

Madison Howard

ASPIRING PHYSICIST + MATHEMATICIAN · TECHNOLOGY ENTHUSIAST · EQUITY ADVOCATOR

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Education

California Institute of Technology (Caltech)

California, USA

DOCTOR OF PHILOSOPHY (PHD) IN PHYSICS

2022 – Present

- NSF GRF Scholar

Texas Tech University (TTU)

Texas, USA

DUAL BACHELOR OF SCIENCE IN PHYSICS AND MATHEMATICS

2018 – 2022

- Summa Cum Laude

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 2021
SA Shanto, S Cano, K Binu, M Howard, C Gabriel, C Moreno, V Bradley *in prep.*
- 3 MUON TOMOGRAPHY FOR SURVEYING QUEEN MAEVE'S CAIRN 2021
K Webb, V Bradley, A Chavez, M Howard, O Schneider, C Moreno *in prep.*

Employment

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.

European Organization for Nuclear Research (CERN)

Geneva, Switzerland

UNDERGRADUATE RESEARCH ASSISTANT

May. 2021- Dec. 2021

- 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.

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 ADVOCATE (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

2024 - 2027	National Science Foundation Graduate Research Fellowship (NSF GRF), NSF	USA
2022 - 2023	First Year Graduate Fellowship, Caltech	Los Angeles, CA, USA
2022	Outstanding Graduating Senior Award, Department of Physics and Astronomy, TTU	Lubbock, TX, USA
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

PRESIDENT (TTU CHAPTER) & MEMBER (NATIONAL)

North America

2021-Present

Society for Advancement of Chicanos and Native Americans in Science (SACNAS)

MEMBER

North America

2021-Present

Women in Physics (WiP)

VICE PRESIDENT, SECRETARY (TTU CHAPTER) & MEMBER (NATIONAL)

North America

2019-Present

American Physical Society (APS)

MEMBER

North America

2019 - Present

Society of Physics Students (SPS)

MEMBER

Lubbock, USA

2018 - 2022

Association for Women in Mathematics

MEMBER

Lubbock, USA

2018 - 2022

Free Market Institute

MCLANE POLITICAL ECONOMY SCHOLAR

Texas, USA

2019 - 2022

Red Raider Orientation, TTU

ORIENTATION CREW LEADER

Lubbock, USA

2019

The Quark Newsletter, SPS

JUNIOR EDITOR

Lubbock, USA

2019

Seminars, Poster Presentations & Conference Talks

2021	UM-CERN-REU Summer Research Presentation , <i>oral pres.</i>	Virtual
	QuarkNET , <i>oral pres.</i>	Lubbock, USA
	Exploring Innovation In Appalachia: An Undergraduate Research Symposium , <i>oral pres.</i>	Virtual
	5th Annual TTU Physics and Astronomy Departmental Poster Competition , <i>organizer</i>	Lubbock, USA
	University Research Conference, Texas Tech University , <i>presenter</i>	Lubbock, USA
	Conference for Undergraduate Women in Physics , <i>attendee</i>	Virtual
2020	SPS and Women In Physics (WiP) Introduction to Programming , <i>speaker</i>	Lubbock, USA
	Departmental Poster Competition, Department of Physics and Astronomy, TTU , <i>oral pres.</i>	Lubbock, USA
	Conference for Undergraduate Women in Physics , <i>attendee</i>	College Station, TX
2019	R-Rated - a talk on Religion , <i>co-speaker</i>	Lubbock, USA
	Cross The Line - a talk on empathy , <i>co-speaker</i>	Lubbock, USA
	Diversity at the Dinner Table - a talk on Diversity and Inclusion , <i>co-speaker</i>	Lubbock, USA
	Love for a Lifetime - a talk on Relationships , <i>co-speaker</i>	Lubbock, USA
	Tunnel of Awareness , <i>co-organizer</i>	Lubbock, USA
	Undergraduate Colloquium: Programming Principles , <i>co-speaker</i>	Lubbock, USA
2018	Tunnel of Oppression , <i>co-organizer</i>	Lubbock, USA
	Game Over - a talk on Motivation , <i>co-speaker</i>	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	<i>Virtual</i>
Sept. 2020	Introduction to Parallel Computing , TTU High Performance Computing Center (HPCC)	<i>Texas, USA</i>
Aug. 2020	Introduction to Geant4 , Advanced Particle Detector Laboratory	<i>Texas, USA</i>
Aug. 2020	Data Analysis with ROOT and pyROOT , Advanced Particle Detector Laboratory	<i>Texas, USA</i>
Jun. 2020	Cybersecurity Basics Training , Texas Tech University	<i>Texas, USA</i>

Outreach & Community Service

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