Mykhaylo Shumko

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EDUCATION

Montana State University   *August 2014 - December 2019*
Ph.D. in Physics
Dissertation title: Connecting Microburst Precipitation to Its Scattering Mechanism

University of California, Santa Cruz   *September 2010 - June 2014*
B.S. in Astrophysics.
Thesis title: Dynamic studies of punch thorough protection of silicon strip detectors with laser-based charge injection system

RESEARCH INTERESTS

· The inner magnetosphere and Van Allen radiation belt physics
· Wave-particle interactions
· Uncovering the magnetosphere-ionosphere coupling mechanisms. Specifically, how auroral precipitation relates to radiation belt dynamics
· Conducting system-level science using novel combinations of single- and multi-point satellite missions and imagers
· Developing reliable, accessible, and intuitive data analysis software to enable rapid exploration of magnetospheric data

TEACHING EXPERIENCE

· **Instructor**, Physics 68, Plasma Physics, Fall 2022
· **Teaching Assistant**, Physics 220, Intro to Physics I (w/ calculus), Spring 2016
· **Instructor**, Physics 201, Physics by Inquiry, Fall 2015
· **Teaching Assistant**, Physics 207, Intro to Physics II, Spring 2015, Summer 2015
· **Teaching Assistant**, Physics 205, Intro to Physics I, Fall 2014

AWARDS

· NASA Goddard Diversity and Inclusion Award, 2021
· NASA Postdoctoral Program Fellowship, 2020-2022
· NASA Earth and Space Sciences Fellowship, 2018-2020
· Vela Fellowship, 2018
· The Best Inner Magnetosphere Poster, GEM Workshop, 2016

· Montana Space Grant Consortium Fellowship, 2015 - 2016
· NASA EPSCoR Travel Grant, 2015

FUNDED GRANTS

· PI, **NASA Heliophysics Tools and Methods**, "Refactor aurora-asi-lib to support THEMIS, REGO, and TREx all-sky imagers", PI: Mykhaylo Shumko, (2023-2024)
· PI, **NASA Heliophysics Flight Opportunities Studies**, "The Loss Through Auroral Microburst Pulsations Satellite (LAMPsat) Flight Opportunity Study", PI: Mykhaylo Shumko, (2023-2024)
· PI, **NASA Postdoctoral Program Fellowship**, "The Connection Between the Inner Magnetosphere Waves and Energetic Particle Precipitation Into Earth's Atmosphere", PI: Mykhaylo Shumko, (2020-2022)
· Collaborator, **Heliophysics Supporting Research**, "Investigating the generation and properties of relativistic electron microbursts", PI: Lauren Blum (2021-2024)
· Co-I, **Internal Scientist Funding Model Grant at GSFC**, "Particle Precipitation: a comprehensive investigation of the drivers and impacts of precipitation across species and energy, PI: Alexa Halford, (2021-2025)
· PI, **NASA Earth and Space Sciences Fellowship**, "Multi-Spacecraft Observations and Modeling of Electron Microburst Precipitation And Its Scattering Mechanism", PI: Mykhaylo Shumko, (2018-2020)
· PI, **Montana Space Grant Consortium Fellowship**, PI: Mykhaylo Shumko, (2015-2016)

PROFESSIONAL EXPERIENCE

University of Maryland   May 2022 - present
Post-Doctoral Associate   *College Park, MD*

· Identifying the wave drivers of pulsating aurora and relativistic electron precipitation using the THEMIS ASIs, THEMIS satellites, and the SAMPEX satellite.
· Advising a graduate student
· Leading the LAMPsat CubeSat mission concept. This CubeSat will contain an imager and two particle detectors to directly observe the concurrency of radiation belt precipitation and the aurora.
· Developed the sampex python package to download, load, and plot the SAMPEX satellite data. This package includes a simple user interface, through documentation with examples, automatic tests, and minimal dependencies.

Dartmouth College   September 2022 - March 2023
Visiting Scholar   *Hanover, NH*

· Taught the undergraduate Plasma Physics Course
· Advising a graduate student
· Co-Investigator on a NASA SMEX proposal, submitted in December 2022
· Partnered with University of Calgary's AuroraX project to develop aurora-asi-lib, a Python package that easily downloads, plots, animates, and analyzes auroral all sky imager (ASI) data

NASA's Goddard Space Flight Center   May 2020 - May 2022
NASA Postdoctoral Program (NPP) Fellow   *Greenbelt, MD*

· Provided microburst physics expertise and now analyzing all-sky imager data for the Loss through Auroral Microburst Pulsations (LAMP) sounding rocket mission
· Interviewed for the Relatively Cosmic podcast.
· Wrote the data processing pipeline for the upcoming Geostationary Transfer Orbit Satellite (GTOsat) mission

- Published studies to understand under what conditions is the low-energy auroral precipitation observed by the THEMIS imagers was associated with relativistic electrons observed by the SAMPEX satellite
- Published studies on multi-point observations of electron curtain and microburst precipitation observed by the AeroCube-6 CubeSats
- Published a study on the duration of electron microbursts observed by NASA's SAMPEX mission
- Advised a summer student

Space Sciences and Engineering Laboratory   September 2014 - April 2020
Graduate Research Assistant and Postdoctoral researcher   *Bozeman, MT*

- Assisted with the launch of a BARREL high altitude balloon out of McMurdo, Antarctica in December 2019
- Operated the FIREBIRD-II CubeSats and developed the data pipeline to automatically process the data from satellite to the internet within a day
- Generated ephemeris and magnetic ephemeris for FIREBIRD-II using Two Line Elements and IRBEM-Lib
- Created a detection algorithm to identify transient and spatial features observed by the AeroCube-6 multi-spacecraft CubeSat mission
- Developed and maintain a Python wrapper for IRBEM-Lib
- Created a database of microbursts observed with the FIREBIRD-II CubeSats, detected using a wavelet filtering and reconstruction
- Advised REU and undergraduate students
- Co-directed the Rocky Mountain Data Science Club

Los Alamos National Laboratory   June - July 2018
Graduate Researcher   *Los Alamos, NM*

- Performed an uncertainty quantification of the Magnetic Electron Ion Spectrometer onboard the Van Allen Probes
- Developed a forward model to convert a flux energy spectra to count rates observed by the Magnetic Electron Ion Spectrometer and optimized the model parameters using a Markov chain Monte Carlo sampler

The Aerospace Corporation   May - August 2017
Graduate Researcher   *El Segundo, CA*

- Analyzed a microburst observed by the Van Allen Probes and used resonant diffusion theory to conclude that the electron transport is inconsistent with particle transport along single-wave characteristics (diffusion curves for monochromatic waves)
- Estimated the magnetic field model footprint error for a variety of magnetic field models using IRBEM-Lib

Santa Cruz Institute for Particle Physics   September 2012 - August 2014
Undergraduate Researcher   *Santa Cruz, CA*

- Tested Punch-Through Protection resistance and safe operating voltage of low resistance silicon strip detectors using DC voltage sweeps and laser injection
- Carefully transported, cooled, biased, and probed the ATLAS detector's strip silicon detectors under a microscope
- Captured charge pulses on an oscilloscope and analyzed the waveforms using ROOT, a C++ interpreter

INVITED TALKS

- UCLA, "The Association of Relativistic Electron Microbursts with the Aurora", 2022.
- Dartmouth College, "The Association of Relativistic Electron Microbursts with the Aurora", 2022.
- CEDAR workshop, "aurora-asi-lib: Easily download, plot, animate, and analyze auroral all sky imager (ASI) data", 2021.
- GEM workshop, "Precipitation Conjunction Events: an Overview of the Precipitation Workshop", 2019.
- UC Berkeley, "Radiation Belt Electron Precipitation: Decoupling the Spatial and Temporal Properties via Multi-Spacecraft CubeSat Missions", 2017.

CONFERENCES, MEETINGS, AND WORKSHOPS

- Member of an ISSI team, "Dynamics of Electromagnetic Ion Cyclotron Wave Activity in the Earth's Magnetosphere", 2021-present
- Co-convener for oral sessions at 2021 AGU Fall Meeting
- Organized and led a Particle Precipitation Workshop at University of New Hampshire, 2019
- Gave talks at: 2022 GEM Workshop, 2021 AGU Fall meeting, 2021 GEM workshop, 2020 AGU Fall meeting, 2020 GSFC Early Career Scientist Forum, 2020 GSFC Director's Seminar, 2020 GEM workshop, 2019 GEM workshop, 2018 GEM workshop, 2017 AGU Fall meeting, 2017 GEM workshop, 2017 MSU Relativity and Astrophysics Seminar, 2016 Montana Space Grant Symposium

SERVICE

- Led and submitted a white paper for the Decadal Survey titled "Recommendations on Funding Mission Operations and Historical Datasets"
- Served on NASA review panels as a Reviewer and Executive Secretary
- Reviewer for AGU's JGR and GRL journals, as well as AGU Books

PUBLICATIONS SINCE HIRE

- **Shumko, M.**, Gallardo-Lacourt B, Halford AJ, Blum LW, Liang J, Miyoshi Y, Hosokawa K, Donovan E, Mann IR, Murphy K, Spanswick EL, Blake JB, Looper MD and Gillies DM (2022), Proton aurora and relativistic electron microbursts scattered by electromagnetic ion cyclotron waves. Front. Astron. Space Sci. 9:975123. doi: 10.3389/fspas.2022.975123
- **Shumko, M.**, Chaddock D., Gallardo-Lacourt B., Donovan E., Spanswick E. L., Halford A. J., Thompson I., Murphy K. R. (2022), AuroraX, PyAuroraX, and aurora-asi-lib: A user-friendly auroral all-sky imager analysis framework. Front. Astron. Space Sci. 9:100945. doi: 10.3389/fspas.2022.1009450
- **Shumko, M** et al., Observational Evidence of Electron Microburst Precipitation With a Positive Time of Flight Energy Dispersion (in preparation)
- Meyer-Reed, C., Blum, L., and **Shumko, M.** (2022). Pitch Angle Isotropy of Relativistic Electron Microbursts as Observed by SAMPEX/HILT: Statistical and Storm-time Properties. Journal of Geophysical Research: Space Physics, 128, e2022JA030926. https://doi.org/10.1029/2022JA030926
- Elliott SS, Breneman A, Colpitts C, Bortnik J, Jaynes A, Halford A, **Shumko M**, Blum L, Chen L, Greeley A and Turner D (2022), Understanding the properties, wave drivers, and impacts of electron microburst precipitation: Current understanding and critical knowledge gaps. Front. Astron. Space Sci. 9:1062422. doi: 10.3389/fspas.2022.1062422
- Narock A, Bard C, Thompson BJ, Halford AJ, McGranaghan RM, da Silva D, Kosar B and **Shumko M** (2022), Supporting responsible machine learning in heliophysics. Front. Astron. Space Sci. 9:1064233. doi: 10.3389/fspas.2022.1064233

· Elliott, S. S., Breneman, A. W., Colpitts, C., Pettit, J. M., Cattell, C. A., Halford, A. J., **Shumko, M.** et al. (2022). Quantifying the size and duration of a microburst-producing chorus region on 5 December 2017. Geophysical Research Letters, 49, e2022GL099655. https://doi.org/10.1029/2022GL099655