

PETER GAO

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EDUCATION

- 2016 PhD, Planetary Sciences, California Institute of Technology
Thesis: Clouds and Hazes in Planetary Atmospheres
2014 MS, Planetary Sciences, California Institute of Technology
2010 BSc, Physics, University of British Columbia

RESEARCH EXPERIENCE

- 2017 – Present 51 Pegasi b Postdoctoral Fellow, University of California, Berkeley
2016 – 2017 NASA Postdoctoral Program Fellow, NASA Ames Research Center
2016 Kavli Summer Program Fellow, University of California, Santa Cruz
2014 NAI Santander Summer School Scholar, Santander, Spain
2010 – 2016 Graduate Research Assistant, California Institute of Technology
2010 NSERC Undergraduate Research Assistant, University of British Columbia

TEACHING & MENTORING EXPERIENCE

- 2018 Guest Lecturer, University of California, Berkeley
Solar System Astrophysics (1 lecture)
Planetary Astrophysics (2 lectures)
2018 – Present URAP Mentor, University of California, Berkeley
2016 – 2017 Graduate Student Mentor, Missouri State University/George Mason University
2016 – 2017 Undergraduate Student Mentor, Missouri State University
2015 – Present Graduate Student Mentor, University of California, Santa Cruz
2015 – Present Graduate Student Mentor, California Institute of Technology
2012 – 2015 Teaching Assistant, California Institute of Technology
Planetary Structure and Evolution (2012 – 2013)
Introduction to the Solar System (2014)
Planetary Habitability (2015)
2009 – 2010 Alma Mater Society Tutor, University of British Columbia

REVIEWERSHIPS

Advances in Space Research | Astrobiology | Astronomy & Astrophysics | The Astrophysical Journal | Atmosphere | Icarus | Monthly Notices of the Royal Astronomical Society | Scientific Reports | Planetary and Space Science

Exoplanet Research Program | Habitable Worlds | Solar System Workings | NASA Earth and Space Science Fellowship

SCHOLARSHIPS & AWARDS

- 2017 NASA Group Achievement Award
2016 51 Pegasi b Fellowship in Planetary Astronomy
2016 NASA Postdoctoral Program Fellowship
2016 Kavli Summer Program in Astrophysics Fellowship
2015 AGU Outstanding Student Paper Award

2015	DPS Hartmann Travel Grant
2015	CESASC Scholarship
2015	AAS International Travel Grant
2014	NASA Astrobiology Institute Scholarship
2013	VEXAG 11 Student Travel Grant
2012	CPS 9 th International School of Planetary Science Travel Fund
2010	NSERC Undergraduate Student Research Award
2009	Dean of Science Scholarship
2008	Volkoff Scholarship in Science
2007-2009	Trek Excellence Scholarship for Continuing Students
2007-2008	Thomas and Evelyn Hebb Memorial Scholarship
2007	Charles and Jane Banks Scholarship
2005	British Columbia Government Scholarship

OBSERVING PROPOSAL INVOLVEMENT

2018	Co-Investigator on Gemini-Subaru Exchange Program Proposal (2 nights): “Spectrophotometric Monitoring of the HR 8799 Planets”
2017	Co-Investigator on JWST ERS Proposal (78.1 hours): “The Transiting Exoplanet Community Early Release Science Program”
2017	Co-Investigator on Cycle-24 HST Proposal (20 orbits): “The First Near-Infrared Reflectance Spectrum of an Exoplanet”

RESEARCH PROPOSAL INVOLVEMENT

2019	Collaborator on NASA New Frontiers Data Analysis Proposal “Photochemical Study of Pluto”
2018	Collaborator on NASA Solar System Workings Grant Proposal “Haze Effects on the Atmospheric Thermal Structures of Pluto, Triton, and Titan”
2017	Collaborator on NSF Grant Proposal “Precision Near-Infrared Radial Velocities”
2016	Collaborator on NASA Astrophysics Probe Mission Concept Studies Proposal “EarthFinder: A Diffraction-Limited Precise Radial Velocity Observatory in Space”

PUBLICATIONS (29 Published/Accepted + 3 Submitted)

First Author Publications

- [9] **Gao P.** and Benneke B. (2018) Microphysics of KCl and ZnS Clouds on GJ 1214 b. *ApJ* **863**, 165
- [8] **Gao P.**, Marley M. S., and Ackerman A. S. (2018) Sedimentation Efficiency of Condensation Clouds in Substellar Atmospheres. *ApJ* **855**, 2
- [7] **Gao P.**, Marley M. S., Zahnle K., et al. (2017) Sulfur Hazes in Giant Exoplanet Atmospheres: Impacts on Reflected Light Spectra. *AJ* **153**, 3
- [6] **Gao P.**, Fan S., Wong M. L., et al. (2017) Constraints on the Microphysics of Pluto’s Photochemical Haze from New Horizons Observations. *Icarus* **287**, 116
- [5] **Gao P.**, Plavchan P. P., Gagné J., et al. (2016) Retrieval of Precise Radial Velocities from Near-Infrared High Resolution Spectra of Low Mass Stars. *PASP* **128**, 104501

- [4] **Gao P.**, Kopparla P., Zhang X., and Ingersoll A. P. (2016) Aggregate Particles in the Plumes of Enceladus. *Icarus* **264**, 227
- [3] **Gao P.**, Hu R., Robinson T. D., et al. (2015) Stabilization of CO₂ Atmospheres on Desiccated M Dwarf Exoplanets. *ApJ* **806**, 249
- [2] **Gao P.**, Zhang X., Crisp D., et al. (2014) Bimodal Distribution of Sulfuric Acid Aerosols in the Upper Haze of Venus. *Icarus* **231**, 83
- [1] **Gao P.** and Stevenson D. J. (2013) Nonhydrostatic Effects and the Determination of Icy Satellites' Moment of Inertia. *Icarus* **226**, 1185

Student Publications

- [2] Adams D., **Gao P.**, de Pater I., and Morley C. V. (2018) Aggregate Hazes in Exoplanet Atmospheres. *ApJ*. Accepted.
- [1] Powell D., Zhang X., **Gao P.**, and Parmentier V. (2018) Formation of Silicate and Titanium Clouds on Hot Jupiters. *ApJ* **860**, 18

Co-Authored Publications

- [*] Kite E. S., Mischna M. A., **Gao P.**, and Yung Y. L. (2019) Climate Optimum on Mars Initiated by Atmospheric Collapse. *PNAS*. Submitted.
- [*] Fan S., Shemansky D. E., Li C., **Gao P.**, et al. (2019) Retrievals of Abundances of Hydrocarbon and Nitrile Species in Titan's Upper Atmosphere. *ESS*. Submitted.
- [*] Huber D., Chaplin W. J., Chontos A., et al. (including **Gao P.**) (2019) A Hot Saturn Orbiting an Oscillating Late Subgiant Discovered by TESS. *ApJ*. Submitted.
- [18] Yung Y. L., Chen P., Nealson K., et al. (including **Gao P.**) (2018) Methane on Mars and Habitability: Challenges and Responses. *Astrobiology* **18**, 1221 (Non-Refereed)
- [17] Bean J. L., Stevenson K. B., Batalha N. M., et al. (including **Gao P.**) (2018) The Transiting Exoplanet Community Early Release Science Program for JWST. *PASP* **130**, 114402
- [16] Grundy W. M., Bertrand T., Binzel R. P., et al. (including **Gao P.**) (2018) Pluto's Haze as a Surface Material. *Icarus* **314**, 232
- [15] Lora J. M., Kataria T., and **Gao P.** (2018) Atmospheric Circulation, Chemistry, and Infrared Spectra of Titan-like Exoplanets around Different Stellar Types. *ApJ* **853**, 58
- [14] Young L. A., Kammer J. A., Steffl A. J., et al. (including **Gao P.**) (2018) Structure and Composition of Pluto's atmosphere from the New Horizons Solar Ultraviolet Occultation. *Icarus* **300**, 174
- [13] Kite E. S., **Gao P.**, Goldblatt, C., et al. (2017) Methane Bursts as a Trigger for Intermittent Lake-Forming Climates on Post-Noachian Mars. *Nature Geoscience* **10**, 737
- [12] Wong M. L., Charnay B. D., **Gao P.**, et al. (2017) Nitrogen Oxides in Early Earth's Atmosphere as Electron Acceptors for Life's Emergence. *Astrobiology* **17**, 975
- [11] Wong M. L., Fan S., **Gao P.**, et al. (2017) The Photochemistry of Pluto's Atmosphere as Illuminated by New Horizons. *Icarus* **287**, 110
- [10] Hu R., Bloom A., **Gao P.**, et al. (2016) Hypotheses for Near-Surface Exchange of Methane on

Mars. *Astrobiology* **16**, 539

- [9] Gagné J., Plavchan P. P., **Gao P.**, et al. (2016) A Near-Infrared Survey for Radial Velocity Variable Low Mass Stars using CSHELL and a Methane Gas Cell. *ApJ* **822**, 40.
- [8] Yi X., Vahala K., Li J., et al. (including **Gao P.**) (2016) Demonstration of a Near-IR Line-Referenced Electro-Optical Laser Comb for Precision Radial Velocity Measurements in Astronomy. *Nat. Commun.* **7**, 10436 (**Winner of a NASA Group Achievement Award**)
- [7] Plavchan P. P., **Gao P.**, Gagné J., et al. (2015) Precise Near-Infrared Radial Velocities. Young Stars & Planets Near the Sun Proceedings, IAU Symposium 314 (Non-Refereed)
- [6] Cheng L., Zhang X., **Gao P.**, and Yung Y. L. (2015) Vertical Distribution of C₃ Hydrocarbons in the Stratosphere of Titan. *ApJL* **803**, L19
- [5] Parkinson C. D., **Gao P.**, Esposito L., et al. (2015) Photochemical Control of the Distribution of Venusian Water. *PSS* **113**, 226
- [4] Parkinson C. D., **Gao P.**, Schulte R., et al. (2015) Distribution of Sulphuric Acid Aerosols in the Clouds and Upper Haze of Venus Using Venus Express VAST and VeRa Temperature Profiles. *PSS* **113**, 205
- [3] Plavchan P. P., Bottom M., **Gao P.**, et al. (2013) Precision near-infrared radial velocity instrumentation II: Non-Circular Core Fiber Scrambler. *SPIE* **8864**, 0G (Non-Refereed)
- [2] Plavchan P. P., Anglada-Escude G., White R., **Gao P.**, et al. (2013) Precision near-infrared radial velocity instrumentation I: Absorption Gas Cells. *SPIE* **8864**, 1J (Non-Refereed)
- [1] Anglada-Escudé G., Plavchan P., Mills S., **Gao P.**, et al. (2012) Design and Construction of Absorption Cells for Precision Radial Velocities in the K Band Using Methane Isotopologues. *PASP* **124**, 586

INVITED TALKS, SEMINARS, & COLLOQUIA

- [17] **Gao P.** (2019) The Best of Both Worlds: Seeking Synergy between Planetary and Exoplanet Science to Reveal our Origins and Life Beyond Earth. Purdue University, West Lafayette, USA
- [16] **Gao P.** (2018) Lessons from Atmospheres of Icy Bodies. *Understanding the Diversity of Planetary Atmospheres*, Bern, Switzerland (remote)
- [15] **Gao P.** (2018) Atmospheres under a Red Sun. University of Washington, Seattle, USA
- [14] **Gao P.** (2018) Building the Exoplanet Cloud Atlas. *51 Pegasi b Science Summit*, Sausalito, USA
- [13] **Gao P.**, Fan S., and Yung Y. L. (2018) Formation and Processing of Haze in Pluto's Atmosphere. *New Horizons Science Team Meeting 38*, Laurel, USA
- [12] **Gao P.** (2017) Aerosols in Planetary Atmospheres, Massachusetts Institute of Technology, Cambridge, USA
- [11] **Gao P.** (2017) Cloud Trends in Exoplanet Atmospheres, Yale University, New Haven, USA
- [10] **Gao P.** (2017) Aerosols in Planetary Atmospheres, Carnegie DTM, Washington, DC, USA
- [9] **Gao P.** (2017) Dark Skies: Understanding Planetary Science Atmospheres Beyond the Solar System, Heising-Simons Foundation, Los Altos, USA
- [8] **Gao P.** (2017) Cloud Physics in the Age of Exoplanets (and Brown Dwarfs), California Institute

of Technology, Pasadena, USA

[7] **Gao P.** (2017) Cloud Physics in the Age of Exoplanets (and Brown Dwarfs), University of California Santa Cruz, Santa Cruz, USA

[6] **Gao P.** (2017) Understanding Exoplanet Clouds and Hazes Using Solar System Analogs, Missouri State University, Springfield, USA

[5] **Gao P.** (2016) Clouds and Hazes in Exoplanet Atmospheres, University of California Berkeley, Berkeley, USA

[4] **Gao P.** (2016) Clouds and Hazes in Planetary Atmospheres. University of Chicago, Chicago, USA

[4] **Gao P.**, Kopparla P., Zhang X., and Ingersoll A. P. (2015) Fractal Aggregate Particles in the Enceladus Plumes. *Cassini Project Science Group Meeting 67*, Pasadena, USA

[3] **Gao P.** (2015) Atmospheric Chemistry of Planets Around M Dwarfs. *Pathways 2015: Pathways Towards Habitable Planets, Satellite Meeting 4*, Bern, Switzerland.

[2] **Gao P.**, Plavchan P. P., Gagné J., et al. (2015) Retrieval of Precise Radial Velocities from M Dwarfs in the Near-IR. Johnson ExoLab, Harvard University, Cambridge, USA.

[1] **Gao P.**, Hu R., Robinson T. D., and Yung Y. L. (2014) Photochemical Destruction of CO₂ in the Atmospheres of M Dwarf Exoplanets, University of California Santa Cruz, Santa Cruz, USA.

CONFERENCE TALKS & POSTERS

[34] **Gao P.** (2018) Exoplanet Cloudscapes: Metallicity, Mixing, and Mass Effects. *DPS 50*, **402.02**, Knoxville, USA

[33] **Gao P.** (2018) Photochemistry of Terrestrial Worlds Orbiting M dwarfs. *CCTP 3*, **2050**, Houston, USA

[32] **Gao P.** (2018) The Exoplanet Cloud Atlas. *COSPAR 42*, **20864**, Pasadena, USA

[31] **Gao P.** (2018) Cloudy Skies on Distant Worlds, OWL Exoplanet Summer Program 2018, University of California Santa Cruz, Santa Cruz, USA

[30] **Gao P.**, Zahnle K., Marley M. S., and Morley C. V. (2018) Disequilibrium Processes and IR Observability of Temperate ExoGiants. *AAS 231*, **427.05**, National Harbor, USA

[29] **Gao P.**, Marley M. S., Liu M., Powell D., and Zhang X. (2017) Cloud Physics at the L-T Transition. *BDEXOCON II*, Newark, USA

[28] **Gao P.**, Marley M. S., Morley C. V., and Fortney, J. J. (2017) The Exoplanet Cloud Atlas. *DPS 49*, **408.08**, Provo, USA

[27] **Gao P.** and Marley M. S. (2017) Will JWST See the Clouds? *Enabling Transiting Exoplanet Observations with JWST*, Baltimore, USA

[26] **Gao P.** (2017) Cloud Physics in Exo-Atmospheres, OWL Exoplanet Summer Program 2017, University of California Santa Cruz, Santa Cruz, USA

[25] **Gao P.**, Marley M. S., Zahnle K., Robinson T. D., and Lewis N. K. (2017) Impacts of Sulfur Hazes on the Reflected Light Spectra of Giant Exoplanets. *AAS 229*, **202.03**, Grapevine, USA

[24] **Gao P.**, Carlson R. W., Robinson T. D., Crisp D., Lyons J. R., and Yung, Y. L. (2016) Sulfur

and Sulfuric Acid Microphysics in the Venus Atmosphere: Implications for the Unknown UV Absorber. *AGU Fall Meeting 2016*, **P53B-2201**, San Francisco, USA

[23] **Gao P.** and Benneke B. (2016) Microphysics of KCl and ZnS Clouds in the Atmosphere of GJ 1214 b. *DPS 48/EPSC 11*, **302.02**, Pasadena, USA

[22] **Gao P.** and Benneke B. (2016) Microphysics of KCl and ZnS Clouds in the Atmosphere of GJ 1214 b. *ExoClimes III*, Squamish, Canada

[21] **Gao P.**, Marley M. S., Zahnle K., and Robinson T. D. (2016) Sulfur Hazes in Giant Exoplanet Atmospheres: Impacts on Reflected Light Spectra. Kavli Summer Program in Astrophysics 2016, Santa Cruz, USA

[20] **Gao P.**, Benneke B., Knutson H. A., and Yung Y. L. (2016) Microphysics of Exoplanet Clouds and Hazes. *AAS 227*, **112.04D**, Kissimmee, USA

[19] **Gao P.**, Kopparla P., Zhang X., and Ingersoll A. P. (2015) Frozen Fractals All Around: Aggregate Particles in the Plumes of Enceladus. *AGU Fall Meeting 2015*, **P11D-08**, San Francisco, USA (**Winner of an Outstanding Student Paper Award**)

[18] **Gao P.**, Benneke B., Knutson H. A., and Yung Y. L. (2015) Microphysics of Exoplanet Clouds and Hazes. *Extreme Solar Systems III*, **111.07**, Waikoloa, USA

[17] **Gao P.**, Benneke B., Knutson H. A., and Yung Y. L. (2015) Microphysics of Exoplanet Clouds and Hazes. *DPS 47*, **504.04D**, National Harbor, USA

[16] **Gao P.**, Hu R., Robinson T. D., Cheng L., and Yung Y. L. (2015) Stability of CO₂ Atmospheres on Dry M Dwarf Exoplanets. *ExSoCal 2015*, Pasadena, USA

[15] **Gao P.**, Hu R., Robinson T. D., Cheng L., and Yung Y. L. (2015) Stability of CO₂ Atmospheres on Desiccated M Dwarf Exoplanets. *Pathways 2015: Pathways Towards Habitable Planets, General Meeting*, **63429**, Bern, Switzerland.

[14] **Gao P.**, Plavchan P. P., Gagné J., et al. (2015) Retrieval of Precise Radial Velocities from M Dwarfs in the Near-IR. *Extreme Precision Radial Velocities II*, New Haven, USA.

[13] **Gao P.**, Plavchan P. P., Gagné J., et al. (2015) Retrieval of Precise Radial Velocities from High Resolution Near-Infrared Spectra of M Dwarfs. *AAS 225*, **258.22**, Seattle, USA.

[12] **Gao P.**, Parkinson C. D., Bardeen C. G., and Yung Y. L. (2014) Venus Then and Now: Simulating Sulfuric Acid Clouds Using Latitudinally Dependent VIRA and VeRA Temperature Profiles. *AGU Fall Meeting 2014*, **P53C-4029**, San Francisco, USA.

[11] **Gao P.**, Hu R., Robinson T. D., Cheng L., and Yung Y. L. (2014) The Role of Hydrogen in Determining the Stability of CO₂ Atmospheres of Terrestrial Exoplanets Around M Dwarfs. *DPS 46*, **301.01**, Tucson, USA.

[10] **Gao P.**, O'Rourke J., Brissaud Q., Blom C., and Lorenz R. (2014) Active Sources for Venus Seismology, KISS Venus Seismology Workshop, Pasadena, USA

[9] **Gao P.**, Hu R., and Yung Y. L. (2013) Stability of CO₂ Atmospheres on Terrestrial Exoplanets in the Proximity of M Dwarfs. *AGU Fall Meeting 2013*, **P21B-1728**, San Francisco, USA.

[8] **Gao P.**, Zhang X., Crisp D., Bardeen C. G., and Yung Y. L. (2013) Modelling the Venus Clouds and Upper Haze using CARMA 3.0. Venus Exploration Analysis Group Meeting 11, Washington DC, USA.

- [7] **Gao P.**, Zhang X., Crisp D., Bardeen C. G., and Yung Y. L. (2013) Bimodal Distribution of Sulfuric Acid Aerosols in the Atmosphere of Venus. *DPS 45*, **118.07**, Denver, USA.
- [6] **Gao P.**, Zhang X., Crisp D., Bardeen C. G., and Yung Y. L. (2012) Meteoric Dust as Condensation Nuclei of Small-Mode Particles in the Upper Haze of Venus. *AGU Fall Meeting 2012*, **P11D-1850**, San Francisco, USA.
- [5] **Gao P.** and Stevenson D. J. (2012) The Effect of Nonhydrostatic Features on the Interpretation of Mercury's Mantle Density from MESSENGER Results. *DPS 44*, **401.08**, Reno, USA.
- [4] **Gao P.** and Stevenson D. J. (2012) How Does Nonhydrostaticity Affect the Determination of Titan's Moment of Inertia? Titan Geophysics Workshop, Caltech, Pasadena, USA.
- [3] **Gao P.** and Stevenson D. J. (2012) How Does Nonhydrostaticity Affect the Determination of Icy Satellites' Moment of Inertia? CPS 9th International School of Planetary Sciences: Across the Earth into Exoplanets, Kobe, Japan.
- [2] **Gao P.** and Stevenson D. J. (2012) How Does Nonhydrostaticity Affect the Determination of Icy Satellites' Moment of Inertia? *LPSC 43*, **1701**, The Woodlands, USA.
- [1] **Gao P.**, Zhang X., Crisp D., Bardeen C. G., and Yung Y. L. (2012) Bimodal Distribution of H₂SO₄ Aerosols in the Upper Atmosphere of Venus. *LPSC 43*, **2906**, The Woodlands, USA.