Madison Howard

Aspiring Physicist + Mathematician · Technology Enthusiast · Equity Advocator

1701 N Quaker Ave, Lubbock, TX, USA

8066321401 | madison.howard@ttu.edu | madihowa.github.io | madihowa | madihowa

Education

Texas Tech University (TTU)

Texas, USA

Bachelor of Science in Professional Physics *2018 – 2022*

- CGPA: 3.969
- Notable Coursework: *Modern Physics, Error Analysis, Optics, Electricity & Magnetism I and II, Quantum Mechanics I and II, Statistical Thermodynamics, Modern Physics Lab, Intermediate Lab, Undergraduate Research*

Texas Tech University (TTU)

Texas, USA

Bachelor of Science in Mathematics *2018 – 2022*

- CGPA: 4.0
- Notable Coursework: *Linear Algebra, Mathematical Computing, Introduction to Proofs and Reasoning, Mathematical Statistics I and II, Advanced Calculus I and II, Mathematical Methods in Physical Sciences I and II*

Publications

1 The Application of Machine Learning Techniques for Local Hadronic Calibration of Topological Cell Clusters in the ATLAS Calorimeters *2021*

M Howard, P Loch, F Pat & N Young *in prep.*

2 Machine Learning Applications in Muon Tomography *in prep.*

SA Shanto, S Cano, K Binu, M Howard, C Gabriel, C Moreno, V Bradley

Employment

European Organization for Nuclear Research (CERN)

Geneva, Switzerland

Undergraduate Research Assistant *May. 2021- Present*

- Developed a Machine Learning approach to calibrate topo-cluster energy data using data from the ATLAS collaboration
- Refactored the legacy ML framework to only rely on python and run on parallel and HPC systems
- Added automated data handling and provision for user defined cuts as inputs to the ML framework
- Analyzed various loss metrics and optimization algorithms for best network calibration
- Documented the software base and conducted various unit tests to ensure reliability
- Conducted the training of the network using several datasets - jets, particles, clusters
- Systematically evaluated different input parameter sets and identified the optimal calibration schema
- Authored and presented on the comprehensive ML approach that works better than the LCW routine at lower energy levels
- Github Repository: `https://github.com/madihowa/EnergyCalibration`
- Supervisor: Peter Loch, PhD.

Advanced Particle Detector Laboratory (APDL)

Lubbock, TX, USA

Undergraduate Research Assistant *Jun. 2020- Present*

- Implementing high fidelity readout schemes using FPGA systems for applications in Muon Telescopes
- Assisted with the development of a Neural Network Architecture (Asymmetric Deep Mixture Density NN) that predicts muon hit locations from photon time propagation with a 87% accuracy
- Aided in the electrical assembly of the sensor enabled microcontroller by soldering various components
- Deployed all the required tools and software on the Raspberry Pi and configured the OS for a robust code development environment
- Designed and implemented the Data Acquisition System (DAQ) schema for the network through use of the MQTT framework
- Implemented a multi-thread sync mechanism in the DAQ system comprised of 13 Raspberry Pi's
- Engineered the calibration and installation of 12 sensor enabled Raspberry Pi's to record data at a user-defined rate
- Conducted Monte Carlo simulation experiments to test sensor data integrity, assess system utility and locate bottlenecks in system design
- Developed an alarm system that notifies the stakeholders of the lab through texts and emails using the SMTP library
- Created a Relational MySQL Database to effectively store all information from the transmitting Microcontrollers
- Deployed an interactive weather station dashboard using LAMP stack
- Supervisors: Nural Akchurin, PhD. & Andrew Whitbeck, PhD.

TECHniques Center *Lubbock, TX, USA*

STEM Peer Tutor *Jun. 2020 - May. 2021*

- Provided course-specific tutoring to undergraduate students with documented evidence of learning disabilities
- Received Level 2 International Tutor Certification from College Reading & Learning Association (CRLA)
- Documented over 260 hours of student tutoring while maintaining federal confidentiality guidelines
- Courses tutored: *Physics I, II and IV, Calculus III, Solar System Astronomy, Observational Astronomy, Mathematical Methods and Linear Algebra*

Texas Tech University Student Housing *Lubbock, TX, USA*

Social Justice Avocate (SJA) *Oct. 2018 - Jun. 2020*

- Conducted workshops in promoting advancement and development of diversity, multiculturalism, social identity, and social justice through training, community development, programming educational interactions, and educational dialogues within five assigned student halls and associations.
- Co-organized bi-annual events with the Office of Diversity and Inclusion to bring awareness to contemporary social justice topics impacting both the local TTU and broader national community
- Collaborated with group members in creation of materials for presentations and workshops
- Led discussions with students about social justice in society on a daily basis
- Performed literature review on the pedagogy of various diversity and inclusion topics

TexPREP (Prefreshman Engineering Program) Lubbock *Lubbock, TX, USA*

Course Instructor *May 2019 - Jul. 2019*

- Instructed a "College Readiness" class where I shared resources and mentored juniors and seniors to prepare them for college success
- Assisted with an introductory Robotics course by teaching the LEGO Mindstorms platform
- Taught advanced programming principles - data types, variables, control flow theory, compilers, loops, animation, game design, booleans, discrete numerical analysis - to middle school students on MIT's Scratch IDE
- Administered the after-school tutoring program by leading and training a group of Assistants

Research Projects

Green Bank Observatory (GBO) and the Pulsar Search Collaboratory *Lubbock, TX, USA*

Undergraduate Research Assistant *Jul. 2019 – Jan. 2020*

- Assisted with the optical and mechanical construction of a mini LIGO prototype
- Performed experiments for laser and mirror calibration in the prototype system
- Completed a training program under Pulsar Search Collaboratory on data analysis of Pulsars and related phenomena
- Conducted various curve fitting and model analysis routines to group data sets (based on pulsar timings) from GBO
- Developed python scripts for multi-threaded batch jobs to be deployed on our High Performance Computing Cluster
- Supervisors: Joseph D. Romano Ph.D. & Nipuni Palliyaguru, Ph.D.

Honors & Awards

2018 – 2022	**Texas Tech University Presidential Scholarship**	*Lubbock, TX, USA*
2018 – 2022	**President's Honor List**, *TTU*	*Lubbock, TX, USA*
2021	**Second Best Research Presenter**, *University Research Conference, TTU*	*Lubbock, TX, USA*
2021	**The Michael Clingan Memorial Scholarship in Physics**, *Department of Physics and Astronomy, TTU*	*Lubbock, TX, USA*
2021	**Fourth Best Research Work in Technological Impact**, *University Research Conference, TTU*	*Lubbock, TX, USA*
2021	**The Dr. Mara Neusel Academic Excellence Award**, *Mathematics and Statistics Department, TTU*	*Lubbock, TX, USA*
2021	**Sherrie and Rick Hale Endowment**, *Mathematics and Statistics Department, TTU*	*Lubbock, TX, USA*
2020	**TrUE Undergraduate Scholar Project Fund**, *Center for Transformative Undergraduate Experiences, TTU*	*Lubbock, TX, USA*
Fall 2020	**Certified Tutor, Level I**, *College Readiness and Learning Association (CRLA)*	*International*
Spring 2020	**Dean's Honor List**, *TTU*	*Lubbock, TX, USA*
2020	**Bucy Undergraduate Scholarship Physics Award**, *Physics and Astronomy Department, TTU*	*Lubbock, TX, USA*
2019	**Henry C. Thomas Scholarship Award in Physics**, *Physics and Astronomy Department, TTU*	*Lubbock, TX, USA*
2019	**Raiders Who Rock: Community Service and Leadership Award**, *Office of Engagement and Transition, TTU*	*Lubbock, TX, USA*
2018	**Ready, Set, Teach Scholarship Recipient**, *Vargas Management*	*Lubbock, TX, USA*

Leadership & Involvement

Sigma Pi Sigma — *North America*
President (TTU Chapter) & Member (National) — *2021-Present*

Society for Advancement of Chicanos and Native Americans in Science (SACNAS) — *North America*
Member — *2021-Present*

Women in Physics (WiP) — *North America*
Vice President, Secretary (TTU Chapter) & Member (National) — *2019-Present*

American Physical Society (APS) — *North America*
Member — *2019-Present*

Society of Physics Students (SPS) — *Lubbock, USA*
Member — *2018-Present*

Association for Women in Mathematics — *Lubbock, USA*
Member — *2018-Present*

Free Market Institute — *Texas, USA*
McLane Political Economy Scholar — *2019 - Present*

Red Raider Orientation, TTU — *Lubbock, USA*
Orientation Crew Leader — *2019*

The Quark Newsletter, SPS — *Lubbock, USA*
Junior Editor — *2019*

Seminars, Poster Presentations & Conference Talks

2021	**UM-CERN-REU Summer Research Presentation**, *oral pres.*	*Virtual*
	QuarkNET, *oral pres.*	*Lubbock, USA*
	Exploring Innovation In Appalachia: An Undergraduate Research Symposium, *oral pres.*	*Virtual*
	5th Annual TTU Physics and Astronomy Departmental Poster Competition, *organizer*	*Lubbock, USA*
	University Research Conference, Texas Tech University, *presenter*	*Lubbock, USA*
	Conference for Undergraduate Women in Physics, *attendee*	*Virtual*
2020	**SPS and Women In Physics (WiP) Introduction to Programming**, *speaker*	*Lubbock, USA*
	Departmental Poster Competition, Department of Physics and Astronomy, TTU, *oral pres.*	*Lubbock, USA*
	Conference for Undergraduate Women in Physics, *attendee*	*College Station, TX*
2019	***R-Rated* - a talk on Religion**, *co-speaker*	*Lubbock, USA*
	***Cross The Line* - a talk on empathy**, *co-speaker*	*Lubbock, USA*
	***Diversity at the Dinner Table* - a talk on Diversity and Inclusion**, *co-speaker*	*Lubbock, USA*
	***Love for a Lifetime* - a talk on Relationships**, *co-speaker*	*Lubbock, USA*
	Tunnel of Awareness, *co-organizer*	*Lubbock, USA*
	Undergraduate Colloquium: Programming Principles, *co-speaker*	*Lubbock, USA*
2018	**Tunnel of Oppression**, *co-organizer*	*Lubbock, USA*
	***Game Over* - a talk on Motivation**, *co-speaker*	*Lubbock, USA*

Technological Skills and Languages

Human Spoken Languages	English (native), Spanish (intermediate), Bengali (beginner)
Programming	Python (proficient), C++ and C (competent), Wolfram Language (proficient), Matlab (competent), TEX(proficient)
Operating System	Linux (professional), Raspbian (professional), MAC OS (professional), Windows 10 (professional)
Data Analysis	Numpy, Scipy, SymPy, Matplotlib, Ray, Vaex, Modin, Pandas, StatsModels, Seaborn
Machine Learning	Tensorflow, Keras, SciKit Learn
High-Energy/Particle Physics	CERN Geant4, CERN Root, PyROOT
Quantum Computing	Qiskit
Digital Electronics	LTspice, KiCad
Microcontrollers	Arduino, Raspberry Pi
3D Modelling	Inventor, Fusion360
Database	SQLite, MySQL, MariaDB
Management	Git, Apache
Web	HTML5, CSS, JS (React)

Workshops

June 2021	**Introduction to Python, C++ and ROOT**, UM-CERN REU	*Virtual*
Sept. 2020	**Introduction to Parallel Computing**, TTU High Performance Computing Center (HPCC)	*Texas, USA*
Aug. 2020	**Introduction to Geant4**, Advanced Particle Detector Laboratory	*Texas, USA*
Aug. 2020	**Data Analysis with ROOT and pyROOT**, Advanced Particle Detector Laboratory	*Texas, USA*
Jun. 2020	**Cybersecurity Basics Training**, Texas Tech University	*Texas, USA*

Outreach & Community Service

2021	**2021 Sigma Pi Sigma Graduate School Information Panel**, Sigma Pi Sigma	*Lubbock, TX, USA*
2020 - Present	**Training and Professional Development Workshops**, WiP	*Lubbock, TX, USA*
2018 - Present	**Volunteering for LGBTQIA+ Annual Pride Event**, LubbockPRIDE	*Lubbock, TX, USA*
2018 - Present	**Volunteering for Wheelchair Dodgeball Events**, South Plains Adaptive Recreation Club	*Lubbock, TX, USA*
2018-2019	**Trick or Treat: Science Demonstration**, SPS	*Lubbock, TX, USA*
2019	**Physics Department Annual Banquet Organizing**, SPS	*Lubbock, TX, USA*
2019	**Physics Department Representation at Major and Minor Fair**	*Lubbock, TX, USA*
2017 - 2019	**Multiple Fund Raisers**, SPS	*Lubbock, TX, USA*
2017 - 2018	**Astronomy Day at the Moody Planetarium**, SPS	*Lubbock, TX, USA*
2018	**Undergraduate Colloquium Organizing**, SPS	*Lubbock, TX, USA*