

Dr. Renyu Hu

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Jet Propulsion Laboratory
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EMPLOYMENT

2019- Scientist IV, Jet Propulsion Laboratory
2015-19 Scientist III, Jet Propulsion Laboratory
2013-15 Hubble Fellow, Jet Propulsion Laboratory

EDUCATION

2013 Ph.D., Planetary Sciences, Massachusetts Institute of Technology
 "Atmospheric Photochemistry, Surface Features, and Potential Biosignature Gases of Terrestrial Exoplanets," Advisor: Sara Seager
2009 M.S., Astrophysics, Tsinghua University
2009 Diplôme d'Ingénieur (French Engineer's Degree), École Centrale Paris
2007 B.S., Mathematics and Physics, Tsinghua University

FIELDS OF INTEREST

Atmospheres of planets and exoplanets from Earth-sized to Jupiter-sized. Remote sensing of exoplanets using transit spectroscopy, phase curve mapping, and direct imaging. Evolution of planetary atmospheres and stable isotope geochemistry. Search for habitable planets and biosignatures. Gas and aqueous phase chemical kinetics.

SELECTED AWARDS AND HONORS

2021 JPL Edward Stone Award for Outstanding Research Publication
2020 NASA Early Career Public Achievement Medal
2019 NASA Group Achievement Award for the Astrophysics Large Mission Studies
2017 JPL Voyager Award for Individual Achievement
2013-15 NASA Hubble Fellowship
2011-13 NASA Earth and Space Science Fellowship
2012 Barrett Prize, Massachusetts Institute of Technology
2011 Fellowship, NASA Astrobiology Institute Summer School
2009 Presidential Fellowship, Massachusetts Institute of Technology
2009 Best Master Dissertation, Tsinghua University
2009 Wu You-Xun Prize, Tsinghua University
2006-07 Dean's Summer Student Scholarship, University College London
2005-07 Alumni Society Fellowship, École Centrale Paris

SPACE MISSION & LEADERSHIP EXPERIENCE

- 2018- **Starshade Scientist**, NASA Exoplanet Exploration Program
- Provided science leadership to the Starshade Technology Development to TRL-5 (S5) project and managed a national-level and community-facing Starshade Science and Industry Partnership program
 - Led a team of 6 scientists and engineers to formulate, develop, and conduct the Starshade Exoplanet Data Challenge, and managed the acquisition of two external participating teams through a proposal process
- 2017-21 **Atmospheric Science Lead**, Starshade Rendezvous Probe concept study and Roman Space Telescope starshade accommodation study
- 2022- **Member**, Uranus flagship mission concept team
- 2021- **Member**, Venus in-situ aerobot mission concept team
- 2018- **Member**, TESS Atmospheric Characterization Working Group
- 2016-21 **Member**, WFIRST (Roman) Coronagraph Science Investigation Teams
- 2016-17 **Member**, NASA Study Analysis Group on science questions for direct imaging exoplanet missions
- 2016-17 **Member**, NASA Study Analysis Group on exoplanet biosignatures
- 2014 **Principal Investigator** for science return of direct-imaging exoplanet missions, NASA Exoplanet Exploration Program

PROFESSIONAL SERVICE

- 2022 **Chair**, Astrophysics Return to Lab Working Group, Jet Propulsion Laboratory
- 2021- **Chair**, Astrophysics Colloquium Committee, Jet Propulsion Laboratory
- 2020 **Panel Reviewer**, Hubble Space Telescope Time Allocation Committee
- 2016- **Founder**, Exoplanet Lunch Seminar Series, Jet Propulsion Laboratory
- 2013- **Referee** for Science, Nature, Nature Geoscience, Nature Astronomy, PNAS, ApJ, ApJS, MNRAS, A&A, Astrobiology, Icarus, EPSL, JGR, and GRL
- 2012- **Panel Reviewer** for NASA's Planetary Atmospheres Program, Mars Data Analysis Program, Mars2020 Participating Scientists Program, Exoplanets Research Program, Exobiology Program, Astrophysics Research and Analysis Program, and Earth and Space Science Fellowship
- 2018 **Panel Reviewer**, Hubble Space Telescope Time Allocation Committee
- 2018 **Member**, Organizing Committee of the workshop "Combining high-resolution spectroscopy and high-contrast imaging for exoplanet characterization"
- 2018 **Member**, Selection Committee of NASA Hubble Postdoctoral Fellowship
- 2017 **Member**, Selection Committee of NSF Astronomy and Astrophysics Postdoctoral Fellowship
- 2015 **Panel Reviewer**, Hubble Space Telescope Time Allocation Committee

POSTDOC ADVISING EXPERIENCE

- 2021- Markus Scheucher, JPL Postdoc Fellow

Renyu Hu

2018- Mario Damiano, JPL Postdoc Fellow
Research led to 5 first-author papers and multiple JWST proposal wins

STUDENT ADVISING EXPERIENCE

2022 Naylynn Tañón Reyes (Smith College)
2022 Audrey DeVault (Caltech)
2020-21 Lexy LeMar (Caltech). Now graduate student at MIT
2018- Trent Thomas (UCLA). Now graduate student at U. Washington
Research led to a paper in Nature Geoscience
2018-19 Héctor Delgado Diaz (Cal State LA). Now graduate student at U. Washington
Research led to a paper in ApJ
2018 Luke Peterson (Northwestern University). Now graduate student at CU Boulder
Research led to a paper in ApJ
2017-18 Tre'Shunda James (Occidental College). Now graduate student at UT Arlington
Research led to a paper in ApJ
2017 Isabel Angelo (UC Berkeley). Now graduate student at UCLA
Research led to a paper in AJ
2017 George Filippatos (Penn State). Now graduate student at Colorado School of Mines
2015 Peter Gao (Caltech). Now staff scientist at the Carnegie Institution for Science
Research led to a paper in ApJ

TEACHING EXPERIENCE

2015 **Co-Instructor**, California Institute of Technology, Class Ge 194: Isotopic Tracers of Mars Atmosphere-Surface Interactions
2015 **Guest Lecturer**, California Institute of Technology, Class Ge 159: Planetary Evolution and Habitability
2014 **Professional Development Program**, Institute for Scientist and Engineer Educators, UC Santa Cruz
2012 **Teaching Certificate Program**, Massachusetts Institute of Technology
2010 **Teaching Assistant**, Tsinghua University, Class: Quantum Mechanics

EXTERNALLY SPONSORED RESEARCH PROJECTS

Awarded \$3.2M since 2015

- **\$2.4M as PI**
- **\$1.3M for JWST projects, in which \$1.0M as PI**

Deep Characterization of the Atmosphere of a Temperate Sub-Neptune

Principal Investigator: **Renyu Hu**

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2025

Renyu Hu

Total Funding: \$394,001

Determining the Atmospheric Composition of the Super-Earth 55 Cancri e

Principal Investigator: **Renyu Hu**

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2024

Total Funding: \$236,320

Exploring the nature of a temperate exoplanet in the Fulton gap

Principal Investigator: Mario Damiano (**Renyu Hu** is Co-PI)

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2024

Total Funding: \$226,553

A Search for Signatures of Volcanism and Geodynamics on the Hot Rocky Exoplanet LHS 3844b

Principal Investigator: Laura Kreidberg (**Renyu Hu** is Co-PI)

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2024

Total Funding: \$176,322

Thermal Structure, Chemistry, and Observational Signatures of Cold Exoplanet Atmospheres

Principal Investigator: **Renyu Hu**

Program: NASA Exoplanets Research Program

Funding Period: 2018 – 2022

Total Funding: \$ 458,552

Constraining Early Mars's Atmosphere and Habitability with Isotopic Measurements

Principal Investigator: **Renyu Hu**

Program: NASA Habitable Worlds

Funding Period: 2017 – 2022

Total Funding: \$ 808,295

First Transmission Spectrum of a Cold, Water-Cloud Gas Giant Planet

Principal Investigator: **Renyu Hu**

Program: Hubble Space Telescope Cycle 24 Guest Observers

Funding Period: 2017 – 2020

Total Funding: \$74,629

The SPACE Program: a Sub-neptune Planetary Atmosphere Characterization Experiment

Principal Investigator: Laura Kreidberg

Program: Hubble Space Telescope Cycle 30 Guest Observers

Renyu Hu

Funding Period: 2022 – 2024

Co-I Funding: \$193,013 (to be reviewed by STScI)

Is it raining lava in the evening on 55 Cancri e?

Principal Investigator: Alexis Brandeker

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2024

Co-I Funding: \$97,764

Searching Our Closest Stellar Neighbor for Planets and Zodiacal Emission

Principal Investigator: Charles Beichman

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2025

Co-I Funding: \$15,362

Unveiling the Atmospheric Composition and Haze Formation Rates in the Young, Cool, Super-Puff Kepler-51d

Principal Investigator: Jessica Libby-Roberts

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2024

Co-I Funding Requested: \$40,003

Hot Take on a Cool World: Does Trappist-1c Have an Atmosphere?

Principal Investigator: Laura Kreidberg

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2023

Co-I Funding: \$18,670

The First and Only Multi-wavelength Map of an Ultra-short-period sub-Earth

Principal Investigator: Michael Zhang

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2023

Co-I Funding: \$18,804

The first near-infrared spectroscopic phase-curve of a super-Earth

Principal Investigator: Nestor Espinoza

Program: James Webb Space Telescope Cycle 1 Guest Observers

Funding Period: 2022 – 2023

Co-I Funding: \$15,813

The Imitation Game: Construction of a Habitable Exoplanet Detection Machine

Renyu Hu

Principal Investigator: Jonathan Jiang
Program: NASA Exoplanets Research Program
Funding Period: 2020 – 2023
Co-I Funding: \$22,100

Confirming a Tentative Detection of an Atmosphere around a Potentially Rocky Planet

Principal Investigator: Thomas Barclay
Program: Hubble Space Telescope Cycle 28 Guest Observers
Funding Period: 2021 – 2023
Co-I Funding: \$29,703

Searching for Secondary Atmospheres in a System of Benchmark Worlds

Principal Investigator: Thomas Barclay
Program: Hubble Space Telescope Cycle 27 Guest Observers
Funding Period: 2021 – 2022
Co-I Funding: \$64,375

Optimizing WFIRST Coronagraph Science

Principal Investigator: Bruce Alan Macintosh
Program: NASA WFIRST Science Investigation Teams and Adjutant Scientists
Funding Period: 2016 – 2021
Co-I Funding: \$113,530

Model Atmospheres and Spectral Irradiance Library of the Exoplanet Host Stars Observed in the MUSCLES Survey

Principal Investigator: Jeffrey Linsky
Program: Hubble Space Telescope Cycle 25 Archival or Theory Research
Funding Period: 2018 – 2020
Co-I Funding: \$85,792

Restoring and Archiving Voyager 1 Cruise Images of Uranus and Neptune

Principal Investigator: Daniel Wenkert
Program: NASA Planetary Data Archiving, Restoration, and Tools
Funding Period: 2018 – 2020
Co-I Funding: \$ 16,510

Detecting and Characterizing Exoplanets with the WFIRST Coronagraph: Colors of Planets in Standard and Designer Bandpasses

Principal Investigator: Margaret Turnbull
Program: NASA WFIRST Preparatory Science
Funding Period: 2015 – 2018

Renyu Hu

Co-I Funding: \$73,910

Chemical Fingerprints of Alien Worlds – Towards an Evolutionary View of Mars and Terrestrial Exoplanet Atmospheres

Principal Investigator: Wesley A. Traub

Science-PI: **Renyu Hu**

Program: NASA Hubble Postdoctoral Fellowship

Funding Period: 2013 – 2015

Total Funding: \$316,500

Photochemistry of Super Earth Exoplanet Atmospheres

Principal Investigator: Sara Seager

Science PI: **Renyu Hu**

Program: NASA Earth and Space Science Fellowship

Funding Period: 2011 – 2013

Total Funding: \$60,000

COMPETITIVE OBSERVATION PROGRAMS

JWST: 4 programs (109.4 hours) as PI and Co-PI, 7 programs (194.6 hours) as Co-I

HST: 1 program (6 orbits) as PI, 3 programs (241 orbits) as Co-I

Spitzer: 2 programs (175.9 hours) as Co-I

TESS: 1 program as Co-I

Deep Characterization of the Atmosphere of a Temperate Sub-Neptune

Principal Investigator: **Renyu Hu**

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 67.9 hours

Determining the Atmospheric Composition of the Super-Earth 55 Cancri e

Principal Investigator: **Renyu Hu**

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 15.4 hours

Exploring the nature of a temperate exoplanet in the Fulton gap

Principal Investigator: Mario Damiano (**Renyu Hu** is Co-PI)

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 14.4 hours

Renyu Hu

A Search for Signatures of Volcanism and Geodynamics on the Hot Rocky Exoplanet LHS 3844b

Principal Investigator: Laura Kreidberg (**Renyu Hu** is Co-PI)

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 11.7 hours

First Transmission Spectrum of a Cold, Water-Cloud Gas Giant Planet

Principal Investigator: **Renyu Hu**

Facility: Hubble Space Telescope

Date of Selection: 10/2016

Allocated Time: 6 orbits

The SPACE Program: a Sub-neptune Planetary Atmosphere Characterization Experiment

Principal Investigator: Laura Kreidberg

Facility: Hubble Space Telescope

Date of Selection: 06/2022

Allocated Time: 205 orbits

Is it raining lava in the evening on 55 Cancri e?

Principal Investigator: Alexis Brandeker

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 25 hours

Searching Our Closest Stellar Neighbor for Planets and Zodiacal Emission

Principal Investigator: Charles Beichman

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 25 hours

Unveiling the Atmospheric Composition and Haze Formation Rates in the Young, Cool, Super-Puff Kepler-51d

Principal Investigator: Jessica Libby-Roberts

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 20.5 hours

Hot Take on a Cool World: Does Trappist-1c Have an Atmosphere?

Principal Investigator: Laura Kreidberg

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Renyu Hu

Allocated Time: 17.9 hours

The First and Only Multi-wavelength Map of an Ultra-short-period sub-Earth

Principal Investigator: Michael Zhang

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 13.2 hours

The first near-infrared spectroscopic phase-curve of a super-Earth

Principal Investigator: Nestor Espinoza

Facility: James Webb Space Telescope

Date of Selection: 03/2021

Allocated Time: 14.9 hours

Confirming a tentative detection of an atmosphere around a potentially rocky planet

Principal Investigator: Thomas Barclay

Facility: Hubble Space Telescope

Date of Selection: 10/2020

Allocated Time: 8 orbits

Searching for Secondary Atmospheres in a System of Benchmark Worlds

Principal Investigator: Thomas Barclay

Facility: Hubble Space Telescope

Date of Selection: 07/2019

Allocated Time: 28 orbits

Characterizing the Super-Earth 55 Cnc e: The Tess Opportunity

Principal Investigator: Diana Dragomir

Facility: Transiting Exoplanet Survey Satellite

Date of Selection: 06/2019

Allocated Time: N/A

A Test for the Existence of An Atmosphere on a Terrestrial Exoplanet Orbiting a Small Star

Principal Investigator: Laura Kreidberg

Facility: Spitzer Space Telescope

Date of Selection: 09/2018

Allocated Time: 100.9 hours

The Transiting Exoplanet Community Early Release Science Program

Principal Investigator: Natalie Batalha

Facility: James Webb Space Telescope

Renyu Hu

Date of Selection: 11/2017

Allocated Time: 78.1 hours

The First Orbital Phase Curve of a Rocky Exoplanet

Principal Investigator: Brice-Olivier Demory

Facility: Spitzer Space Telescope

Date of Selection: 12/2012

Allocated Time: 75 hours

INVITED TALKS

Seminars and Colloquia

- 2021 The University of Arizona, Tucson, AZ, Lunar and Planetary Laboratory Colloquium
- 2021 NASA Nexus for Exoplanet System Science, CLEVER Planets Seminar
- 2021 Institute of Planetary Research, German Aerospace Center, Berlin, Germany, Seminar
- 2021 Northwestern University, Evanston, IL, Astrophysics Seminar
- 2021 National Astronomical Observatory of Japan, Tokyo, Japan, Seminar
- 2019 California State University, Los Angeles, CA, Physics and Astronomy Seminar
- 2019 Max Planck Institute for Astronomy, Heidelberg, Germany, Origins of Life Seminar
- 2019 Purdue University, West Lafayette, IN, Department Seminar
- 2018 University of Geneva, Geneva, Switzerland, Seminar
- 2018 University of California, Los Angeles, CA, Planetary Science Seminar
- 2018 University of Florida, Gainesville, FL, Astronomy Seminar
- 2017 CNRS Orléans, Orléans, France, Space Science Seminar
- 2017 Caltech, Pasadena, CA, Geological and Planetary Sciences Seminar
- 2017 Academia Sinica, Taipei, Taiwan, Astronomy Colloquium
- 2016 California State University, Northridge, CA, Physics and Astronomy Seminar
- 2016 ETH Zurich, Zurich, Switzerland, Astrophysics Seminar
- 2016 University of Bern, Bern, Switzerland, Space Research Seminar
- 2016 Geneva Observatory, Geneva, Switzerland, Seminar
- 2016 Arizona State University, Tempe, AZ, Astrobiology Seminar
- 2014 Caltech, Pasadena, CA, Kliegel Lectures in Planetary Sciences
- 2014 University of California, Los Angeles, CA, Planetary Seminar
- 2013 University of California, Los Angeles, CA, iPLEX Lunch Seminar
- 2013 California Institute of Technology, Pasadena, CA, Yuk Lunch Seminar
- 2012 Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, SSP Seminar
- 2012 Institute for Advanced Study, Princeton, NJ, Seminar

Invited Conference Talks

- 2022 Chianti International Workshop on Atmospheres, Florence, Italy
- 2021 The Mars panel of the planetary science and astrobiology decadal survey

Renyu Hu

- 2019 The 234th Meeting of the American Astronomical Society, St Louis, MO
- 2019 The EGU General Assembly, Vienna, Austria
- 2018 Defining the Landscape for Precision Radial Velocity (PRV) Science in the 2018-2028 Time Frame, Pasadena, CA
- 2018 Technology for Direct Detection and Characterization of Exoplanets, Pasadena, CA
- 2017 Asia Oceania Geosciences Society 14th Annual Meeting, Singapore
- 2016 NASA Starshade Technology Workshop, Pasadena, CA
- 2016 Community Astrophysics with WFIRST, Guest Observer and Archival Science, Pasadena, CA
- 2016 The 227th Meeting of the American Astronomical Society, Kissimmee, FL
- 2015 Exoplanetary Atmospheres and Habitability, Nice, France
- 2015 IAU XXIX General Assembly, Honolulu, HI
- 2015 Planetary Systems: a Synergistic View, Quy Nhon, Vietnam
- 2015 Physics of Exoplanets: From Earth-sized to Mini Neptunes, Santa Barbara, CA

MEDIA REPORTS AND PUBLIC OUTREACH

- 2022 *JWST Science Feature Volcanic Worlds*, by STScI
- 2021 *How to Find Hidden Oceans on Distant Worlds? Use Chemistry*, by NASA
- 2021 *Where are the water worlds? New tool to find out*, by EarthSky
- 2021 *The Water on Mars Vanished – This Might Be Where It Went*, by NY Times, National Geographic, and multiple news outlets
- 2019 *A Rare Look at the Surface of a Rocky Exoplanet*, by NASA
- 2018 Science advisor for “Signs of Life”, an award-winning planetarium show at the Griffith Observatory, Los Angeles (premiered in May 2022)
- 2017 *Lava or Not, Exoplanet 55 Cancri e Likely to Have Atmosphere*, by National Geographic
- 2017 *Our Living Planet Shapes the Search for Life Beyond Earth*, by NASA
- 2017 Panel Discussion on “Arrival” at the Los Angeles Public Library
- 2017 *Signs of Alien Air Herald a New Era of Exoplanet Discoveries*, by Scientific American
- 2016 *Testing for Methane on Mars*, by Airspacemag.com
- 2015 *Mystery on Mars: Does Methane Really Indicate Life?* by Space.com
- 2015 *Mars’ Ancient Atmosphere Wasn’t Very Thick After All*, by Discovery Channel
- 2015 *Helium-Filled Exoplanets Likely Float Throughout the Galaxy*, by Discovery Channel and Space.com
- 2013 *Investigating Exoplanet Surfaces*, by Astrobiology Magazine
- 2012 *Mars Snowflakes Are as Tiny as Red Blood Cells*, by CBS, Nature, Discovery Channel, National Geographic, and Space.com
- 2011 *How Astronomers May Hunt for Life on Alien Planets*, by Astrobiology Magazine

LANGUAGE SKILLS

Chinese High Proficiency

Renyu Hu

French Diplôme Supérieur Langue et Culture Françaises, corresponding to CEFR Level C1

German Basic, 200 hours of study

PUBLICATIONS

Refereed Publications

23 first-author papers, h-index = 28 (using NASA ADS)

*student advised, #postdoc advised, ^equal contribution

ADS Library: <https://ui.adsabs.harvard.edu/public-libraries/im9iiqF6Se268wGNIdielA>

Copies of the papers are available at: <http://web.gps.caltech.edu/~ryh/publication.html>

[68] JWST Transiting Exoplanet Community Early Release Science Team (2022), *Identification of carbon dioxide in an exoplanet atmosphere*, submitted to **Nature**

[67] #Mario Damiano, **Renyu Hu**, et al. (2022), *A transmission spectrum of the sub-Earth planet L98-59 b in 1.1 – 1.7 μm* , submitted to **AJ**

[66] Christopher D. Parkinson, Stephen W. Bougher, Franklin P. Mills, **Renyu Hu**, Guillaume Gronoff, Jiazheng Li, Amanda Brecht, and Yuk L. Yung (2022), *Venus as an Exoplanet: I. An Initial Exploration of the 3-D Energy Balance for a CO₂ Exoplanetary Atmosphere Around an M-Dwarf Star*, submitted to **J. Geophys. Res. Planets** (arXiv: 2205.10958)

[65] Emily A. Whittaker, ... **Renyu Hu**, et al. (2022), *The Detectability of Rocky Planet Surface and Atmosphere Composition with JWST: The Case of LHS 3844b*, submitted to **ApJ** (arXiv: 2207.08889)

[64] Robert A. West, Philip Dumont, **Renyu Hu**, Vijay Natraj, James Breckinridge, and Pin Chen (2022), *Spectropolarimetry as a Means to Address Cloud Composition and Habitability for a Cloudy Exoplanetary Atmosphere in the Habitable Zone*, submitted to **ApJ**

[63] Stefan Martin, ... **Renyu Hu**, et al. (2022), *ATSA- A Next Generation Active Telescope for Space Astronomy*, submitted to **Journal of Astronomical Telescopes, Instruments, and Systems**

[62] Steffen Buessecker, Hiroshi Imanaka, Tucker Ely, **Renyu Hu**, Stephen J. Romaniello, and Hinsby Cadillo-Quiroz (2022), *Marine mineral-catalyzed NO and N₂O formation on the anoxic early Earth*, **Nature Geoscience**, in press (EarthArxiv: n6tv2)

[61] #Mario Damiano and **Renyu Hu** (2022), *Reflected spectroscopy of small planets II: characterization of terrestrial exoplanets*, **AJ**, 163, 299

[60] **Renyu Hu** and *Trent Thomas (2022), *A nitrogen-rich atmosphere on ancient Mars consistent with isotopic evolution models*, **Nature Geoscience**, 15, 106

[59] Jiazheng Li, Jonathan H. Jiang, Huanzhou Yang, Dorian S. Abbot, **Renyu Hu**, Thaddeus D. Komacek, Stuart J. Bartlett, and Yuk L. Yung (2022), *Rotation Period Detection for Earth-like Exoplanets*, **AJ**, 163, 27

- [58] Caprice L. Phillips, Ji Wang, Sarah Kendrew, Thomas P. Greene, **Renyu Hu**, Jeff Valenti, Wendy R. Panero, and Joseph Schulze (2021), *Detecting Biosignatures in the Atmospheres of Gas Dwarf Planets with the James Webb Space Telescope*, **ApJ**, 923, 144
- [57] #Mario Damiano and **Renyu Hu** (2021), *Reflected spectroscopy of small exoplanets I: determining the atmospheric composition of sub-Neptune planets*, **AJ**, 162, 200
- [56] **Renyu Hu**, #Mario Damiano, #Markus Scheucher, Edwin Kite, Sara Seager, and Heike Rauer (2021), *Unveiling shrouded oceans on temperate sub-Neptunes via transit signatures of solubility equilibria vs. gas thermochemistry*, **ApJ Letters**, 921, L8
- [55] **Renyu Hu** (2021), *Photochemistry and Spectral Characterization of Temperate and Gas-Rich Exoplanets*, **ApJ**, 921, 27
- [54] *Danica Adams, ... **Renyu Hu**, and Yuk Yung (2021), *Nitrogen Fixation on Early Mars*, **Astrobiology**, 21, 8
- [53] *Eva L. Scheller, Bethany Ehlmann, **Renyu Hu**, *Danica Adams, and Yuk Yung (2021), *Long-Term Drying of Mars by Sequestration of Ocean-Scale Volumes of Water in the Crust*, **Science**, 372, 56
- [52] Michael Zhang, Heather A. Knutson, Lile Wang, Fei Dai, Antonija Oklopčić, and **Renyu Hu** (2021), *No Escaping Helium from 55 Cnc e*, **AJ**, 161, 181
- [51] Andrew Romero-Wolf, ... **Renyu Hu**, et al. (2021), *Starshade Rendezvous: Exoplanet Orbit Constraints from Multi-Epoch Direct Imaging*, **Journal of Astronomical Telescopes, Instruments, and Systems**, 7, 021219
- [50] **Renyu Hu**, Sergi R. Hildebrandt, #Mario Damiano, Stuart Shaklan, Stefan Martin, and Doug Lisman (2021), *Starshade Exoplanet Data Challenge*, **Journal of Astronomical Telescopes, Instruments, and Systems**, 7, 021216
- [49] Andrew Romero-Wolf, ... **Renyu Hu**, et al. (2021), *Starshade Rendezvous: Exoplanet Sensitivity and Observing Strategy*, **Journal of Astronomical Telescopes, Instruments, and Systems**, 7, 021210
- [48] **Renyu Hu**, Doug Lisman, Stuart Shaklan, Stefan Martin, Phil Willems, and Kendra Short (2021), *Overview and Reassessment of Noise Budget of Starshade Exoplanet Imaging*, **Journal of Astronomical Telescopes, Instruments, and Systems**, 7, 021205
- [47] #Mario Damiano, **Renyu Hu**, and Sergi Hildebrandt (2020), *Multi-orbital-phase and Multiband Characterization of Exoplanetary Atmospheres with Reflected Light Spectra*, **AJ**, 160, 206
- [46] Sukrit Ranjan, ... **Renyu Hu** (2020), *Photochemistry of Anoxic Abiotic Habitable Planet Atmospheres: Impact of New H₂O Cross-Sections*, **ApJ**, 896, 148
- [45] #Mario Damiano and **Renyu Hu** (2020), *ExoREL-R: A Bayesian Inverse Retrieval Framework for Exoplanetary Reflected Light Spectra*, **AJ**, 159, 175

- [44] **Renyu Hu**, *Luke Peterson, and Eric T. Wolf (2020), *O₂- and CO-Rich Atmospheres for Potentially Habitable Environments on TRAPPSIT-1 Planets*, **ApJ**, 888, 122
- [43] Charles Beichman, ... **Renyu Hu**, et al. (2020), *Searching for Planets Orbiting α Cen A with the James Webb Space Telescope*, **PASP**, 132, 015002
- [42] Clara Sousa-Silva, ... **Renyu Hu**, et al. (2020), *Phosphine as a Biosignature Gas in Exoplanet Atmospheres*, **Astrobiology**, 20, 2
- [41] **Renyu Hu** (2019), *Information in the Reflected Light Spectra of Widely Separated Giant Exoplanets*, **ApJ**, 887, 166
- [40] **Renyu Hu** and *Héctor Delgado Diaz (2019), *Stability of Nitrogen in Planetary Atmospheres in Contact with Liquid Water*, **ApJ**, 886, 126
- [39] Megan Mansfield, Edwin S. Kite, **Renyu Hu**, et al. (2019), *Identifying Atmospheres on Rocky Exoplanets through Infrared High Albedo*, **ApJ**, 886, 141
- [38] Laura Kreidberg, ^Daniel Koll, ^Caroline Morley, ^**Renyu Hu**, et al. (2019), *Absence of a Thick Atmosphere on the Terrestrial Exoplanet LHS 3844b*, **Nature**, 573, 87
- [37] Jonathan Jiang, Xuan Ji, Nicholas Cowan, **Renyu Hu**, and Zonghong Zhu (2019), *Empirical Predictions for the Period Distribution of Planets to be Discovered by the Transiting Exoplanet Survey Satellite*, **AJ**, 158, 96
- [36] **Renyu Hu** (2019), *Predicted Diurnal Variation of the Deuterium to Hydrogen Ratio in Water at the Surface of Mars Caused by Mass Exchange with the Regolith*, **Earth Planet Sci Lett**, 519, 192
- [35] #Yui Kawashima, **Renyu Hu**, and Masahiro Ikoma (2019), *Detectable Molecular Features above Hydrocarbon Haze via Transmission Spectroscopy with JWST: Case Studies of GJ 1214b, GJ 436b, HD 97658b, and Kepler-51b*, **ApJ Letters**, 876, L5
- [34] R. O. Parke Loyd, ... **Renyu Hu**, et al. (2018), *The Muscles Treasury Survey. V. FUV Flares On Active And Inactive M Dwarfs*, **ApJ**, 867, 71
- [33] *Tre'Shunda James and **Renyu Hu** (2018), *Photochemical Oxygen in Non-1 Bar CO₂ Atmospheres of Terrestrial Exoplanets*, **ApJ**, 867, 17
- [32] Yuk L. Yung, ... **Renyu Hu**, et al. (2018), *Methane on Mars and Habitability: Challenges and Responses*, **Astrobiology**, 18, 1221
- [31] Eliza M.-R. Kempton, ... **Renyu Hu**, et al. (2018), *A Framework for Prioritizing the TESS Planetary Candidates Most Amenable to Atmospheric Characterization*, **PASP**, 130, 114401
- [30] Jacob L. Bean, ... **Renyu Hu**, et al. (2018), *The Transiting Exoplanet Community Early Release Science Program for JWST*, **PASP**, 130, 114402
- [29] Chester E. Harman, Ryan Felton, **Renyu Hu**, et al. (2018), *Abiotic O₂ Levels on Planets around F, G, K, and M Stars: Effects of Lightning-Produced Catalysts in Eliminating Oxygen False Positives*, **ApJ**, 866, 56

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