

Dr. Renyu Hu

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Jet Propulsion Laboratory
4800 Oak Grove Dr., MS 169-237
Pasadena, CA 91109, USA

1 (818) 281 9459
renyu.hu@jpl.nasa.gov
<http://web.gps.caltech.edu/~ryh/>

EMPLOYMENT

2019- Research Scientist IV, Jet Propulsion Laboratory
2015-19 Research Scientist III, Jet Propulsion Laboratory
2018- Starshade Scientist, NASA Exoplanet Exploration Program
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 planets 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

2017 Voyager Award for Individual Achievement, Jet Propulsion Laboratory
2013-15 NASA Hubble Fellowship
2011-13 NASA Earth and Space Science Fellowship
2012 Barrett Prize, Massachusetts Institute of Technology
2012 Fellowship, Sao Paulo Advanced School of Astrobiology
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 EXPERIENCE

- 2018- **Member**, TESS Atmospheric Characterization Working Group
- 2017- **Atmospheric Science Lead**, Starshade Rendezvous Probe Study
- 2016- **Member**, WFIRST 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

STUDENT ADVISING EXPERIENCE

- 2018- Trent Thomas (UCLA)
- 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 postdoc at UC Berkeley
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

PROFESSIONAL SERVICE

- 2017- **Member**, Astrophysics Colloquium Committee and Astrophysics Hiring Committee, Jet Propulsion Laboratory
- 2016- **Founder**, Exoplanet Lunch Seminar Series, Jet Propulsion Laboratory
- 2013- **Referee** for ApJ, ApJS, MNRAS, A&A, Nature Geosciences, Nature Astronomy, Astrobiology, Icarus, EPSL, JGR, GRL, and Astrophysics and Space Science

Renyu Hu

- 2012- **Panel Reviewer** for NASA's Planetary Atmospheres Program, Mars Data Analysis Program, Exoplanets Research Program, Exobiology Program, Astrophysics Research and Analysis Program, and Earth and Space Science Fellowship
- 2018 **Member**, 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 **Member**, Hubble Space Telescope Time Allocation Committee

EXTERNALLY SPONSORED RESEARCH PROJECTS

Awarded \$1.5M since 2015, in which \$1.1M as PI

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

Principal Investigator: **Renyu Hu**

Program: NASA Exoplanets Research Program

Funding Period: 2018-2021

Total Funding: \$ 458,552

Constraining Early Mars's Atmosphere and Habitability with Isotopic Measurements

Principal Investigator: **Renyu Hu**

Program: NASA Habitable Worlds

Funding Period: 2017-2020

Total Funding: \$ 576,260

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 Imitation Game: Construction of a Habitable Exoplanet Detection Machine

Principal Investigator: Jonathan Jiang

Program: NASA Exoplanets Research Program

Funding Period: 2020-2023

Co-I Funding: \$22,100

Optimizing WFIRST Coronagraph Science

Principal Investigator: Bruce Alan Macintosh

Program: NASA WFIRST Science Investigation Teams and Adjutant Scientists

Renyu Hu

Funding Period: 2016 to 2021

Co-I Funding: \$113,530

Searching for Secondary Atmospheres in a System of Benchmark Worlds

Principal Investigator: Thomas Barclay

Program: Hubble Space Telescope Cycle 27 Guest Observers

Funding Period: 2019 to 2021

Co-I Funding: \$81,085

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 to 2018

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 to 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

Renyu Hu

Funding Period: 2011 to 2013

Total Funding: \$60,000

COMPETITIVE OBSERVATION PROGRAMS

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

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

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

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

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

- 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

- 2019 *A Rare Look at the Surface of a Rocky Exoplanet*, by NASA
- 2018 Consultant for “Signs of Life”, a planetarium show at the Griffith Observatory, Los Angeles
- 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

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- 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
- French Diplôme Supérieur Langue et Culture Françaises, corresponding to CEFR Level C1
- German Basic, 200 hours of study

PUBLICATIONS

Refereed Publications

18 first-author papers, h-index = 18, *student advised, #postdoc advised, ^equal contribution

[45] #Mario Damiano and **Renyu Hu** (2019), *ExoREL-R: A Bayesian Inverse Retrieval Framework for Exoplanetary Reflected Light Spectra*, submitted to **ApJ**

[44] **Renyu Hu**, *Luke Peterson, and Eric T. Wolf (2019), *O₂-Dominated Atmospheres for Potentially Habitable Environments on TRAPPSIT-1 Planets*, submitted to **ApJ**

[43] **Renyu Hu** (2019), *Information in the Reflected Light Spectra of Widely Separated Giant Exoplanets*, **ApJ**, in press

[42] Charles Beichman, ... **Renyu Hu**, et al. (2019), *Searching for Planets Orbiting α Cen A with the James Webb Space Telescope*, **PASP**, in press (arXiv:1910.09709)

[41] Clara Sousa-Silva, ... **Renyu Hu**, et al. (2019), *Phosphine as a Biosignature Gas in Exoplanet Atmospheres*, **Astrobiology**, in press (arXiv:1910.05224)

[40] **Renyu Hu** and Héctor Delgado Diaz (2019), *Stability of Nitrogen in Planetary Atmospheres in Contact with Liquid Water*, **ApJ**, in press (arXiv:1910.04111)

[39] Megan Mansfield, Edwin S. Kite, **Renyu Hu**, et al. (2019), *Identifying Atmospheres on Rocky Exoplanets through Infrared High Albedo*, **ApJ**, in press (arXiv: 1907.13150)

[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
- [28] Ji Wang, Dimitri Mawet, **Renyu Hu**, et al. (2018), *Baseline Requirements for Detecting Biosignatures with the HabEx and LUVOIR Mission Concepts*, **Journal of Astronomical Telescopes, Instruments, and Systems**, 4, 035001
- [27] Jonathan Jiang, ... **Renyu Hu**, et al. (2018), *Using Deep Space Climate Observatory Measurements to Study the Earth as An Exoplanet*, **AJ**, 156, 26
- [26] Charles Beichman, ... **Renyu Hu**, et al. (2018), *Validation and Initial Characterization of the Long Period Planet Kepler-1654 b*, **AJ**, 155, 158
- [25] Edward Schwieterman, ... **Renyu Hu**, et al. (2018), *Exoplanet Biosignatures: A Review of Remotely Detectable Signs of Life*, **Astrobiology**, 18, 663
- [24] *Isabel Angelo and **Renyu Hu** (2017), *A Case for an Atmosphere on Super-Earth 55 Cancri e*, **AJ**, 154, 6
- [23] Ji Wang, Dimitri Mawet, Garreth Ruane, **Renyu Hu**, and Björn Benneke (2017), *Observing Exoplanets with High Dispersion Coronagraphy. I. The scientific potential of current and next-generation large ground and space telescopes*, **AJ**, 153, 183
- [22] Bethany Ehlmann, ... **Renyu Hu**, et al. (2016), *The sustainability of habitability on terrestrial planets: Insights, questions, and needed measurements from Mars for understanding the evolution of Earth-like worlds*, **J. Geophys. Res. Planets**, 121, 1927
- [21] **Renyu Hu**, Anthony Bloom, *Peter Gao, Charles E. Miller, and Yuk L. Yung (2016), *Hypotheses for near-surface exchange of methane on Mars*, **Astrobiology**, 16, 539
- [20] Brice-Oliver Demory, ... **Renyu Hu**, et al. (2016), *A map of the large day-night temperature gradient of a super-Earth exoplanet*, **Nature**, 532, 207
- [19] R. O. Parke Loyd, ... **Renyu Hu**, et al. (2016), *The MUSCLES Treasury Survey III: X-ray to Infrared Spectra of 11 M and K Stars*, **ApJ**, 824, 102
- [18] **Renyu Hu**, David Kass, Bethany L. Ehlmann, and Yuk L. Yung (2015), *Tracing the Fate of Carbon and the Atmospheric Evolution of Mars*, **Nature Communications**, 6, 10003
- [17] Avi Shporer and **Renyu Hu** (2015), *Studying Atmosphere-Dominated Hot Jupiter Kepler Phase Curves: Evidence that Inhomogeneous Atmospheric Reflection is Common*, **AJ**, 150, 112
- [16] **Renyu Hu**, Sara Seager, and Yuk L. Yung (2015), *Helium Atmospheres on Warm Neptune- and Sub-Neptune-Sized Exoplanets and Applications to GJ 436 b*, **ApJ**, 807, 8

- [15] *Peter Gao, **Renyu Hu**, Tyler Robinson, Cheng Li, and Yuk L. Yung (2015), *Stabilization of CO₂ Atmospheres on Exoplanets around M Dwarf Stars*, **ApJ**, 806, 249
- [14] **Renyu Hu**, Brice-Oliver Demory, Sara Seager, Nikole Lewis, and Adam P. Showman (2015), *A Semi-Analytical Model of Visible-Wavelength Phase Curves of Exoplanets and Applications to Kepler-7 b and Kepler-10 b*, **ApJ**, 802, 51
- [13] **Renyu Hu** and Sara Seager (2014), *Photochemistry in Terrestrial Exoplanet Atmospheres III: Photochemistry and Thermochemistry in Thick Atmospheres on Super Earths*, **ApJ**, 784, 63
- [12] Sara Seager, William Bains, and **Renyu Hu** (2013), *Biosignature Gases in H₂-Dominated Exoplanet Atmospheres*, **ApJ**, 777, 95
- [11] Sara Seager, William Bains, and **Renyu Hu** (2013), *A Biomass Model for Exoplanet Biosignature Gases*, **ApJ**, 775, 104
- [10] **Renyu Hu**, Sara Seager, and William Bains (2013), *Photochemistry in Terrestrial Exoplanet Atmospheres II: H₂S and SO₂ Photochemistry in Anoxic Atmospheres*, **ApJ**, 769, 6
- [9] **Renyu Hu**, Sara Seager, and William Bains (2012), *Photochemistry in Terrestrial Exoplanet Atmospheres I: Photochemistry Model and Benchmark Cases*, **ApJ**, 761, 166
- [8] **Renyu Hu** and Shuang-Nan Zhang (2012), *Quasars' Optical Polarization and Balmer Edge Feature Revealed by Ultra-violet, and Polarized Visible to Near Infrared Emissions*, **MNRAS**, 426, 2847-2858
- [7] **Renyu Hu**, Kerri Cahoy, and Maria T. Zuber (2012), *Mars CO₂ Condensation Above The North and South Poles Revealed by Radio Occultation, Climate Sounding, and Laser Ranging*, **J. Geophys. Res.**, 117, E07002
- [6] **Renyu Hu**, Bethany L. Ehlmann, and Sara Seager (2012), *Theoretical Spectra of Terrestrial Exoplanet Surfaces*, **ApJ**, 752, 7-21
- [5] **Renyu Hu** (2010), *Transport of the First Rocks of the Solar System by X-winds*, **ApJ**, 725, 1421-1428
- [4] Yu-Qing Lou and **Renyu Hu** (2010), *General Polytropic Magnetofluid under Self-Gravity: Voids and Shocks*, **New Astronomy**, 15, 198-214
- [3] **Renyu Hu** and Yu-Qing Lou (2009), *Magnetic Massive Stars as Magnetar Progenitors*, **MNRAS**, 396, 878-886
- [2] **Renyu Hu** and Yu-Qing Lou (2008), *Self-Similar Champagne Flow of Polytropic HII Regions*, **MNRAS**, 390, 1619-1634
- [1] **Renyu Hu**, Yulia V. Bogdanova, Christopher J. Owen, Claire Foullon, Andrew N. Fazakerley, and Henri Rème (2008), *Cluster Observations of the Mid-Altitude Cusp under Strong Northward Interplanetary Magnetic Field*, **J. Geophys. Res.**, 113, A07S05

Reports, White Papers, Book Chapters, and Conference Proceedings

- [12] **Renyu Hu**, et al. (2019), *The Super-Earth Opportunity - Search for Habitable Exoplanets in the 2020s*, White paper to the Astro2020 decadal survey (arXiv: 1903.05258)
- [11] Benjamin Rackham, ... **Renyu Hu**, et al. (2019), *Constraining Stellar Photospheres as an Essential Step for Transmission Spectroscopy of Small Exoplanets*, White paper to the Astro2020 decadal survey (arXiv: 1903.06152)
- [10] Charles Beichman, ... **Renyu Hu**, et al. (2019), *Direct Imaging and Spectroscopy of Exoplanets with the James Webb Space Telescope*, White paper to the Astro2020 decadal survey
- [9] Jonathan Fortney, ... **Renyu Hu**, et al. (2019), *The Need for Laboratory Measurements and Ab Initio Studies to Aid Understanding of Exoplanetary Atmospheres*, White paper to the Astro2020 decadal survey (arXiv: 1905.07064)
- [8] Daniel Apai, ... **Renyu Hu**, et al. (2018), *Understanding Stellar Contamination in Exoplanet Transmission Spectra as an Essential Step in Small Planet Characterization*, White paper to the NAS Committee on Exoplanet Science Strategy (arXiv: 1803.08708)
- [7] Daniel Apai, ... **Renyu Hu**, et al. (2017), *Exploring Other Worlds: Science Questions for Future Direct Imaging Missions*, ExoPAG SAG 15 Report (arXiv: 1708.02821)
- [6] Dimitri Mawet, ... **Renyu Hu**, et al. (2016), *Keck Planet Imager and Characterizer: concept and phased implementation*, in Proceedings of SPIE 9909, Adaptive Optics Systems V
- [5] Kevin France, ... **Renyu Hu**, et al. (2015), *Characterizing the Habitable Zones of Exoplanetary Systems with a Large Ultraviolet/Visible/Near-IR Space Observatory*, in response to NASA call for white papers: Large Astrophysics Missions to Be Studied by NASA Prior to the 2020 Decadal Survey (arXiv:1505.01840)
- [4] **Renyu Hu** (2014), *Ammonia, Water Clouds and Methane Abundances of Giant Exoplanets and Opportunities for Super-Earth Exoplanets*, Report of a quick study of science return from direct-imaging exoplanet missions, commissioned by the NASA Exoplanet Exploration Program (arXiv:1412.7582)
- [3] **Renyu Hu** (2014), *Photochemistry in Terrestrial Exoplanet Atmospheres*, Invited Chapter in Planetary Exploration and Science: Recent Results and Advances, ed. S. Jin et al., Springer-Verlag
- [2] Roy van Boekel, Björn Benneke, Kevin Heng, **Renyu Hu**, et al. (2012), *The Exoplanet Characterization Observatory (EChO): performance model EclipseSim and applications*, in Proceedings of SPIE 8442, Space Telescopes and Instrumentation 2012: Optical, Infrared, and Millimeter Wave
- [1] **Renyu Hu** and Yu-Qing Lou (2008), *Rebound Shock Breakouts of Exploding Massive Stars: A MHD Void Model*, in AIP Conference Proceedings, 1065, 310-313 (arXiv:0808.3905)

Selected Conference Presentations

Héctor Delgado and **Renyu Hu** (2019), *Stability of Nitrogen in Exoplanetary Atmospheres in Contact with Liquid Water*, Astrobiology Science Conference 2019, Seattle, WA

Renyu Hu (2019), *Studying Exoplanet Atmospheres with Laboratory Data*, AAS 234th meeting, St Louis, MO

Renyu Hu, Luke Peterson, and Eric T. Wolf (2018), *Atmospheric Chemistry Models of Habitable-Zone Exoplanets in the TRAPPIST-1 System*, DPS 50th Meeting, Knoxville, TN

Renyu Hu (2018), *A Thick Atmosphere on the Super-Earth 55 Cancri e*, Challenge to Super-Earths and Their Atmospheres, Tokyo, Japan

Renyu Hu (2017), *Characterizing Terrestrial Exoplanets – the Present and the Future*, Geoscience for Understanding Habitability in the Solar System and beyond Conference, Azores, Portugal

Renyu Hu (2017), *Cloud and Haze in the Atmospheres of Wide-Separation Exoplanets*, AAS 229th meeting, Grapevine, TX

Renyu Hu (2016), *Exoplanet Science Enabled by Starshades*, Starshade Technology Workshop, Pasadena, CA

Renyu Hu and Yuk L. Yung (2016), *Diurnal and Seasonal Exchange of Deuterated Water Between Martian Atmosphere and Regolith*, The Sixth International Conference on Mars Polar Science and Exploration, Reykjavik, Iceland

Renyu Hu (2016), *Exoplanet Spectra with WFIRST – Cool Planets, Exciting Sciences*, Community Astrophysics with WFIRST, Guest Observer and Archival Science Conference, Pasadena, CA

Renyu Hu (2016), *Colors of Alien Worlds from Direct Imaging Exoplanet Missions*, AAS 227th Meeting, Kissimmee, FL

Renyu Hu (2015), *Hypotheses for a Near-Surface Reservoir of Methane and Its Release on Mars*, AGU Fall Meeting, San Francisco, CA

Renyu Hu (2015), *Equilibrium and Disequilibrium Chemistry in Evolved Exoplanet Atmospheres*, DPS 47th Meeting, National Harbor, MD

Renyu Hu (2015), *Colors of Alien Worlds from Direct Imaging Exoplanet Missions*, IAU XXIX General Assembly, Honolulu, Hawaii

Renyu Hu (2015), *Characterizing Exoplanet Atmospheres with Visible-Wavelength Phase Curves*, IAU XXIX General Assembly, Honolulu, Hawaii

Renyu Hu (2015), *Highly Evolved Exoplanet Atmospheres*, Planetary Systems: a Synergistic View Conference, Quy Nhon, Vietnam

Renyu Hu (2015), *Measuring Atmospheric Compositions of Giant Exoplanets and Distinguishing Water-World Exoplanets with Direct-Imaging Exoplanet Missions*, Hubble Fellows Symposium, Baltimore, MD

Renyu Hu, Peter Gao, Charles E. Miller, and Yuk L. Yung (2015), *Hypotheses for a Near-Surface Reservoir of Methane and Its Release on Mars*, 46th LPSC, Woodlands, TX, LPI Contribution No. 1832, p.2279

Renyu Hu (2015), *Highly Evolved Exoplanet Atmospheres*, AAS 225th Meeting, Seattle, WA

Renyu Hu, David M. Kass, Bethany L. Ehlmann, and Yuk L. Yung (2014), *Carbon Reservoir History of Mars Constrained by Atmospheric Isotope Signatures*, AGU Fall Meeting, San Francisco, CA

Peter Gao, **Renyu Hu**, Tyler D. Robinson, and Yuk L. Yung (2014), *The Role of Hydrogen in Determining the Stability of CO₂ Atmospheres of Terrestrial Exoplanets Around M Dwarfs*, DPS 46th Meeting, Tucson, AZ

Renyu Hu (2014), *Helium Atmosphere on Neptune-Sized Exoplanet GJ 436 b Formed by Irradiation Driven Escape*, 40th COSPAR Scientific Assembly, Moscow, Russia

Renyu Hu and Sara Seager (2014), *H₂S and SO₂ Photochemistry in Anoxic Atmospheres of Terrestrial Exoplanets*, 45th LPSC, The Woodlands, TX, LPI Contribution No. 1777, p.1481

Renyu Hu (2014), *Helium Atmosphere on Neptune-Sized Exoplanet GJ 436 b Formed by Irradiation Driven Escape*, Hubble Fellows Symposium, Baltimore, MD

Renyu Hu (2014), *Helium-Dominated Atmosphere on Neptune-Size Planet GJ 436 b*, Exoclimates III Conference, Davos, Switzerland

Renyu Hu and Sara Seager (2013), *Thermochemistry and Photochemistry in Thick Atmospheres on Super Earths and Mini Neptunes*, AGU Fall Meeting, San Francisco, CA

Renyu Hu and Sara Seager (2013), *Photochemistry in Thick Atmospheres on Super Earths*, 44th LPSC, The Woodlands, TX, LPI Contribution No. 1719, p.1428

Renyu Hu and Sara Seager (2013), *Atmospheric Photochemistry and Potential Biosignatures on Terrestrial Exoplanets*, AAS 221st Meeting, Long Beach, CA

Renyu Hu (2012), *Photochemistry of Terrestrial Exoplanet Atmospheres and Applications in Searching for Biosignature Gases*, IAU Symposium 293, Beijing, China

Renyu Hu (2012), *A New Photochemistry Code for Terrestrial Exoplanet Atmospheres*, Modeling Atmospheric Escape Workshop, Charlottesville, VA

Renyu Hu, Kerri Cahoy, and Maria T. Zuber (2011), *Particle Size of CO₂ Condensates in Mars' Atmosphere: a Joint Analysis of Radio Occultation, Climate Sounder and Laser Ranging Experiments*, AGU Fall Meeting, San Francisco, CA

Renyu Hu (2011), *Radial Transport of First Solids of the Solar System by X-Winds*, Workshop on Formation of the First Solids in the Solar System, Kauai, HI, LPI Contribution No. 1639, p.9061

Renyu Hu, Sara Seager, and William Bains (2011), *Can Hydrogen Sulfide Gas Be a Biosignature in a Habitable Exoplanet?*, AAS 218th Meeting, Boston, MA

Renyu Hu (2010), *Transport of First Rocks of The Solar System by X-winds*, ESF Research Conference: Putting our Solar System in Context, Obergurgl, Austria

Renyu Hu and Yu-Qing Lou (2010), *Fossil Fields as The Origin of Ultra-Intense Magnetic Fields on Magnetars*, AAS 215th Meeting, Washington, DC

Renyu Hu and Yu-Qing Lou (2009), *Magnetic massive stars as magnetar progenitors*, The First Panda Symposium, Lijiang, China,

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