

HOWARD CHEN

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CURRENT POSITION

NASA Postdoctoral Program Fellow • NASA Goddard Space Flight Center • 2021 -

PREVIOUS POSITION

NASA Future Investigator in Earth and Space and Technology • Northwestern University • 2016 - 2021

EDUCATION

Northwestern University 2016 - 2021 • Evanston, IL
Ph.D Earth & Planetary Sciences, M.S. Earth & Planetary Sciences

Boston University 2012 - 2016 • Boston, MA
B.A. Physics

RESEARCH INTERESTS

1. Predicting exoplanet habitability and detectability for future instruments
2. Developing numerical models of early Earth and Earth-like planets
3. Retrieving observational and remotely sensed data using novel analysis techniques

HONORS AND AWARDS

1. Recipient of 2021 NASA Postdoctoral Program Fellowship
2. Recipient of 2020 Horace A. Scott NU EPS Award for Excellence in Graduate Research
3. Recipient of 2019 American Geophysical Union (AGU) Outstanding Student Presentation Award
4. Recipient of 2019 Future Investigators in NASA Earth and Space Science and Technology (FINESST) Award
5. Recipient of 2014 Caltech Summer Undergraduate Research Fellowship (SURF)
6. Recipient of 2015 Boston University Undergraduate Research Opportunities Program (UROP) Grant
7. Recipient of 2013 Boston University Student Academic Enhancement Fund Travel Award

GRANTS

1. Interdisciplinary Consortia for Astrobiology Research (ICAR), Collaborator in NNH19ZDA001N-ICAR, proposal No. 19-ICAR19.2-0009, PI: Kevin Stevenson (STScI), October 26th 2020

Peer-Reviewed Articles

1. **Chen, H.** and Jacobson, S. A., C/N and C/H on Earth-like Planets as Outcomes of Impact Loss and Degassing, in 2nd round of review (Earth and Planetary Science Letters).
2. **Chen, H.**, Zhan, Z., Youngblood, A., Wolf, E.T., Feinstein, A.D. and Horton, D.E., 2021. Persistence of flare-driven atmospheric chemistry on rocky habitable zone worlds. *Nature Astronomy*, 5(3), pp.298-310.
3. **Chen, H.**, Wolf, E.T., Zhan, Z. and Horton, D.E., 2019. Habitability and spectroscopic observability of warm M-dwarf exoplanets evaluated with a 3D chemistry-climate model. *The Astrophysical Journal*, 886(1), p.16.
4. **Chen, H.**, Wolf, E.T., Kopparapu, R., Domagal-Goldman, S. and Horton, D.E., 2018. Biosignature anisotropy modeled on temperate tidally locked M-dwarf planets. *The Astrophysical Journal Letters*, 868(1), p.L6.
5. **Chen, H.**, Forbes, J.C. and Loeb, A., 2018. Habitable evaporated cores and the occurrence of Panspermia near the galactic center. *The Astrophysical Journal Letters*, 855(1), p.L1.
6. **Chen, H.**, Chatterjee, S. and, 2018. Effects of planetesimal accretion on the thermal and structural evolution of sub-Neptunes. *The Astrophysical Journal*, 852(1), p.58.
7. **Chen, H.** and Rogers, L.A., 2016. Evolutionary analysis of gaseous sub-Neptune-mass planets with MESA. *The Astrophysical Journal*, 831(2), p.180.
8. Fauchez, T.J., Turbet, M., Sergeev, D.E., Mayne, N.J., Spiga, A., Sohl, L., Saxena, P., Deitrick, R., Gilli, G., Domagal-Goldman, S.D. Forget, F., and 10 other authors including **Chen, H.**, 2021. TRAPPIST Habitable Atmosphere Intercomparison (THAI) Workshop Report. *The Planetary Science Journal*, 2(3), p.106.
9. Payne, R.C., Britt, A.V., **Chen, H.**, Kasting, J.F. and Catling, D.C., 2016. The response of Phanerozoic surface temperature to variations in atmospheric oxygen concentration. *Journal of Geophysical Research: Atmospheres*, 121(17), pp.10-089.
10. Kasting, J.F., **Chen, H.** and Kopparapu, R.K., 2015. Stratospheric temperatures and water loss from moist greenhouse atmospheres of Earth-like planets. *The Astrophysical Journal Letters*, 813(1), p.L3.
11. Schlawin, E., Herter, T., Zhao, M., Teske, J.K. and **Chen, H.**, 2016. Reduced Activity and Large Particles from the Disintegrating Planet Candidate KIC 12557548b. *The Astrophysical Journal*, 826(2), p.156.

Unrefereed Articles

1. Méndez, A., Rivera-Valentín, E.G., Schulze-Makuch, D., Filiberto, J., Ramírez, R., Wood, T.E., Dávila, A., McKay, C., Ceballos, K.O., Jusino-Maldonado, M., Nery, G., and 32 other authors including **Chen, H.**, 2020. Habitability Models for Planetary Sciences. arXiv preprint arXiv:2007.05491, White Paper for the Planetary Science and Astrobiology Decadal Survey 2023-2032

Books and Reviews

1. **Chen, H.**, 2021. Lithopanspermia at the Center of Spiral Galaxies. Planet Formation and Panspermia: New Prospects for the Movement of Life Through Space, p.149; Editor: Branislav Vukotic, October 2021, Wiley-Scrivener Publishing LLC

Papers in Preparation

1. **Chen, H.**, Luo, Yangcheng, and Horton, D.E., 2021, Modulations of the Water-Loss Timescales by Planetary Oxygenation Levels, to be submitted to the AAS Journals.
2. **Chen, H.**, and Pingao, G., On the D/H of Photoevaporating Kepler Planets
3. **Chen, H.**, Wolf. E. T., Kopparapu, R. K., 3D Photochemical Implications of Dry, Wet, and Desiccated Climates:
Case of TRAPPIST-1d, e and f

SEMINARS, COLLOQUIA, & INVITED TALKS

1. 'Chemistry-Climate Dynamics of Warm Rapidly and Slowly-Rotating Exoplanets', 1023719, Invited Oral, Astrobiology Science Conference, Atlanta GA, May 19th 2022
2. 'Stellar Flare, UV Radiation, and Circulation Driven Temperate Exoplanet Atmospheres', Caltech Department of Geological and Planetary Science (GPS) YukLunch Seminar, November 8th 2021
3. '3D Effects of Large Stellar Flares', Invited Oral Presentation at the AGU Fall Meeting 2021 Session 'Cool stars and their influence on (exo)planetary habitability', December 2021
4. 'Predicting the Atmospheres of Habitable Zone Planets using a 3D Chemistry-Climate Model', University of California at Santa Cruz Other Worlds Laboratory, Planetary Lunch (PLUNCH) Seminar Series, October 4th 2021
5. 'Influence of Stellar Superflares on the Atmospheric Chemistry of Tidal Locked Exoplanets', Invited Virtual Space Science Webinar Series at NYU Abu Dhabi and the UAE Space Agency, February 2021
6. 'On the Ionospheres of Strongly- to Weakly-Oxygenated Terrestrial Exoplanets', Invited Online American Geophysical Union 2020 Union SEED session talk, December 2020
7. 'Insights from 3D Chemistry-Climate Models: Moist Greenhouses and Impacts of X-ray/UV Flares', Invited TRAPPIST Habitable Atmosphere Intercomparison (THAI) Workshop, September 2020
8. 'Influence of Stellar Flares and X-ray Radiation on the Atmospheres of Planets Orbiting M-dwarf Stars', Academia Sinica Institute of Astronomy and Astrophysics (ASIAA)
9. 'Influence of Stellar Flares and Coronal Mass Ejections on the Atmospheres of Tidally-Locked Planets', University of Chicago Exoplanet Journal Club, September 30th 2019
10. 'From Sub-Neptunes to Earth-like Exoplanets: Modeling Thick and Thin Planetary Atmospheres', Harvard-Smithsonian CfA Small-Scale Phenomenon Seminar, Sept 28th 2015

TEACHING

- Class Assistant for EARTH 340 Physics of Weather and Climate, Fall 2019, with Prof. Daniel Horton
- Teaching Assistant for EARTH 110 Exploration of the Solar System, Spring 2019, with Prof. Seth Jacobson
- Teaching Assistant for EARTH 110 Exploration of the Solar System, Winter 2018, with Prof. Seth Jacobson
- Discussion Assistant and Grader for EARTH 351 Forming a Habitable Planet, Spring 2017, with Prof. Seth Stein and Donna Jurdy

MENTORSHIP

Alexandra Yao (High School Researcher, July 2021 -)

- Alexandra is a high school student who is a part of the Research Experiences in Astronomy at CIERA for High School Students (REACH) program hosted annually at Northwestern University. She is studying the atmospheric spectra of terrestrial exoplanets by using NASA Goddard's online tool Planetary Spectrum Generator. We are working on a paper publication together.

Rachel Fry (Undergraduate Student, June 2020 - September 2020)

- Rachel is a undergraduate researcher from NSF-funded Research Experience for Undergraduate (REU) program. She worked with me on modeling the ionospheric compositions of planets orbiting active stars. She presented her results at the 2020 CIERA REU virtual poster session.

Allen Gu (High School Student, June 2019 - December 2019)

- Allen worked with me on the effects of stellar energetic particles on ozone variability. A portion of his analysis was published in Chen et al. *Nature Astronomy* (2021). We collaborated through the Research Experiences in Astronomy at CIERA for High School Students (REACH) program during the summer of 2019. He will be attending UC Berkeley for his undergraduate degree.

OUTREACH

Research Experiences in Astronomy at CIERA for High School Students (2019-Present)

- As a long-term participant of the REACH program at CIERA, I led research projects, lectures on astronomy and astrobiology, and looked after the students during the summer program. I also mentored students on individual research projects.

Only One Sky (2019-Present)

- Created lesson plans for K-12 teachers, example link: <http://skydayproject.com/stars/>

Skype-a-Scientist (2019-Present)

- I presented three separate K-12 classroom presentations, entitled "Are we alone in the Universe?"

Ask-an-Expert Event at Niles North High School (2019-Present)

- In this program, I visited local Illinois high school. I went over a series of presentations talking about who I am and how I came to me and answered student questions.

STEAM Academy at Benavides (2019-Present)

- Taught students about my path to be a scientist and general descriptions of my research

Cheyenne River Sioux Native American Reservation Youth Project (2019-Present)

- I spent 3 months between high school and college doing volunteer work at a Youth Center located in South Dakota. I am the founder of the “Science Caf’e”.

SERVICE

Referee (The Astrophysical Journal, The Astrophysical Journal Letters, Astrobiology, Icarus)

- 6 manuscripts reviewed to date

Review Panel Member (NASA, STFC)

Organizer for the Annual Lake Michigan Area Exoplanet Meeting (2019-Present)

- Solicited speakers and scheduled the meeting held at Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA) and Department of Earth & Planetary Sciences on Northwestern University campus

Judge for Student Presentations (AGU, AAS)

CONFERENCE PRESENTATIONS

1. Chen, H., Mendillo, M., Becker, J. and Horton, D.E., 2020, December. On the Ionospheres of Strongly-to Weakly-Oxygenated Terrestrial Exoplanets. In AGU Fall Meeting Abstracts (Vol. 2020, pp. U008-11).
2. Chen, H., Wolf, E., Zhan, Z. and Horton, D., 2019. M-dwarf Activity Driven 3D Climate and Photochemistry of Inner Habitable Zone Tidally-Locked Planets. AAS/Division for Extreme Solar Systems Abstracts, 51, pp.502-04.
3. Chen, H., Wolf, E.T., Zhan, Z. and Horton, D.E., 2019, June. Coupled 3D Chemistry-Climate Simulations of Moist Greenhouse Terrestrial Planets: Water-Loss and Spectroscopic Observability. In 2019 Astrobiology Science Conference. AGU.
4. Chen, H. and Horton, D., 2018, January. Modeled 3-D Biosignatures from the Stratospheres of Proxima Centauri b and M-dwarf Planets. In American Astronomical Society Meeting Abstracts# 231 (Vol. 231, pp. 148-13).
5. Chen, H., Rogers, L. and Kasting, J., 2016, January. From Sub-Neptunes to Earth-like Exoplanets: Modeling Optically Thick and Thin Planetary Atmospheres. In American Astronomical Society Meeting Abstracts# 227 (Vol. 227, pp. 138-29).
6. Chen, H. and Rogers, L., 2015, January. Constructing Mass-radius Relationships of Low Mass Gaseous Exoplanets with MESA. In American Astronomical Society Meeting Abstracts# 225 (Vol. 225, pp. 257-14).
7. Chen, C., Chen, H., Chuang, Y.L., Chan, W.W., Jiang, M. and Liang, W., 2013, December. Shear-wave splitting unmasks deformation properties in the Eastern Himalayan Syntaxis and Namcha Barwa region. In AGU Fall Meeting Abstracts (Vol. 2013, pp. D111A-2169).
8. Payne, R.C., Britt, A.V., Chen, H., Kasting, J.F. and Catling, D.C., 2016, December. The Response of Phanerozoic Surface Temperature to Variations in Atmospheric Oxygen Concentration. In 2016 AGU Fall Meeting. AGU.

PLEASE CONTACT THE FOLLOWING REFERENCES FOR CONFIDENTIAL LETTERS OF REC:

James F. Kasting, Evan Pugh Professor of Geosciences and Meteorology (Pennsylvania State University, jfk4@psu.edu)

Frederic Rasio, Joseph Cummings Professor of Physics (Northwestern University, rasio@northwestern.edu)

Daniel E. Horton, Assistant Professor of Earth & Planetary Sciences (Northwestern University, daniel.horton@northwestern.edu)