and Planet Formation Seminar, Sep. 24, 2018  
Europa Clipper Team, E-THEMIS Science Team Meeting, Nov. 8, 2017

**PUBLICATIONS (11 first author, 7 significant author, 20 total)**

**(full list)**

20. **Trumbo, S.K.** and Brown, M.E. (2023) The distribution of CO<sub>2</sub> on Europa indicates an internal source of carbon. *Science*, 381, 1308, [doi:10.1126/science.adg4155](https://doi.org/10.1126/science.adg4155).
19. Davis, M.R., Brown, M.E., **Trumbo, S.K.** (2023) The spatial distribution of the unidentified 2.07 μm absorption feature on Europa and implications for its origin. *PSJ*, 4, 148, [doi: 10.3847/PSJ/aced96](https://doi.org/10.3847/PSJ/aced96).
18. **Trumbo, S.K.**, Brown, M.E., Bockelée-Morvan, D., de Pater, I., Fouchet, T., Wong, M.H., Fletcher, L.N., de Kleer, K., Lellouch, E., Mura, A., Poch, O., Quirico, E., Rodriguez-Ovalle, P., Showalter, M.R., Tiscareno, M.S., and Tosi, F. (2023) Hydrogen peroxide at the poles of Ganymede. *Science Advances*, 9, 29, [doi:10.1126/sciadv.adg3724](https://doi.org/10.1126/sciadv.adg3724).
17. de Pater, I., Lellouch, E., Strobel, D., de Kleer, K., Fouchet, T., Wong, M.H., Holler, B., Stansberry, J., Fry, P.M., Brown, M.E., Bockelée-Morvan, D., **Trumbo, S.K.**, Fletcher, L.N., Hedman, M.M., Molter, E.M., Showalter, M., Tiscareno, M.S., Cazaux, S., Hueso, R., Luszcz-Cook, S., Melin, H., Moeckel, C., Mura, A., Orton, G., Roth, L., Saur, J., and Tosi, F. (2023) An energetic eruption with associated SO 1.707 micron emissions at Io's Kanehekili Fluctus and a brightening event at Loki Patera observed by JWST. *JGR: Planets*, 128, e2023JE007872, [doi:10.1029/2023JE007872](https://doi.org/10.1029/2023JE007872).
16. **Trumbo, S.K.**, Davis, M.R., Cassese, B., and Brown, M.E. (2022) Spectroscopic mapping of Io's surface with HST/STIS: SO<sub>2</sub> frost, sulfur allotropes, and large-scale compositional patterns. *PSJ*, 3, 272, [doi:10.3847/PSJ/aca46d](https://doi.org/10.3847/PSJ/aca46d).
15. Becker, T.M., **Trumbo, S.K.**, Molyneux, P., Retherford, K.D., Hendrix, A., Roth, L., Raut, U., Alday, J., and McGrath, M.A. (2022) Mid-ultraviolet Hubble observations of Europa and the global distribution of SO<sub>2</sub>. *PSJ*, 3, 129, [doi:10.3847/PSJ/ac69eb](https://doi.org/10.3847/PSJ/ac69eb).

14. **Trumbo, S.K.**, Becker, T.M., Brown, M.E., Denman, W.T.P., Molyneux, P., Hendrix, A., Retherford, K.D., Roth, L., and Alday, J. (2022) A new UV spectral feature on Europa: Confirmation of NaCl in leading-hemisphere chaos terrain. *PSJ*, 3, 27, doi:10.3847/PSJ/ac4580.
13. Denman, W.T.P., **Trumbo, S.K.**, and Brown, M.E. (2022) The influence of temperature and photobleaching on irradiated sodium chloride at Europa-like conditions. *PSJ*, 3, 26, doi:10.3847/PSJ/ac4581.
12. Brown, M.E., Denman, W.T.P., and **Trumbo, S.K.** (2022) The mid-UV spectrum of irradiated NaCl at Europa-like conditions. *PSJ*, 3, 28, doi:10.3847/PSJ/ac457f.
11. **Trumbo, S.K.**, Brown, M.E., Adams, D. (2021) The geographic distribution of dense-phase O<sub>2</sub> on Ganymede. *PSJ*, 2, 139, doi:10.3847/PSJ/ac0cee.
10. de Kleer, K., Butler, B.J., de Pater, I., Gurwell, M.A., Moullet, A., **Trumbo, S.K.**, and Spencer, J. (2021) Thermal properties of Ganymede's surface from millimeter and infrared emission. *PSJ*, 2, 5, doi:10.3847/PSJ/abcbf4.
9. **Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2020) Endogenic and exogenic contributions to visible-wavelength spectra of Europa's trailing hemisphere. *AJ*, 160, 282, doi:10.3847/1538-3881/abc34c.
8. Ingersoll, A.P., Ewald, S.P., and **Trumbo, S.K.** (2020) Time variability of the Enceladus plumes: Orbital periods, decadal periods, and aperiodic change. *Icarus*, 344, 113345, doi: 10.1016/j.icarus.2019.06.006.
7. **Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2019) H<sub>2</sub>O<sub>2</sub> within chaos terrain on Europa's leading hemisphere. *AJ*, 158, 127, doi:10.3847/1538-3881/ab380c.
6. **Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2019) Sodium chloride on the surface of Europa. *Science Advances*, 5, 6, doi: 10.1126/sciadv.aaw7123.
5. **Trumbo, S.K.**, Brown, M.E., and Butler, B.J. (2018) ALMA thermal observations of Europa. *AJ*, 156, 161, doi:10.3847/1538-3881/aada87.
4. **Trumbo, S.K.**, Brown, M.E., and Butler, B.J. (2017) ALMA thermal observations of a proposed plume source region on Europa. *AJ*, 154, 148, doi:10.3847/1538-3881/aa8769.
3. **Trumbo, S.K.**, Brown, M.E., Fischer, P.D., and Hand, K.P. (2017) A new spectral feature on the trailing hemisphere of Europa at 3.78 μm. *AJ*, 153, 250, doi:10.3847/1538-3881/aa6d80.
2. Corrales, L.R., Yi, T.D., **Trumbo, S.K.**, Shalloway, D., Lunine, J.I., and Usher, D.A. (2017) Acetonitrile cluster solvation in a cryogenic ethane-methane-propane liquid: Implications for Titan lake chemistry. *The Journal of Chemical Physics*, 146, 104308, doi:10.1063/1.4978395.
1. Fischer, P.D., Brown, M.E., **Trumbo, S.K.**, and Hand, K.P. (2016) Spatially resolved spectroscopy of Europa's large-scale compositional units at 3-4 μm with Keck NIRSPEC. *AJ*, 153, 13, doi:10.3847/1538-3881/153/1/13.

## CONFERENCE TALKS

- Trumbo, S.K.**, Davis, M.R., Cassese, B., and Brown, M.E. (2022) Volcanic Sulfur Products and Large-scale Compositional Patterns on Io from HST/STIS. 54<sup>th</sup> AAS DPS Meeting, London, Ontario, Canada, 112.02.
- (Invited) **Trumbo, S.K.** (2022) Surface chemistry of the icy Galilean satellites: Observations, laboratory perspectives, and future directions. Japan Geoscience Union Meeting (Hybrid), Chiba, Japan, PPS01-04.
- (Invited) **Trumbo, S.K.** (2022) The surface of Europa: A window to the ocean below? Ice-Ocean Interactions on Icy Moons in the Solar System. Princeton Center for Theoretical Science, Princeton, NJ.
- (Invited) **Trumbo, S.K.**, Becker, T.M., Brown, M.E., Denman, W.T.P., Molyneux, P., Hendrix, A., Retherford, K.D., Roth, L., and Alday, J. (2022) A new UV absorption on Europa's surface: Confirmation of NaCl in leading-hemisphere chaos terrain. AGU Fall Meeting, New Orleans, LA, P24C-05.
- Trumbo, S.K.**, Brown, M.E., and Adams, D. (2021) The geographic distribution of dense-phase O<sub>2</sub> on Ganymede. 53<sup>rd</sup> AAS DPS Meeting (Virtual), 103.02.
- Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2020) Endogenic and exogenic contributions to visible-wavelength spectra of Europa's trailing hemisphere. 52<sup>nd</sup> AAS DPS Meeting (Virtual), 106.03.
- Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2020) H<sub>2</sub>O<sub>2</sub> within chaos terrain on Europa. Keck Science Meeting (Virtual).
- Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2019) H<sub>2</sub>O<sub>2</sub> within chaos terrain on Europa's leading hemisphere, 51<sup>st</sup> AAS DPS Meeting/EPSC Meeting, Geneva, Switzerland, EPSC-DPS2019-825.

**Trumbo, S.K.**, Brown, M.E., and Hand, K.P. (2018) A Search for signatures of irradiated chloride salts on the surface of Europa. 50<sup>th</sup> AAS DPS Meeting, Knoxville, TN, 407.02.

**Trumbo, S.K.**, Brown, M.E., de Kleer, K., and Hand, K.P. (2018) Observational constraints on the distribution and temperature dependence of H<sub>2</sub>O<sub>2</sub> on the surface of Europa. Europa Deep Dive 2: Composition, Houston, TX, 3020.

**Trumbo, S.K.**, Brown, M.E., de Kleer, K., and Hand, K.P. (2018) Observational constraints on the distribution and temperature dependence of H<sub>2</sub>O<sub>2</sub> on the surface of Europa. European Planetary Science Congress (EPSC), Berlin, Germany, EPSC2018-203.

**Trumbo, S.K.**, Brown, M.E., and Butler, B.J. (2017) ALMA thermal observations of Europa. 49th AAS DPS Meeting, Provo, UT, 203.05.

**Trumbo, S.K.**, Ewald, S.P., and Ingersoll, A.P. (2016) The time variability of individual geysers in the plume of Enceladus. AGU Fall Meeting, San Francisco, CA, P32A-04.

**Trumbo, S.K.**, Fischer, P.D., Hand, K.P., and Brown, M.E. (2016) A new spectral feature on the trailing hemisphere of Europa at 3.78  $\mu$ m. 48th AAS DPS Meeting, Pasadena, CA, 517.01.

**Trumbo, S.K.**, Palacios, S.L., Zimmerman, R.C., and Kudela, R.M. (2012) A mathematical model for estimation of kelp bed productivity: Age dependence and contributions of subsurface kelp. AGU Fall Meeting, San Francisco, CA, B34D-06.