Mykhaylo Shumko

Johns Hopkins University Applied Physics Laboratory
(909) 648-5575
msshumko@gmail.com
https://mshumko.github.io

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

Johns Hopkins University Applied Physics Laboratory — **May 2023 - present**
Post-Doctoral Fellow — ***Laurel, MD***

· **Helping maintain the data pipeline for the Energetic Ion Spectrometer onboard NASA's MMS mission**
· **Uncovering how particles are energized to relativistic energies in the magneto tail**
· **Leading the LAMPsat CubeSat mission concept to understand if pulsating aurora and relativistic microbusts are part of the same phenomenon**
· **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**

University of Maryland — **May 2022 - April 2023**
Post-Doctoral Associate — ***College Park, MD***

· **Discovered and published results on a relativistic electron microburst with a inverse time-of-flight energy dispersion**
· **Identified the wave drivers of pulsating aurora and relativistic electron precipitation using the THEMIS ASIs, THEMIS satellites, and the SAMPEX satellite.**
· **Advised a graduate student**
· **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**

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

- **Magnetosphere Online Seminar Series, "On the Coupling Between Radiation Belt Precipitation and The Aurora: Conjunctive Observations Using aurora-asi-lib", 2023.**
- **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

- **Kandar H., Blum L., Shumko M., Lunjin Chen, and Jih-Hong Shue, The properties of MeV electron microbursts and their repetition periods compared to chorus waves. Geophysical Research Letters (in preparation)**

- **Shumko M. et al., (2023). Observation of an Electron Microburst With an Inverse Time of Flight Energy Dispersion. Geophysical Research Letters (in preparation)**
- **Namekawa T., Mitani T., Asamura K., Miyoshi Y., ... Shumko M. (2023) Simultaneous Precipitation of Sub-Relativistic Electron Microburst and Pulsating Aurora Electrons. Geophysical Research Letters (submitted)**
- **Nosé M., Hosokawa K., Nomura R., Teramoto M., Asamura K., Miyoshi Y., Shumko M., (2023). Field-aligned currents associated with pulsating auroral patches: Observation with Magneto-Impedance Magnetometer (MIM) onboard Loss through Auroral Microburst Pulsations (LAMP) sounding rocket. Journal of Geophysical Research: Space Physics (submitted)**
- **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**
- **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**
- **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**
- **Shumko M., Blum, L. W., & Crew, A. B. (2021). Duration of individual relativistic electron microbursts: A probe into their scattering mechanism. Geophysical Research Letters, 48, e2021GL093879. https://doi.org/10.1029/2021GL093879**
- **Shumko M., Gallardo-Lacourt, B., Halford, A. J., Liang, J., Blum, L. W., Donovan, E., et al. (2021). A strong correlation between relativistic electron microbursts and patchy aurora. Geophysical Research Letters, 48, e2021GL094696. https://doi.org/10.1029/2021GL094696**
- **Johnson, A. T., Shumko M., Sample, J., Griffith, B., Klumpar, D., Spence, H., & Blake, J. B. (2021). The energy spectra of electron microbursts between 200 keV and 1 MeV. Journal of Geophysical Research: Space Physics, 126, e2021JA029709. https://doi.org/10.1029/2021JA029709**
- **Capannolo, L., Li, W., Spence, H., Johnson, A. T., Shumko, M., Sample, J., & Klumpar, D. (2021). Energetic electron precipitation observed by FIREBIRD-II potentially driven by EMIC waves: Location, extent, and energy range from a multievent analysis. Geophysical Research Letters, 48(5), e2020GL091564.**
- **Duderstadt, K. A., Huang, C. L., Spence, H. E., Smith, S., Blake, J. B., Crew, A. B., Shumko, M., ... & Vitt, F. M. (2021). Estimating the impacts of radiation belt elec-**

trons on atmospheric chemistry using FIREBIRD II and Van Allen Probes observations. Journal of Geophysical Research: Atmospheres, 126(7), e2020JD033098.

- Shumko, M., Johnson, A. T., O'Brien, T. P., Turner, D. L., Greeley, A. D., Sample, J. G., ... & Halford, A. J. (2020). Statistical Properties of Electron Curtain Precipitation Estimated With AeroCube-6. Journal of Geophysical Research: Space Physics, 125(12), e2020JA028462.
- Shumko, M., Johnson, A. T., Sample, J. G., Griffith, B. A., Turner, D. L., O'Brien, T. P., ... & Claudepierre, S. G. (2020). Electron microburst size distribution derived with AeroCube-6. Journal of Geophysical Research: Space Physics, 125(3), e2019JA027651.
- Johnson, A. T., Shumko, M., Griffith, B., Klumpar, D. M., Sample, J., Springer, L., ... & Blake, J. B. (2020). The FIREBIRD-II CubeSat mission: Focused investigations of relativistic electron burst intensity, range, and dynamics. Review of Scientific Instruments, 91(3), 034503.
- Capannolo, L., Li, W., Ma, Q., Shen, X., Spence, H. E., Shumko, M., ... & Redmon, R. J. (2019). Direct Observation of Sub-Relativistic Electron Precipitation Driven by EMIC Waves. In AGU Fall Meeting Abstracts (Vol. 2019, pp. SM23C-3220).
- Shumko, M., Turner, D. L., O'Brien, T. P., Claudepierre, S. G., Sample, J., Hartley, D. P., ... & Mitchell, D. G. (2018). Evidence of microbursts observed near the equatorial plane in the outer Van Allen radiation belt. Geophysical Research Letters, 45(16), 8044-8053.
- Shumko, M., Sample, J., Johnson, A., Blake, B., Crew, A., Spence, H., ... & Handley, M. (2018). Microburst scale size derived from multiple bounces of a microburst simultaneously observed with the FIREBIRD-II CubeSats. Geophysical Research Letters, 45(17), 8811-8818.
- Breneman, A. W., Crew, A., Sample, J., Klumpar, D., Johnson, A., Shumko, M., ... & Kletzing, C. A. (2017). Observations directly linking relativistic electron microbursts to whistler mode chorus: Van Allen Probes and FIREBIRD II. Geophysical Research Letters, 44(22), 11-265.
- Ullán, M., Benítez, V., Quirion, D., Zabala, M., Pellegrini, G., Shumko, M., ... & Sadrozinski, H. W. (2014). Low-resistance strip sensors for beam-loss event protection. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 765, 252-257.