

GREG FURLICH

Research Scientist

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6 years expertise in cosmic rays, computational physics, and analyzing large data structures in Python with experience in:

- reconstructing and analyzing transient moving optical events.
- aggregating, querying, and manipulating Pandas DataFrames.
- machine learning image classification using the Keras machine learning framework.
- Linux systems administration of computational clusters and data servers.
- scrapping data from websites and interfacing with application programming interfaces (APIs).
- using remote sensing data from satellite or space shuttle to create maps with informational overlays.

EDUCATION

Doctorate of Philosophy, *Physics*
Master of Science, *Physics*

Fall 2014 - Spring 2020
Fall 2014 - Summer 2018

[University of Utah, Salt Lake City, UT](#)

Bachelor of Science, *Physics*

Fall 2010 - Spring 2014

[Michigan Technological University, Houghton, MI](#)

Magna Cum Laude

Minors: Mathematical Sciences and German

SKILLS

Programming Languages: [Python \(Numpy, Pandas, Keras, TensorFlow, Scipy, Pyroot\)](#) [C](#) [C++](#) [Cern Root](#) [MATLAB](#) [Mathematica](#)

Markup Languages: [HTML](#) [CSS](#) [L^AT_EX](#)

Foreign Languages: [German](#)

Miscellaneous: Strong analytic and problem solving experience, exceptional verbal and written communication skills, and collaborative finesse.

RESEARCH EXPERIENCE

Research Assistant in Cosmic Rays

Summer 2014 - Spring 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 are analyzed by reconstructing event geometry and energy. The event information is aggregated into a large database to produce the event energy distribution. The aperture of the detectors in monocular mode is 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. These videos of 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.
- Analyzed the preliminary data into a Cosmic Ray Energy Spectrum from the new fluorescence detectors for the expansion of TA known as TAx4. Calculated a preliminary spectrum and compared to previous results to gauge the new detector's abilities.

- Created composite satellite maps in Python with site information overlays of TA using data from the Landsat 8 satellite pulled from Amazon Web Services and created topographical and shaded relief maps in Python with site information overlays using Shuttle Radar Topography Mission data.
- Built, tested, and deployed the system of fluorescence telescopes for TAx4.
- Field team leader in charge of safety of field crew and overseeing helicopter deployment to new surface detector's field site for TAx4.
- Maintaining and operating current surface and fluorescence detectors for cosmic ray event data collection.
- Analyzed fluorescence detector's sensitivity to energy and development of cosmic ray event interactions in the atmosphere through Monte Carlo simulation. The reconstructed event information were analyzed by being binned into histograms and fitted using ROOT data analysis framework.
- Linux systems administrator of the Telescope Array's data server and computational clusters at the University of Utah for 2 years.

Project Data Analyst

Spring 2019 - Summer 2019

[College of Computing, University of Utah](#)

- Collaborated on a College of Computing PhD Candidate's thesis project by analyzing air quality data with Python and Pandas DataFrames to query, aggregate, and present data in infographical plots in a quick fashion during face-to-face interviews with study participants.
- Aggregated outside data of local weather conditions and Air Quality Index through web application programming interfaces to give prospective to study participants about their collected home air quality data.

Research Assistant in Cosmic Rays

Summer 2013 - Spring 2014

[Department of Physics, Michigan Technological University](#)

Research Advisor: [Brian Fick](#)

- Conducted a preliminary search for exotic particle events in the Pierre Auger Cosmic Ray Observatory surface detector data by identifying possible delayed development features in the cosmic ray's interaction in our atmosphere.

Research Assistant in Nanofabrication

Fall 2011-Summer 2012

[Department of Physics, Michigan Technological University](#)

Research Advisor: [Yoke Khin Yap](#)

- Analyzed growth parameters for Boron Nitride Nanotubes and Vertically Aligned Multi-Walled Carbon Nanotubes in a Chemical Vapor Deposition method.
- Adapted Chemical Vapor Deposition synthesis method to a scanning thermal source for greater growth yield.

PUBLICATIONS

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. (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. (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. (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. (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. (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. (Telescope Array Collaboration), *Journal of Geophysical Research: Atmospheres* 123 (2018)

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

PROCEEDINGS AND PRESENTATIONS

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

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 (ICRC2019) 260, 36th International Cosmic Ray Conference, Madison, WI, July 2019

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

Hosting Your Own Website from Home with a Raspberry Pi, Graduate Research Seminar, University of Utah, Salt Lake City, UT, Oct. 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

AWARDS

Departmental Scholar, Department of Physics, Michigan Technological University

Spring 2013

Sigma Pi Sigma, Physics Honor Society

Inducted Spring 2013

Michigan Space Grant Consortium Recipient

Summer 2012

EXTRACURRICULAR

Academic Senate, University of Utah

Member, Graduate Assembly Ad Hoc Committee

Fall 2019

College of Science, University of Utah

Member, College of Science Council

Fall 2017 - Summer 2018

Member, College of Science Curriculum Committee

Fall 2017 - Summer 2018

Member, College of Science College Student Council

Fall 2017 - Summer 2018

Department of Physics and Astronomy, University of Utah

Chair, Graduate Student Advisory Council

Summer 2017 - Spring 2018

Member, Graduate Student Advisory Council

Fall 2015 - Spring 2019

Science Outreach

Volunteer, Physics Open House, Weber State University

Fall 2017, 2018, 2019

Volunteer, Science Open House, University of Utah

Fall 2019

Volunteer and Speaker, Great Basin Astronomy Festival, Great Basin NP

Summer 2018

Volunteer, Science Day, University of Utah

Fall 2017

MEDIA COVERAGE

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