

Samantha K. Trumbo

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

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

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

PUBLICATIONS

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.
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.
16. **Trumbo, S.K.**, Davis, M.R., Cassese, B., and Brown, M.E. (2022) Spectroscopic mapping of Io's surface with HST/STIS: SO₂ frost, sulfur allotropes, and large-scale compositional patterns. *PSJ*, 3, 272, doi: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 SO₂. *PSJ*, 3, 129, doi: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 O₂ 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) H₂O₂ 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 μ m. *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 μ m with Keck NIRSPEC. *AJ*, 153, 13, doi:10.3847/1538-3881/153/1/13.

**GRANT
FUNDING**

Space Telescope Science Institute (PI), *Targeted observations of Ceres' Occator crater with HST/STIS*, \$74,748 (awarded 2022, 3-year period).
Space Telescope Science Institute (PI), *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, GO), *Complete spectral maps of the Galilean satellites from 200-1000 nm: salts, radiolytic cycles, and O₂ production*, \$175,842 (awarded 2019).
Space Telescope Science Institute (Co-I, AR), *Complete spectral maps of the Galilean satellites from 200-1000 nm: salts, radiolytic cycles, and O₂ 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**

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): 2 programs, Cycles 24 & 27 (2016–2020), STIS, 29 total orbits.
The Atacama Large Millimeter Array (ALMA): 1 program, Cycle 5 (2017–2018), 4 hours.

**RESEARCH
ADVISING**

Research Advisor & Thesis Committee Member , Peiyu Wu, Ph.D. student, Cornell	2021–present
Research Advisor , Sherry Liang, undergraduate student, Caltech	Fall 2019
Research Advisor , Yiluo Li, Visiting undergraduate student, Caltech	Summer 2018

UNIVERSITY TEACHING	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)
ADDITIONAL TEACHING & ADVISING	AMP-UP Mentor , Astronomy Mentorship Program for Upcoming Postdocs June 2023–present
	Career Mentor , Pasadena City College Natural Sciences Mentoring Program 2021
	Math Tutor , Caltech Rise Program for the Pasadena Unified School District 2020–2021
	Physics Tutor , Volunteer Physics Tutoring Pilot Program, Pasadena City College 2020–2021
PROFESSIONAL DEVELOPMENT	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.
PROFESSIONAL AFFILIATIONS & SERVICE	NASA Europa Clipper Science Team , Postdoctoral Affiliate (MISE) 2021–present
	NASA Europa Clipper Science Team , Graduate-student Affiliate (Europa-UVS) 2019–2021
	Review Panelist for NSF, STScI
	Referee for <i>Geophysical Research Letters</i> , <i>AAS Journals</i> , <i>Icarus</i>
	AAS Division of Planetary Sciences (DPS) , session co-chair (2020, 2021) American Geophysical Union (AGU)
OUTREACH	Cornell REU Program Guest Lecture , June 2023
	Cornell Friends of Astronomy Lecture , March 2022
	Cornell Astronomical Society Lecture , March 2022
	W.M. Keck Observatory Donor Talk , Dec. 2020
	Science Magazine Podcast Guest Appearance , June 2019
	L.A. Public Radio Guest Appearance , June 2019
	NASA SARP Guest Lecture , July 2017
Public Education Volunteer , The Birth 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	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
	Scientific American , “Water on Europa—with a Pinch of Salt”, June 2019
	Caltech/JPL Press Release , “Table Salt Compound Spotted on Europa”, June 2019
	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	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

JPL, Icy Worlds Seminar, April 18, 2019

University of Copenhagen, Centre for Star and Planet Formation Seminar, Sep. 24, 2018

**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. 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 O₂ on Ganymede. 53rd 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. 52nd AAS DPS Meeting (Virtual), 106.03.

Trumbo, S.K., Brown, M.E., and Hand, K.P. (2020) H₂O₂ within chaos terrain on Europa. Keck Science Meeting (Virtual).

Trumbo, S.K., Brown, M.E., and Hand, K.P. (2019) H₂O₂ within chaos terrain on Europa's leading hemisphere, 51st 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. 50th 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 H₂O₂ 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 H₂O₂ 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 μm . 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.