Rachel M. Huchmala

Postdoctoral Research Fellow for the CIDSR STEM Network

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Education

University of Washington *2018 - 2023*
Ph.D. Chemistry *Seattle, WA*
- Thesis Title: Using Reduced Dimensional Models to Interpret Spectral Signatures of Large Amplitude Motions of OH Bonds
- Research Advisor: Dr. Anne McCoy

University of Washington *2018 - 2020*
M.Sc. Chemistry *Seattle, WA*
- By Coursework | GPA: 3.52

Northern Arizona University *2014 - 2018*
B.Sc. Chemistry *Flagstaff, AZ*
- Minors in Physics and Astronomy | GPA: 3.78
- Research co-advisors: Dr. Gerrick Lindberg and Dr. Jennifer Hanley

Positions

Postdoctoral Research Fellow *2023 - Present*
Advisor: Prof. Brian Jackson *Boise State University*

Discussion Section Instructor *Fall 2023*
Advisor: Prof. Brian Jackson *Boise State University*

Graduate Research Associate *2018 - 2023*
Advisor: Prof. Anne McCoy *University of Washington*

Graduate Teaching Associate *2018 - 2021*
Advisor: Dr. Andrea Carroll *University of Washington*

Arizona Space Grant Consortium Fellow *Academic Year 2017-2018*
Co-Advisors: Dr. Jennifer Hanley and Dr. Gerrick Lindberg *Northern Arizona University*

Public Program Educator *2016-2018*
Supervisor: Kevin White *Lowell Observatory*

Grants

NASA Citizen Science Seed Funding Program *2024*
SuPerPiG Observing Grid
- PI: Rachel Huchmala
- $63.884.00

Projects

Boise State University *2023-Present*

SuPerPiG Observing Grid *Boise, ID*

- Extension of the Telescopes for Teachers Program providing an opportunity for research-grade exoplanet transit observations.
- Primary goal is to provide consistent follow-up observations of Ultra-Hot Jupiter Exoplanets in order to aid in the search for evidence of tidal decay.
- Won NASA Citizen Science Seed Finding to support the initial year of the program (2024).
- Collaboration with NASA's Exoplanet Watch and the Unistellar Citizen Science Network.

Telescopes for Teachers Program

- Led effort to provide long-term loans of robotic telescopes to K-12 teachers across the state of Idaho.
- Organizes engagement opportunities for participants including monthly webinars and a slack workspace.
- Supports all telescope use by the participants and their students via training and online resources.

Short Period Planets Group (SuPerPiG)

- Created an observing program for undergraduate students in physics at Boise State.
- Led efforts to collect and conduct photometric analysis on exoplanet transit data.
- Contributing to understanding of tidal decay in Ultra-Hot Jupiter exoplanets.

Central Idaho Dark Sky Reserve STEM Network

- Selected for position from a national competition
- Creates public engagement activities for program.
- Trains undergraduate students in telescope use and public outreach geared for K-12 students.
- Assists at star parties and other public engagement events around the Treasure Valley.

University of Washington *2018-2023*

Graduate Research Associate *Seattle, WA*

- Determined how various degrees of hydrogen bonding manifest in vibrational spectroscopy through theoretical calculations.
- Participated in numerous collaborations with Dr. Mark Johnson at Yale, Dr. Marsha Lester at University of Pennsylvania and Dr. Henrik Kjærgaard at University of Copenhagen.
- Expert in quantum chemistry and vibrational spectroscopy of small molecules.

Northern Arizona University *2017-2018*

NAU/NASA Space Grant Consortium *Flagstaff, AZ*

- Used the Gaussian electronic structure package to calculate harmonic frequencies and intensities of vibrations in chlorine salt unit cells to aid in the understanding of MRO CRISM images of Columbus Crater.

Professional Development

2024 **Local Organizing Committee Member for the 56th Annual DPS Meeting**, American Astronomical Society - Division of Planetary Science

"Diversifying Voices to Communicate Science" Workshop Attendance, American Association of Physics Teachers

Judge for the Undergraduate Student Chambliss Award for AAS 243, American Astronomical Society

2022 **Research University Alliance - Research Exchange to California Institute of Technology**, NSF - Alliances for Graduate Education and the Professoriate

Alma Mater Travel Award, University of Washington

Publications

† indicates Senior Scientist; ^{W} indicates co-authors from the McCoy group at the University of Washington.

Peer-Reviewed

Jackson, B.†; **Huchmala, R.M.**; Barker, M.; Kirk, A.; Carlson, D.; Adams, E.R.†; Morgenthaler, J.P.†; Sickafoose, A.† Metrics for Distinguishing Orbital Precession from Tidal Decay via Transit- and Occultation-Timing. *In progress.*

Huchmala, R.M.; McCoy, A.B. Using the Intensity of the OH Bend-Stretch Combination Band to Elucidate the Hydrogen Bonding Environment in Water Clusters. *J. Phys. Chem. A* **2023**, 127, 32, 6711–6721.

Finney, J.M.; Choi, T.H.; **Huchmala, R.M.**; Heindel, J.P.; Xantheas, S.S.; Jordan, K.D.; McCoy, A.B. Isotope effects in the Eigen-Zundel Isomerization of $H^+(H_2O)_6$. *J. Phys. Chem. Lett.* **2023**, 14, 4666-4672.

- RMH performed all VPT2 calculations for this project. Led analysis and interpretation of VPT2 results. Made all figures pertaining to spectral information. Revised the manuscript.

Yang, N.; **Huchmala, R.M.**^{W}; McCoy, A.B.†; Johnson, M.A.† On the Character of the OH Bend-Stretch Combination Band in the Vibrational Spectra of the 'Magic' Number $H_3O^+(H_2O)_{20}$ and $D_3O^+(D_2O)_{20}$ Cluster ions. *J. Phys. Chem. Lett.* **2022**, 13, 8116-8121.

- RMH was lead theoretician in this experiment and theory collaboration. Developed the models and performed all calculations. Co-wrote the manuscript.

Huchmala, R.M.; McCoy, A.B.† Exploring the Origins of Spectral Signatures of Strong Hydrogen Bonding in Protonated Water Clusters. *J. Phys. Chem.* **2022**, 126(8), 1360-1368.

Mitra, S.; Khuu, T.; Choi, T.H.; **Huchmala, R.M.**^{W}; Jordan, K.D.†; McCoy, A.B.†; Johnson, M.A.† Vibrational Signatures of HNO_3 Acidity When Complexed With Microhydrated Alkali Metal Ions, $M^+ \cdot (HNO_3)(H_2O)_{n=5}$ (M=Li, K, Na, Rb, Cs), at 20 K. *J. Phys. Chem. A* **2022**, 126(10), 1640-1647. *ACS Editors' Choice*

- RMH refined and analyzed computations. Assisted in writing the manuscript.

Hansen, A.S.; Bhadge, T.; Qian, Y.; Cavazos, A.; **Huchmala, R.M.**^{W}; Boyer, M.A.^{W}; Gavin-Hanner, C.F.^{W}; Klippenstein, S.J.†; McCoy, A.B.†; Lester, M.I.† Infrared Spectroscopic signature of a hydroperoxyalkyl radical (·QOOH) *J. Chem. Phys.* **2022**, 156, 014301.

- RMH was lead theoretician. Extended models from her TBHP work to 3D in order to model the radical. Performed and led analysis of all associated computations. Co-wrote and revised the manuscript.

Vogt, E.; **Huchmala, R.M.**^{W}; Jensen, C.V.; Boyer, M.A.^{W}; Wallberg, J.; Hansen, A.S.; Kjærsgaard, A.†; Lester, M.I.†; McCoy, A.B.†; Kjærgaard, H.G.† Coupling of Torsion and OH-stretching in Tert-butyl Hydroperoxide. II. The OH-stretching Fundamental and Overtone Spectra *J. Chem. Phys.* **2021**, 154, 164307.

- RMH was lead author from her group in this collaboration with a second theory group and an experimental group. Extended the 2D and Reaction Path Models from below publication for this work. Performed all associated calculations. Co-wrote and revised the manuscript.

Hansen, A.S.; **Huchmala, R.M.**^{W}; Vogt, E.; Boyer, M.A.^{W}; Bhagde, T.; Vansco, M.F.; Jensen, C.V.; Kjærsgaard, A.; Kjærgaard, H.G.†; McCoy, A.B.†; Lester, M.I.† Coupling of Torsion and OH-stretching in Tert-butyl Hydroperoxide. I. The Cold and Warm First OH-stretching Overtone Spectrum. *J. Chem. Phys.* **2021**, 154, 164306.

- RMH was co-first author and lead theoretician. Developed the 2D and Reaction Path Models for this work. Performed all associated calculations. Co-wrote and revised the manuscript.

Conference Proceedings

Huchmala, R.M.; Austin, K.; Jackson, B. Telescopes for Teachers, a new program within the Central Idaho Dark Sky Reserve STEM Network. *AAS/Division for Planetary Sciences Abstracts*. **2024**.

Huchmala, R.M.; Stubbers, H.; Carlson, D.; VanLooy, H.; Jackson, B.; Adams, E.; Morgenthaler, J.; Siackafoose, A. SuPerPiG @ Boise State: Ground-Based Transit Searches for Tidal Decay. *American Astronomical Society Meeting Abstracts*. **2024**, 243, 105.17.

Huchmala, R.M.; McCoy, A.B. Origins of the Intensity of the Stretch-Bend Combination Transition in Water Clusters and Implications for Characterizing Hydrogen Bonding. *12th Triennial Congress of the World Association of Theoretical and Computational Chemists*. **2022**.

Huchmala, R.M.; McCoy, A.B. Origins of the Intensity of the Stretch-Bend Combination Transition in Water Clusters and Implications for Characterizing Hydrogen Bonding. *75th International Symposium of Molecular Spectroscopy*. **2022**.

Huchmala, R.M.; Boyer, M.A.; McCoy, A.B. Coupling of Torsion and OH-Stretching in *Tert*-Butyl Hydroperoxide and It's Radical Analog, ·QOOH. *International Symposium of Molecular Spectroscopy*. **2021**.

Huchmala, R.M., McCoy, A.B. Exploring the Role of Coupling in Studies of Protonated Water Clusters. *Virtual Conference on Theoretical Chemistry*. **2020**.

Huchmala, R.M.; Hanley, J.; Lindberg, G.E.; Horgan, B.N. Understanding Chlorine Salt Spectra Through Computational Methods With Implications for Martian Geochemistry. *Arizona NASA Space Grant Statewide Symposium*. **2018**.

Huchmala, R.M.; Hanley, J.; Lindberg, G.E.; Horgan, B.N. Understanding Chlorine Salt Spectra Through Computational Methods With Implications for Martian Geochemistry. *49th Lunar and Planetary Science Conference* **2018**, LPI Contrib. No. 2083.

Outreach Experience

Telescopes for Teachers Program Lead
2023 - Present

Boise State University — *Boise, ID*

- Designed and Held 4 hour workshop for teacher participants of the program
- Local Media Features:
  - Boise State program provides telescopes to classrooms across Idaho - Boise State Public Radio
  - Idaho teachers can get a free telescope for their classroom after NASA donation to BSU - KTVB
  - Star light, star bright! BSU prepares dozens of telescopes for use in Boise classrooms - KIVI

Central Idaho Dark Sky Reserve STEM Network Fellow
2023 - Present

Boise State University — *Boise, ID*

- Organized and Supervised Public Viewing on Friday Nights at the Boise State Observatory.
- Participated in organization of Boise State Physics' First Friday Astronomy Lecture Series.
- Trained undergraduate students in scientific communication and telescope use.
- Events attended:
  - Stanley Star Party - July 2023
  - Idaho Science and Aerospace Scholars Boise State Campus Visit - July 2023
  - Stanley Museum Dark Sky International Information Booth - July 2023
  - Saturn-gazing at Boise State - August 2023
  - Meridian Library Mobile Planetarium Show - September 2023
  - Stargazing for Boise State University's Parents & Family Weekend - October 2023
  - Annular Solar Eclipse Event at Boise State University - October 2023
  - Future Jr. High visit to Boise State Physics - January 2024
  - Aerospace Day at Riverside Elementary - March 2024
  - Syringa Middle School Science Project Judge - May 2024

Chemistry Graduate Student Club President
2020 - 2022

University of Washington — *Seattle, WA*

- Helped to maintain and foster community between chemistry graduate students during the COVID-19 pandemic.
- Led social events during graduate student recruitment open houses and throughout the academic year.
- Served on panels for current and prospective students discussing graduate student life, work/life balance, and teaching.

Inclusion in Chemical Sciences Outreach Volunteer *2018 - 2023*
University of Washington *Seattle, WA*
- Set up booth events for elementary and middle school students
- Helped get students engaged in STEM
- Completed small science demos with the students
- Events attended:
  - Introduce a Girl to Code - September 2018
  - Echo Lake Elementary Science Night - February 2023

Lowell Observatory *2016-2018*
Public Program Educator *Flagstaff, AZ*
- Prepared and gave lectures to general audiences to engage interest in current astronomy topics.
- Operated small reflecting telescopes and the historic Clark Refracting Telescope for public viewing.

Invited Talks

Huchmala, R.M. 2024. Illuminating the Path Less Travelled: Following Light through Chemistry & Astronomy. Boise Astronomical Society Member Meeting, Boise, ID.

Huchmala, R.M. 2024. Illuminating the Path Less Travelled: Following Light through Chemistry & Astronomy. Natural Sciences Colloquium: College of Idaho, Caldwell, ID.

Huchmala, R.M. 2023. Spectral Signatures of Hydrogen Bonding. Physics Colloquium: Boise State University, Boise, ID.

Huchmala, R.M. 2023. Using Reduced Dimensional Models to Interpret Spectral Signatures of Large Amplitude Motions. Special Seminar: California Institute of Technology, Pasadena, CA. *NSF-AGEP Research University Alliance Invited Talk*

Huchmala, R.M. 2022. Spectral Signatures of Hydrogen Bonding. Chemistry Seminar: Northern Arizona University, Flagstaff, AZ. *Alma Mater Travel Award Invited Talk*

Awards & Fellowships

2020 **National Science Foundation Graduate Research Fellowship Honorable Mention**,

2018 **Junia E. McAlister Outstanding Senior Award**, Northern Arizona University - Dept. of Chemistry & Biochemistry
Kenneth Bean Teaching Award, Northern Arizona University - Dept. of Chemistry & Biochemistry

2017 **Northern Arizona University/NASA Space Grant Undergraduate Research Internship**, NASA Space Grant
Russ B. Powell Chemistry Scholarship, Northern Arizona University - Dept. of Chemistry & Biochemistry
Physical Chemistry Award, Northern Arizona University - Dept. of Chemistry & Biochemistry

2016 **Nancy & Henry Wettaw Organic Chemistry Award**, Northern Arizona University - Dept. of Chemistry & Biochemistry

Teaching Experience

UF 100: Alien Worlds, Alien Life *Boise State University*
Discussion Section Leader *1 Semester*
- Led discussions on topics from “Becoming a Learner” by Matthew Sanders and “Strange New Worlds” by Ray Jayawardhana

Chem 152: General Chemistry II *University of Washington*
Lead Teaching Assistant *1 Quarter*
- In addition to standard TA duties, I organized and mentored other teaching assistants of the course

Chem 142: General Chemistry I & Chem 153: Accelerated General Chemistry II *University of Washington*
Teaching Assistant *5 Quarters*
- Taught discussion sections, supervised laboratory, held weekly office hours

Chem 461: Physical Chemistry Lab *University of Washington*
Teaching Assistant *2 Quarters*
- Supervised laboratory, assisted in interpretation and analysis of data
- Created laboratory report rubrics and helped transition course online in Spring 2020

Chm 151L: General Chemistry I Lab *Northern Arizona University*
Teaching Assistant *4 Semesters*
- Supervised laboratory, trained and mentored new teaching assistants
- Developed introductory content to teach students applications of vibrational spectroscopy