

GREG FURLICH

Research Associate, US Citizen

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Research Faculty and the Space Domain Awareness research lead for the Center for National Security Initiatives at the University of Colorado Boulder. Leads the Data Exploitation Lab for Trusted Autonomy (DELTA) research group. Research interests include sensors, and sensing, mission data processing, and trusted autonomy. PhD in Physics from the University of Utah with a thesis on the ultraviolet remote sensing of ultra-high energy cosmic ray interactions within the atmosphere. Raised over \$1.87 million awards in the past 3.5 years and was conferred a courtesy appointment with the Aerospace Engineering Sciences at CU Boulder.

EDUCATION

Doctorate of Philosophy, Physics

2014 – 2020

Master of Science, Physics

2014 – 2018

University of Utah, Salt Lake City, UT

Bachelor of Science, Physics

2010 – 2014

Michigan Technological University, Houghton, MI

Magna Cum Laude

Minors: Mathematical Sciences and German

RESEARCH INTERESTS

Sensors and Sensing: image collection, processing, and analysis over many spectral regimes (visible, infrared, ultraviolet, multispectral, hyperspectral); expeditionary low SWAP sensor systems for situational awareness

Mission Data Processing: signal, image, and video processing; feature extraction and exploitation; algorithm development for dim object detection and disparate data fusion for object tracking and state estimation; event detection, characterization, and typing; machine learning for automatic target recognition, stochastic processing modeling, anomaly detection, physics-informed neural networks

Trusted Autonomy: autonomous decisions for proliferated distributed systems; battle management architectures; killchain or threat decomposition; course of action recommendation; hostility and intent assessment; risk assessment and management; data provenance and validation

PROFESSIONAL RESEARCH EXPERIENCE

Research Associate

Aug 2022 – Present

Space Domain Awareness Research Lead

University of Colorado Boulder,

Center for National Security Initiatives (NSI),

Data Exploitation Lab for Trusted Autonomy (DELTA)

- Leading the Data Exploitation Lab for Trusted Autonomy (DELTA) research group, a multidisciplinary group focused on applied physics, mathematics, and computer science for mission data processing for SDA, MWD, and ISR. Current group is composed of 2 post doctoral research associates and 4 students.
- Led many multi-disciplinary DoW and IC proposal efforts as CU Principal Investigator. Awarded \$1.87M in funding efforts and proposals.
- Leading applied research projects in the USSF Space Systems Command (SSC) Boulder and Space Domain Awareness (SDA) Tools, Applications, and Processing (TAP) Labs.
- Selected for the inaugural Project Apollo Technology Accelerator cohort of the SDA TAP Lab. Continued participation up to present, Cohort 9. Developed and successfully tested a unrestricted operational capability for detection of launches using publicly available weather satellite imagery. Capability is named Open-data Weather imagery Launch Alerts and Tracklets (OWLAT).
- Selected as a fellow for the AFOSR Summer Faculty Fellowship Program and invited perform impactful research at the AFRL Information Directorate (AFRL/RI).

PROFESSIONAL RESEARCH EXPERIENCE CONTINUED

A/AI Research Engineer
Senior Research Scientist

May 2022 – Aug 2022
Jan 2021 – May 2022

Lockheed Martin Space Systems,
Advanced Programs and Exploitations (APEX)

- Developed innovative algorithms which improved the efficiency and accuracy in signal and image processing for a variety of sensor types (visible, infrared, multispectral, and RF). Developed data fusion algorithm for object detection, tracking, and state estimation.
- Designed novel machine learning networks for super resolution, image-to-image translation, and style transfer with Generative Adversarial Networks (GANs), image segmentation with UNETs and FCNs, and object classification with Convolution Neural Networks (CNNs).
- Selected as a Lockheed Martin Recognized Technical Talent for technical contributions within first year.
- Generated intellectual property which provided technical advantage for many applications and was therefore awarded and protected as a trade secret.

Graduate Research Assistant in Cosmic Rays

2014 – 2020

Telescope Array (TA) Cosmic Ray Observatory, Institute of High Energy Astrophysics,
Department of Physics and Astronomy, University of Utah

Research Advisor: Douglas Bergman

Thesis : Observation of the GZK Suppression with the Telescope Array Fluorescence Telescopes and Deployment of the Telescope Array Expansion

- Analyzed 10 years of monocular fluorescence data to create a Cosmic Ray Energy Spectrum. Raw cosmic ray event data were analyzed by reconstructing event geometry and energy. The event information was aggregated into a large database to produce the event energy distribution. The aperture of the detectors in monocular mode was calculated through Monte Carlo thrown events over TA and simulating the response of the detectors.
- Analyzed the significance of the Greisen–Zatsepin–Kuzmin (GZK) Suppression at the highest energies of cosmic rays in the 10 year cosmic ray spectrum. Analyzed other features that give insight into cosmic ray populations or propagation effects.
- Classified weather over TA with the fluorescence detector photomultiplier tube baselines to create false color images of the detectors' field of view. Videos of these snapshots were then used as inputs in a Recurrent Convolution Neural Network (RCNN) model constructed with Keras machine learning framework to determine clear weather data for further cosmic ray analysis.
- Refurbished, tested, calibrated, and deployed the system of ultraviolet fluorescence telescopes for the TAx4 expansion. Collected first light with these new instruments.
- Analyzed the preliminary data from the new fluorescence detectors for the expansion of TA known as TAx4 into a preliminary Cosmic Ray Energy Spectrum and compared to previous results to gauge the new detector's capabilities.

AWARDS

Air Force Office of Scientific Research (AFOSR) Summer Faculty Fellow, AFRL/RI
Recognized Technical Talent, Lockheed Martin
Departmental Scholar, Department of Physics, Michigan Technological University
Sigma Pi Sigma, Physics Honor Society
Michigan Space Grant Consortium Recipient

Summer 2023
Selected 2021
2013
Inducted 2013
2012

PUBLICATIONS

Time-resolved leader spectra of downward Terrestrial Gamma-ray Flashes observed at the Telescope Array Surface Detector, N. Kieu et al., *Journal of Geophysical Research: Atmospheres*, 130, e2025JD043812, 2025, <https://doi.org/10.1029/2025JD043812>
Intermediate fluence downward terrestrial gamma-ray flashes as observed by the Telescope Array Surface Detector, Abbasi, R. et al., *Journal of Geophysical Research: Atmospheres*, 129, e2024JD041260, 2025, <https://doi.org/10.1029/2024JD041260>
First Time-Resolved Leader Spectra Associated With a Downward Terrestrial Gamma-Ray Flash Detected at the Telescope Array Surface Detector, N. Kieu et al., *Journal of Geophysical Research: Atmospheres*, 129, e2024JD041720, 2024, <https://doi.org/10.1029/2024JD041720>
Isotropy of cosmic rays beyond 10²⁰ eV favors their heavy mass composition, R.U. Abbasi et al. (The Telescope Array Collaboration), *Phys. Rev. Lett.* **133**, 041001, 2024, doi: 10.1103/PhysRevLett.133.041001

PUBLICATIONS CONTINUED

Mass composition of ultrahigh energy cosmic rays from distribution of their arrival directions with the Telescope Array, R.U. Abbasi et al. (The Telescope Array Collaboration), *Phys. Rev. Lett.* **110**, 022006, 2024, doi: 10.1103/PhysRevD.110.022006

An extremely energetic cosmic ray observed by a surface detector array, R.U. Abbasi et al. (The Telescope Array Collaboration), *Science* **382**, 2023, doi: 10.1126/science.abo5095

The energy spectrum of cosmic rays measured by the Telescope Array using 10 years of fluorescence detector data, R.U. Abbasi et al. (The Telescope Array Collaboration), *Astropart. Phys.* **151**, 2023, doi: 10.1016/j.astropartphys.2023.102864.

Infrared Small Target Detection Enhancement Using a Lightweight Convolutional Neural Network, M. Gupta, J. Chan, M. Krouss, **G. Furlich**, P. Martens, M. Chan, M. L. Comer, E. J. Delp, *Geoscience and Remote Sensing Letters*, 2022, doi: 10.1109/LGRS.2022.3203931.

Search for Spatial Correlations of Neutrinos with Ultra-high-energy Cosmic Rays, A. Albert et al. (The ANTARES Collaboration, the IceCube Collaboration, the Pierre Auger Collaboration, and the Telescope Array Collaboration), 2022 *ApJ* **934** 164. DOI 10.3847/1538-4357/ac6def

Observation of variations in cosmic ray single count rates during thunderstorms and implications for large-scale electric field changes, R. U. Abbasi et al. (The Telescope Array Collaboration), *Phys. Rev. D* **105** 164, 2022. DOI: 10.1103/PhysRevD.105/062002

The Cosmic-Ray Composition between 2 PeV and 2 EeV Observed with the TALE Detector in Monocular Mode, R. U. Abbasi et al. (The Telescope Array Collaboration), 2021 *ApJ* **909** 178. DOI 10.3847/1538-4357/abdd30

Measurement of the proton-air cross section with Telescope Array's Black Rock Mesa and Long Ridge fluorescence detectors, and surface array in hybrid mode, R. U. Abbasi et al. (The Telescope Array Collaboration), *Phys. Rev. D* **102**, 062004, 2020. DOI: <https://doi.org/10.1103/PhysRevD.102.062004>

Evidence for a Supergalactic Structure of Magnetic Deflection Multiplets of Ultra-high-energy Cosmic Rays, R. U. Abbasi et al. (The Telescope Array Collaboration), 2020 *ApJ* **899** 86, 2020. DOI 10.3847/1538-4357/aba26c

Search for Ultra-High-Energy Neutrinos with the Telescope Array Surface Detector, R. U. Abbasi et al. (The Telescope Array Collaboration), *J. Exp. Theor. Phys.* **131**, 255–264 (2020). <https://doi.org/10.1134/S106377612005012X>

Observations of the Origin of Downward Terrestrial Gamma-Ray Flashes, JW Belz et al., *Journal of Geophysical Research: Atmospheres*, 125, e2019JD031940, 2020. <https://doi.org/10.1029/2019JD031940>

Observation of the GZK Suppression with the Telescope Array Fluorescence Telescopes and Deployment of the Telescope Array Expansion, **Greg Furlich**, Thesis, University of Utah, April 2020

Constraints on the diffuse photon flux with energies above 10^{18} eV using the surface detector of the Telescope Array experiment, R.U. Abbasi et al. (The Telescope Array Collaboration), *Astropart. Phys.* **110** (2019)

Testing a Reported Correlation between Arrival Directions of Ultra-high-energy Cosmic Rays and a Flux Pattern from nearby Starburst Galaxies using Telescope Array Data, R.U. Abbasi et al. (The Telescope Array Collaboration), *ApJ* **867** 2 (2018)

The Cosmic-Ray Energy Spectrum between 2 PeV and 2 EeV Observed with the TALE detector in monocular mode, R.U. Abbasi et al. (The Telescope Array Collaboration), *ApJ* **865** 74 (2018)

Evidence of Intermediate-scale Energy Spectrum Anisotropy of Cosmic Rays $E \geq 10^{19.2} \text{ eV}$ with the Telescope Array Surface Detector R.U. Abbasi et al. (The Telescope Array Collaboration), *ApJ* **862** 91 (2018)

Depth of Ultra High Energy Cosmic Ray Induced Air Shower Maxima Measured by the Telescope Array Black Rock and Long Ridge FADC Fluorescence Detectors and Surface Array in Hybrid Mode, R.U. Abbasi et al. (The Telescope Array Collaboration), *ApJ* **858** 76 (2018)

Gamma-ray Showers Observed at Ground Level in Coincidence With Downward Lightning Leaders, R.U. Abbasi et al. (The Telescope Array Collaboration), *Journal of Geophysical Research: Atmospheres* **123** (2018)

PROCEEDINGS AND NON-REVIEWED PUBLICATIONS

A Spatial-Spectral Convolutional Neural Network for Dim, Unresolved Target Detection in Multispectral Imagery, B Sweeney, **G Furlich**, S Rossland, M W Chan, S Kerner, *SPIE Defense + Security*, 2026, Accepted

Data-driven chromaticity-space rotations for enhanced target detection in multispectral overhead imagery, S Rossland, **G Furlich**, M W Chan, S Kerner, *SPIE Defense + Security*, 2026, Accepted

In-Transit Space Object Recognition via Physics-Based Remote Sensing, B Joens, K Miller, **G Furlich**, A Shirkhodaie, *SPIE Defense + Security*, 2026, Accepted

Utilizing Civilian Launches as Live Exercises for Evaluating a Federated Protect and Defend SDA Battle Management System, **G. Furlich** et al., 2025 Advanced Maui Optical and Space Surveillance Technology Conference (AMOS) (**Best Poster Award**)

Towards an AI-enabled Space Battle Management System on Space Protocol's Quantum Resilient Blockchain, Latif, Yasir ; Bagchi, Samya ; Madhuri Pratti, Latha ; Reed, Harvey ; Stilwell, Ruth ; [Furlich, Greg](#), 2025 Advanced Maui Optical and Space Surveillance Technology Conference (AMOS)

Open Data Weather Imagery Launch Alerts and Tracklets, [G Furlich](#), S Rossland, B Sweeney, T Behrer, NRO Forum for Innovative Research in Science and Technology (FIRST), 2025, Accepted but Conference Canceled

Automated, Collaborative Applications to Close Kill Chain Gaps, [G. Furlich](#) et al., 2024 Advanced Maui Optical and Space Surveillance Technology Conference (AMOS)

SubPixel Localization of Objects Using Multiple Spectral Bands, M. Gupta, J. Chan, M. Krouss, [G. Furlich](#), P. Martens, M. Chan, M. L. Comer, E. J. Delp, IEEE Aerospace Conference, 2022, *accepted*

Recent measurement of the Telescope Array energy spectrum and observation of the shoulder feature in the Northern Hemisphere, D. Ivanov, D. Bergman, [G. Furlich](#), R. Gonzalez, G. Thomson and Y. Tsunesada, Proceedings of Science 395 (ICRC2021), 341, 37th International Cosmic Ray Conference, Berlin, Germany, July 2021

Telescope Array 10-Year Monocular Spectrum, Douglas Bergman, [Greg Furlich](#), Proceedings of Science 395 (ICRC2021), 339, 37th International Cosmic Ray Conference, Berlin, Germany, July 2021

Telescope Array FD Weather Classification using Machine Learning, [Greg Furlich](#), Proceedings of Science (ICRC2019) 261, 36th International Cosmic Ray Conference, Madison, WI, July 2019

Towards a Telescope Array 10 Year FD Monocular Energy Spectrum, [Greg Furlich](#), Douglas Bergman, Proceedings of Science (ICRC 2019) 260, 36th International Cosmic Ray Conference, Madison, WI, July 2019

Increasing the Yield of Boron Nitride Nanotubes in a CVD Method, [Greg Furlich](#), Michigan Space Grant Consortium, Michigan in Space 14 (2012)

PRESENTATIONS

Data Exploitation for Space Domain Awareness Mission Data Processing, AES Department Seminar, University of Colorado Boulder, Boulder, CO, January 2026

Open-data Weather imagery Launch Alerts and Tracklets, AFRL Blank Space Talk, Virtual, January 2026

Defeating Emerging Threats with Advanced Algorithms, United States Space Command (USSPACECOM) Space Concepts 2040, Colorado Springs, CO, April 2024

Defeating Emerging Threats with Advanced Algorithms, United States Space Command (USSPACECOM) Academic Engagement Enterprise (AEE), Colorado Springs, CO, April 2024

Multi-spectral Object Detection Algorithms, Joint Algorithm Workshop, Lockheed Martin, Orlando, FL, April 2022

Observation of the GZK Suppression with the Telescope Array Fluorescence Telescopes and Deployment of the Telescope Array Expansion, Thesis Defense, University of Utah, April 2020

Weather Classification using Machine Learning at the Telescope Array Cosmic Ray Observatory, APS April Meeting, Denver, CO, April 2019

Weather Classification using Machine Learning at the Telescope Array Cosmic Ray Observatory (Poster), Department of Physics and Astronomy Annual Symposium, University of Utah, Salt Lake City, UT, April 2019

Machine Learning Weather Classification with Fluorescence Detector Pedestal Data at the Telescope Array Cosmic Ray Observatory, APS Four Corners Meeting, University of Utah, Salt Lake City, UT, Oct. 2018

Machine Learning Weather Classification with Fluorescence Detector Pedestal Data at the Telescope Array Cosmic Ray Observatory, Graduate Research Seminar, University of Utah, Salt Lake City, UT, Oct. 2018

Dark Nights and Desert Air: Understanding the Highest Energy Particles in the Universe, Great Basin Astronomy Festival, Great Basin National Park, NV, Sept. 2018

TAX4 Fluorescence Detection (Poster), Physics and Astronomy Symposium, University of Utah, Salt Lake City, UT, April 2017

Once More Unto the Breach: Advice from a Physics graduate Student, Physics Seminar, Weber State University, Ogden, UT, Feb. 2017

Peer Mentoring: Training and Supporting Physics TAs at the University of Utah (Poster), AAPT Idaho-Utah Section Meeting, Pocatello, ID, April 2016

Preliminary Search for Exotic Events in the Pierre Auger Cosmic Ray Observatory Data, Physics Senior Research Oral Presentations, Michigan Technological University, Houghton, MI, April 2014

AWARDED GRANTS AND FUNDING

Received **19 Awards: \$ 1.87 M total** funding, **11 unique** awards, **9 extensions**, with awards from over **10 sponsors**.

Lockheed Martin Space Systems IRAD Extension V, PI, \$99,000 <i>Multi-modal Dim Object Detection</i>	Jun 2026
Lockheed Martin Space Systems IRAD Extension IV, PI, \$40,000 <i>Multi-modal Dim Object Detection</i>	Dec 2025
Lockheed Martin Space Systems IRAD Extension III, PI, \$10,000 <i>Multi-modal Dim Object Detection</i>	Dec 2025
SDA TAP Lab Cohort Award Extension II, Institutional PI (Prime: InTrack Radar Technology), \$80,000 <i>Open-Source Launch Detection</i>	Aug 2025 – Dec 2025
Aerospace Corporation Award Extension, PI, \$90,000 <i>SDA TAP Lab Student Projects</i>	Sept 2025 – Aug 2026
SDA TAP Lab Cohort Award, Institutional PI (Prime: GTC Analytics), \$25,000 <i>Open Source Launch Detection</i>	Mar 2025 – Mar 2026
SDA TAP Lab Cohort Award, PI, \$28,000 <i>Crimson Shock: SWIR Expeditionary SDA</i>	Jun – Aug 2025
Lockheed Martin Space Systems IRAD Extension II, PI, \$99,000 <i>Multi-modal Dim Object Detection</i>	Dec 2024
Lockheed Martin Space Systems IRAD Extension I, PI, \$50,000 <i>Multi-modal Dim Object Detection</i>	Dec 2024
SDA TAP Lab Cohort Award Extension I, Institutional PI (Prime: InTrack Radar Technology), \$80,000 <i>Open-Source Launch Detection</i>	Oct 2024
DoD USAF SBIR SF243-D003, Institutional PI, \$38,600 <i>SDA Target Detection and Characterization using WFOV Staring Data</i>	Nov 2025 – Jan 2026
AFRL ML-RCP POA-24-RV-001, Institutional PI, \$40,000 Grant Institution: Ohio State University, Partner Institution: Tennessee State University <i>Multimodality Sensor Data Synthesis and Fusion for Improved Space Domain Awareness (SDA)</i>	Aug 2024 – Aug 2026
AFX24D PTS01 STTR, Institutional PI (Prime: Exclosure), \$33,000 , <i>Highest Revisit Frequency Space Situational Awareness Observatory</i>	May – June 2024
SDA TAP Lab Cohort Award, Institutional PI (Prime: InTrack Radar Technology), \$30,000 <i>Open-Source Launch Detection</i>	Jun – Aug 2024
Aerospace Corporation Award, PI, \$80,000 <i>SDA TAP Lab Student Projects</i>	Sept 2024 – Aug 2025
Lockheed Martin Space Systems IRAD, PI, \$50,000 <i>Multi-modal Dim Object Detection</i>	Jan – June 2024
NSTXL OTA # FA8814-21-9-0001, Institutional PI (Prime: Lockheed Martin Space Systems), \$968,541 <i>Overhead Persistent Infrared Data Exploitation Technology Transition, OPIR ODETT</i>	Apr 2023 – Mar 2027
Information Institute Visiting Faculty Research Program Extension, PI, \$10,000 <i>Orbit-to-Tracklet Track-before-Detect Algorithm Development Extension</i>	Oct 2023
AFOSR Summer Faculty Fellowship Program, PI, \$24,240 <i>Orbit-to-tracklet Hypothesis Constraints to Frame Shifting in a Track-Before-Detect Method for Wide Field of View Survey Telescopes</i>	June – Sept 2023

STUDENT MENTORING

Research Mentor, University of Colorado

Ike Olelewe, AES PhD Student <i>Transformer-based Time Sequence Characterization</i>	2025 – Present
Skye Crocker, Data Science Masters Student <i>Multi-spectral Launch Detection with Weather Satellite Imagery</i>	2025 – 2026
Copeland Laris, Data Science Masters Student <i>Foreign Launch Detection with Weather Satellite Imagery</i>	2025 – 2026

STUDENT MENTORING CONTINUED

Research Mentor, University of Colorado Tanner Gill, AES Masters Student <i>RSO Characterization with Transformers</i>	2024 – 2026
Hank Rains, AES Masters Student <i>Similarity-based Clustering</i>	2024 – 2025
Tim Behrer, AES Masters Student, Graduated Spring 2025 <i>CNNs for Launch False Detection Control</i>	2024 – 2025
Pranav Chopdekar, Data Science Masters Student, <i>Multi-spectral Object Detection</i>	2024
Joanna Wang, Computer Science Masters Student, Graduated Spring 2025 <i>Multi-Modal Object Detection Algorithms</i>	2024 - 2025

Research Mentor, Lockheed Martin Mridul Gupta, Purdue University Electrical and Computer Engineering PhD Candidate, Graduated 2023 Thesis Advisor: Ed Delp, Video and Image Processing Laboratory (VIPER) <i>Sub-pixel localization and multi-spectral signal processing</i>	2021 – 2022
United States Military Academy Cadet <i>Synthetic Image Generation Explainability</i>	2022
United States Military Academy Cadet <i>Machine Learning Cloud Segmentation in Satellite Imagery</i>	2021 – 2022

SERVICE

Center for National Security Initiatives, University of Colorado Boulder Lead, Seminar Series	2023 – 2024
Academic Senate, University of Utah Member, Graduate Assembly Ad Hoc Committee	2019
College of Science, University of Utah Member, College of Science Council	2017 – 2018
Member, College of Science Curriculum Committee	2017 – 2018
Member, College of Science College Student Council	2017 – 2018
Department of Physics and Astronomy, University of Utah Chair, Graduate Student Advisory Council	2017 – 2018
Member, Graduate Student Advisory Council	2015 – 2019
Science Outreach Volunteer, Physics Open House, Weber State University	2017, 2018, 2019
Volunteer, Science Day, University of Utah	2017, 2019
Volunteer and Speaker, Great Basin Astronomy Festival, Great Basin NP	2018
Society of Physics Students, Michigan Technological University Chapter Treasurer	2012 – 2013

MEDIA COVERAGE

Best Poster Award announced in *The 2025 AMOS Conference Highlights Collaboration and Partnerships*, amostech.com
Quoted in *Space Force Turns to TAP Labs To Bridge Tech Gaps*, Payload, Tim Fernholz, October 8, 2024
Participation annouced in *Game Changing U.S. Space Domain Awareness (SDA) at Space Systems Command*, USSF Space Systems Command (SSC) Public Affairs, El Segundo, CA, April 22, 2024
Participation annouced in *Startups, universities selected for accelerator focused on space domain awareness*, SpaceNews, Sandra Erwin, November 8, 2023
Award annouced in *Space Systems Command awards Data Exploitation Technology Transition I contract to Lockheed Martin*, USSF Space Systems Command (SSC) Media Release, El Segundo, CA, Oct. 2, 2023

MEDIA COVERAGE CONTINUED

Weather Classification using Machine Learning, University of Utah, Center for High Performance Computing, Research Highlights
Keeping the Student Voice: Student Involvement in the Tenure Process, Katelyn Collett, The Daily Utah Chronicle, May 22, 2019
Pictured in Telescope Array TAx4 expansion work: Installation of surface particle detector begins in extreme cold (translated), Makio Nakamura, ICRR News, **104**, Winter and Spring 2019
PhD candidate sheds light on work of Millard County cosmic-ray observatory that's largest in Northern Hemisphere, Rhett Wilkinson, Millard County Chronicle Progress, Sept. 19, 2018