Dr. Zach Ulibarri

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Education

University of Colorado
Ph.D. in Physics, 2022
Thesis Title: *On the Genesis and Measurement of Complex Organics and Isotopic Ratios in Hypervelocity Impact Ice Spectra*
Graduate Student Affiliate, Surface Dust Analyzer (SUDA)

Northern Arizona University
B.S. in Physics, *Summa Cum Laude*, 2013
B.S.E. in Electrical Engineering, *Summa Cum Laude*, 2013
GPA: 4.0

Research Experience

Cornell University: July 2022 - Present
Postdoctoral Associate under Dr. Elaine Petro

- Developed an electrospray ionization (ESI) source to gently ionize biomolecules for time-of-flight mass spectrometry
- Designed parts to integrate a goniometer for in-vacuo pitch and yaw control of the ESI ion source assembly in CAD, and machined, assembled, and tested resulting system
- Designed and machined a precision alignment system for ESI time-of-flight beamline
- Designed and assembled a downstream current-measuring diagnostic device
- Managed graduate and undergraduate students by overseeing their projects, assigning tasks, and reviewing their progress
    - Managed high-level ESI ion source redesign by an undergrad
    - Managed an undergrad in design, fabrication, and testing of a heated ESI source to launch new types of viscous ionic liquids in-vacuo
    - Assigned laboratory tasks to incoming PhD students and guided them in designing their own experiments and apparatuses

University of Colorado at Boulder: Fall 2015 – June 2022
Graduate Research Assistant under Dr. Tobin Munsat

- Performed impact ionization time-of-flight mass spectroscopy experiments of hypervelocity plasma plumes from dust impacts into ice (including projects in support of the NASA Europa Clipper flagship mission)
- Designed and carried out experiment to determine the "speed limit" of spacecraft for hypervelocity ionization studies of organic molecules (6-8 km/s)
- Managed all aspects of day-to-day operation of the IMPACT ultra-high vacuum cryogenic target and designed, developed, and implemented multiple new iterations of it to improve efficiency, modularity, and data collection
- Ran IT for the lab, managed and upgraded laboratory servers, LabVIEW data acquisition pipeline, Windows and Linux computer networks, and software infrastructure (including a complete system rebuild)
- Operated the Colorado Dust Accelerator for numerous projects, including the Europa Clipper's Surface Dust Analyzer (SUDA)
- Operated a 20-ton overhead crane for laboratory use (OSHA, ASME, and CMAA certified crane operator)
- Assigned tasks to undergrad students and summer interns and guided them in experimental and hardware design

University of Colorado at Boulder: Fall 2014 - Fall 2016
Graduate Research Assistant under Dr. Tobin Munsat and Dr. Xu Wang

- Set up and characterized the Colorado Solar Wind Experiment, a high current, large aperture ion source to simulate solar wind interaction
- Designed and ran diagnostic experiments with Langmuir probes and energy analyzers to measure source performance and ambient plasma characteristics
- Assigned tasks to an undergrad student working to automate system measurements

University of Colorado at Boulder – Fall 2014 - Spring 2015
Graduate Research Assistant under Dr. Tobin Munsat

- Worked on software development of plasma turbulence diagnostic software

University of Colorado at Boulder - Summer 2013
REU student under Dr. Tobin Munsat

- Performed SolidWorks CAD and circuit layout, assembly, and testing for a dust coordinate sensor for the IMPACT dust accelerator

Northern Arizona University - Fall 2012 - Spring 2013
Capstone research project under Dr. Allison Kipple

- Led a team of two other engineers on a project to design a shunt active power filter to reduce harmonic distortion in off-grid power systems

Cornell University – Summer 2012
REU student under Dr. Zhi Zhao

- Constructed and characterized a fiber laser oscillator for the Energy Recovery Linac Project

Northern Arizona University – Spring 2012
Engineering design research project under Dr. Allison Kipple

- Led a team of five other undergrad engineers on a project to design a $30,000 renewable energy system for Moencopi Day School on the Navajo Nation
- Presented design options to both an engineering team and a non-technical audience of elementary school teachers

Invited Colloquia

- NASA Jet Propulsion Laboratory, Planetary Science Seminar – March 2022
  Measurement of the Amino Acid Histidine and its Breakup Products in Hypervelocity Dust-Ice Impact Mass Spectra.
- Cornell University, Mechanical and Aerospace Engineering and Dept. of Astronomy Colloquium – April 2022. Measurement of the Amino Acid Histidine and its Breakup Products in Dust-Ice Hypervelocity Impact Mass Spectra

Publications

- Zach Ulibarri, Tobin Munsat, Michael Voss, John Fontanese, Sascha Kempf, Mihály Horányi, and Zoltan Sternovsky. "Detection of the amino acid histidine and its breakup products in hypervelocity impact ice spectra." *Icarus* 391 (2023): 115319.
- Zach Ulibarri, Oliver Jia-Richards, and Elaine Petro. "Ultra-Long Baseline Time-of-Flight Mass Spectrometry with the Advanced Mass Spectrometry in Gravity-Free Architectures (AMIGAS) Mission Concept." Accepted for publication in *IEEE Aerospace Conference 2023*.
- Shawn Cogan, Zach Ulibarri, Elaine Petro, and Amy Hofmann. "Electrospray Mass Spectrometry for In-Orbit Biomolecule Analysis." Accepted for Publication in *IEEE Aerospace Conference 2023*.
- Michael Voss, Zach Ulibarri, Tobin Munsat. "Novel airbrushing technique for creation of ice surfaces with homogenous distributions of complex organics." In preparation for *Review of Scientific Instruments*.
- Ethan Ayari, Jon Hillier, Mihály Horányi, Rebecca Mikula, Tobin Munsat, Jan Schmitt, Zoltan Sternovsky, Mario Trieloff, Neal J. Turner, Zach Ulibarri, and Andrew J. Westphal. "Composition Measurement Capabilities of the Hyperdust Instrument From Laboratory Accelerator Experiments with Particles of Crystalline Olivine." In preparation for *Review of Scientific Instruments*.

- T. Becker, M. Zolotov, M. Gudipati, J. Soderblom, M. McGrath, B. Henderson, M. Hedman, M. Choukroun, R. Clark, C. Chivers, N. Wolfenbarger, C. Glein, J. Castillo-Rogez, O. Mousis, K. Scanlan, S. Diniega, F. Seelos, W. Goode, F. Postberg, C. Grima, S. Hsu, L. Roth, S. Trumbo, K. Miller, K. Chan, C. Paranicas, S. Brooks, K. Soderlund, W. McKinnon, C. Hibbits, H. Smith, P. Molyneux, G. Gladstone, M. Cable, Z. Ulibarri, B. Teolis, M. Horanyi, X. Jia, E. Leonard, K. Hand, S. Vance, S. Howell, L. Quick, M. Ishan, A. Rymer, C. Briois, D. Blaney, U. Raut, H. Waite, K. Retherford, K, E. Shock, P. Withers, J. Westlake, and I. Jun. "Exploring the Composition of Europa with the upcoming Europa Clipper mission." Submitted to *Space Science Reviews*.
- William Goode, Tobin Munsat, David James, and Zach Ulibarri. "Trajectory measurements for individual dust particles on the Colorado dust accelerator." *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 908: 269-276 (2018)
- Zach Ulibarri, Jia Han, Mihály Horányi, Tobin Munsat, Xu Wang, Guy Whittall-Scherfee, and Li Hsia Yeo. "A large ion beam device for laboratory solar wind studies." *Review of Scientific Instruments* 88(11): 115112 (2017)
- Andrew Oakleigh Nelson, Richard Dee, Murthy S. Gudipati, Mihály Horányi, David James, Sascha Kempf, Tobin Munsat, Zoltán Sternovsky, and Zach Ulibarri. "New experimental capability to investigate the hypervelocity micrometeoroid bombardment of cryogenic surfaces." *Review of Scientific Instruments* 87(2): 024502 (2016)

Scientific Presentations

- IEEE Aerospace Conference, Big Sky, MT – March 2023.
  Ultra-Long Baseline Time-of-Flight Mass Spectrometry with the Advanced Mass Spectrometry in Gravity-Free Architectures (AMIGAS) Mission Concept.
  and
  Electrospray Mass Spectrometry for In-Orbit Biomolecule Analysis
- American Geophysical Union Fall Meeting, New Orleans, LA – December 2021. Detection of complex organic molecules and D-H ratios in laboratory mass-spectra of hypervelocity dust impacts into ice (*E-Lightning* Presentation).
- Asia and Oceania Geosciences Society Annual Meeting, Singapore – July 2019. On the genesis and detectability of organic chemistry in hypervelocity impact ice spectra.
- American Geophysical Union Fall Meeting, Washington DC – December 2018. On the genesis and detectability of organic chemistry in hypervelocity impact ice spectra.
- Europa Deep Dive 2: Composition, Houston, TX – October 2018. On the genesis and detectability of organic chemistry in hypervelocity impact ice spectra.
- COSPAR Scientific Assembly, Pasadena, CA – July 2018. On the detectability of organics in hypervelocity impact ice spectra.

- LunGradCon, Ames Research Center, Mountain View, CA – June 2018. On the generation and detectability of organic chemistry in hypervelocity impact ice spectra.
- Carbon in the Solar System SSERVI Workshop, Boulder, CO – April 2018. On the generation and detectability of organic chemistry in hypervelocity impact ice spectra.
- LunGradCon, Ames Research Center, Mountain View, CA - July 2017. Laboratory study of hypervelocity impact-driven chemical reactions and surface evolution of icy targets.
- LunGradCon, Ames Research Center, Mountain View, CA - July 2016. The Colorado Solar Wind Experiment.
- Northern Arizona University UGRADS, Flagstaff, AZ - April 2013. Reduction of harmonic distortion in off-grid power systems.
- Cornell University, Ithaca, NY - August 2012. A fiber laser oscillator for the ERL.

Conference Poster Presentations

- Lunar and Planetary Science Conference, Digital 2021.
- 5x NASA Exploration Science Forum, Digital 2020, Ames Research Center, Mountain View, CA 2016-2019.
- 3x American Geophysical Union Fall Meeting, Digital 2020, San Francisco, CA 2019, New Orleans, LA 2017.
- European Geophysical Union General Assembly, Vienna, Austria 2018.
- Dust, Atmospheres, and Plasma (DAP), Boulder, CO 2017.
- IEEE PES General Meeting, Vancouver, BC 2013.
- Northern Arizona UGRADS, Flagstaff, AZ 2012.

Conference Organizing

LunGradCon

Head organizer, 2017-2021

A NASA-SSERVI funded graduate student conference covering lunar and small body science held annually as a precursor to the Exploration Science Forum.

http://impact.colorado.edu/lungradcon/

Outreach

Public Works Founder and Lead Organizer

A public colloquium series held at a local bar to allow academics and other experts to communicate their work to the public. I also gave the inaugural science talk.

https://publicworks.info

Selected Awards and Honors

NASA Exploration Science Forum Poster Competition, Second Place (2018)

NASA Exploration Science Forum Poster Competition, Third Place (2017)

Lowell Prize – Given to a single outstanding student from the College of Forestry, Engineering, and Natural Sciences at NAU each year (2014)

Gold Axe – Highly prestigious award given to top seniors at NAU (2013)

Arthur and Catherine Adel Scholar – Given to a single NAU Physics student (2013)

Sigma Pi Sigma Physics Honor Society (2013)

Tau Beta Pi Engineering Honor Society (2013)

NAU Physics Chair's Award (2012)

Bull HN Multicultural Engineering Scholarship (2011)

National Science Foundation Scholarship (undergraduate) (2009)

Specialized Skills

- *Technical:* Design of Experiments, Ultra-High Vacuums, Mass Spectrometry, Hypervelocity Plasma Plumes, Vacuum Cryogenic Hardware Design, CAD, Machining, High-Pressure Gases
- *Software:* SolidWorks, LabVIEW, Eagle PCB Design, PCB Artist, GIT, Adobe Illustrator/Photoshop/Premiere/Lightroom.
- *Networking and IT:* Ran networking and IT for the Colorado Dust Accelerator. Reconfigured LabVIEW data acquisition pipeline consisting of NI-PXI DAQs, Windows control machines, and Linux servers. Managed laboratory-wide network attached storage (NAS) Samba shares.
- *Programming:* Python, LabVIEW, HTML, C, VHDL
- *Project Management:* Lead organizer of LunGradCon 2017-2021 (team of 5), Founder/lead organizer of Public Works 2022-2023 (team of 4), Managed undergrad and grad student projects at both Cornell and Boulder
- *Science Communication:* 22 conference presentations (11 oral, 11 posters) across USA, Europe, and Asia. *2x NASA Exploration Science Forum poster awards*.
- *Other:* Rode a bicycle solo across North America. Solo travelled to India's border with Tibet and to Cambodia's Angkor Wat. Hobbyist woodworker.

In the Media

- Popular Science
  Interviewed as a relevant expert on mass spectrometers for astrobiology searches in the article "Astronomers want to wield a tiny laser to look for life on neighboring worlds."
  https://www.popsci.com/science/orbitrap-laser-alien-life/?amp

- Xploration Outer Space
  Interviewed and gave a lab tour for Xploration Outer Space episode 707: "The Search for Life." Appeared on Fox syndicates on Oct. 29th, 2022.
  https://rotfeldproductions.wistia.com/medias/3fegt0vzd9

- How on Earth KGNU Guest Speaker
  May 2021
  Gave an interview to the KGNU radio science show about my research and the grad school experience.
  https://howonearthradio.org/archives/tag/zach-ulibarri