# Sadman Ahmed **Shanto**

Budding Physicist · Aspiring Mathematician · Ardent Programmer

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## Education

### Texas Tech University (TTU)

*Texas, USA*

**Bachelor of Science in Applied Physics**

*2017 – 2021*

- Minors: *Computer Science* and *Mathematics*
- Applied Physics Concentration: *Quantum Information and Computation*
- CGPA: 3.7

## Peer Review publications

1 High-Resolution Muography Using a Prototype Portable Muon Telescope — *2020*

*R Perez, SA Shanto, M Moosajee, & S Cano* — *Journal of Undergraduate Reports in Physics*

2 Challenges of Microsimulation Calibration with Traffic Waves using Aggregate Measurements — *accepted*

*SA Shanto, G Gunter, DB Work, R Ramadan, B Seibold* — *2021 Transportation Research Board Annual Meeting*

3 Drive Like Ants: Design Autonomous Vehicle Behaviors in Heterogeneous Traffic Flow — *in prep.*

*SA Shanto, J Li*

## Employment

### Advanced Particle Detector Laboratory (APDL)

*Lubbock, TX, USA*

Undergraduate Research Assistant

*Nov. 2018 - Present*

- Objective: Develop portable muon telescope capable of 0.5 milliradian resolution imaging capability
- Aided in the mechanical assembly of the phase 1 muon telescope
- Designed custom Winston Cone light collectors for increased optical transmission
- Facilitated the design of custom PCB's and assembled various components
- Implemented a multi-thread sync mechanism in the DAQ system comprised of 40 Arduino's and CAMAC systems
- Engineered the calibration and installation of 40 SiPM's (Phase 1) and 44 PMTs (Phase 2) on the telescope
- Designed and implemented Monte Carlo simulation and automated analysis program to test experimental data integrity, assess theorized designs and meausre telescope efficiency
- Conducted Monte Carlo studies on the scattering/absorption behaviour of muons and the consequent effects in image quality
- Deployed all software used by the lab on our university's High Performance Computing Cluster
- Trained new undergraduate members in the lab to use Geant4, ROOT, and our custom software base
- Assisted with the tomogram generation algorithm using the muon tracks
- Coauthored the proposal for IRIS-HEP Fellows Program
- Currently incorporating concepts of image segmentation and ML to enhance final image and improve muon track reconstruction efficiency
- Supervisors: Shuichi Kunori, PhD. & Nural Akchurin, PhD.

### Texas Tech University

*Lubbock, TX, USA*

Teaching Assistant, *"Introduction to Quantum Information and Computation (QIC)"*

*Aug. 2020 - Present*

- Delivered supplemental lecture notes and interactive jupyter notebooks to teach quantum computing through the use of IBM's qiskit
- Prepared bi-weekly computational assignments on the implementation of various Quantum Information and Computing topics
- Helped students with their problems during office hours each week
- Graded both computational and theoretical/mathematical assignments for the 25+ students enrolled in the course
- Assisted and collaborated with the students in their semester research project
- Materials covered: *qiskit API, single and multi qubit systems, statevector evolution, superposition and entanglement, quantum circuit model, quantum teleportation, Deutsch's algorithm, Deutsch-Jozsa Algorithm, Grover's Algorithm, Bernstein-Vazirani algorithm, VQE, and Jordan's Algorithm*
- Supervising Professor: Ismael Regis de-Farias, PhD.

### Texas Tech Multidisciplinary Research in Transportation (TechMRT)

*Lubbock, TX, USA*

Undergraduate Research Assistant — *Jan. 2019 - Jun. 2020*

- Project 1: Develop a customisable analysis and simulation software for studying various heterogeneous traffic flow of Human Driven (HVs) and Autonomous Vehicles (AVs)
- Project 2: Design and test various AV models for efficient shared lane mobility in multi-lane networks using a novel approach based on the Nagel-Schreckenberg Cellular Automaton Model
- Project 3: Incorporate Reinforcement Learning functionality to the simulation and analysis software (incomplete - Covid 19)
- Supervisor: Jia Li, PhD.

### TECHniques Center

*Lubbock, TX, USA*

STEM Peer Tutor — *Jan. 2018 - May 2019*

- 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 670 hours of student tutoring while maintaining federal confidentiality guidelines
- Courses tutored: *Physics I and II, Calculus I and II, Circuits I, Object Oriented Programming, Wind Energy, Linear Algebra, Advanced Calculus, Differential Equations, Combinatorics and Statistics*

### TexPREP (Prefreshman Engineering Program) Lubbock

*Lubbock, TX, USA*

Course Instructor — *May 2019 - Jul. 2019*

- 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.

## Internships

### Institute for Software Integrated Systems (ISIS), Vanderbilt University

*Nashville, TN, USA*

Summer Research Intern — *Jun. – Aug. 2020*

- Designed computationally efficient models for various microscopic traffic simulations using a system written in C++, Python, Bash and XML
- Contributed to developing a computational framework (Flow by UC Berkeley) for deep RL and control experiments for traffic microsimulation
- Established an objected oriented system for calibrating results from stochastic simulations under multi-objective methods using gradient free algorithms
- Incorporated Ray to the software package to parallelize the simulations resulting in massive speedup of running simulation experiments
- Developed scripts to convert microscopic data from the Intelligent Driver Model (IDM) to RDS/radar style data
- Implemented various non-trivial optimization routines to fit simulation data to macroscopic RDS data sets
- Studied the various challenges of Microsimulation Calibration with Traffic Waves using Aggregate Measurements and co-authored a conference paper
- Supervisors: Daniel Work, PhD. & George Gunter (PhD Candidate)

### Virtual-Thermal-Fluids LLC

*Lubbock, TX, USA*

Business Development Intern — *Aug.– Dec. 2019*

- Conducted primary market research for commercialization of our consultation services for a National Science Foundation-funded program
- Developed data-driven strategies to explore emerging markets by implementing Web Scraping algorithms in Python with BeautifulSoup and creating visualizations using Tableu
- Prepared and led presentations to pitch our company raising $50000 in series A funding

## Seminars, Poster Presentations & Conference Talks

| | | |
|---|---|---|
| 2021 | **Physics Departmental Colloquium**, *invited* | *Lubbock, USA* |
| 2020 | **SPS and Women In Physics (WiP) Introduction to Programming**, *speaker* | *Lubbock, USA* |
| | **Departmental Poster Competition, Department of Physics and Astronomy, TTU** | *Lubbock, USA* |
| | **Quantum 2020 (Institute Of Physics) Virtual Conference** | *Virtual* |
| | **Summer Showcase! at the Institute for Software Integrated Systems** | *Tennessee, USA* |
| | **International Symposium on Transportation Data and Modeling (ISTDM)**, *postponed* | *Michigan, USA* |
| | **TTU Undergraduate Research Conference**, *Muon Tomography Talk* | *Virtual Conference* |
| | **TTU Undergraduate Research Conference**, *Autonomous Vehicle Model Poster* | *Virtual Conference* |
| 2019 | **Far West Section of American Physical Society (FWSAPS), Stanford University** | *Stanford, USA* |
| | **Texas Section of American Physical Society (TSAPS)** | *Lubbock, USA* |
| | **Departmental Poster Competition, Department of Physics and Astronomy, TTU** | *Lubbock, USA* |
| | **International Conference for Physics Students 2019, University of Köln** | *Köln, Germany* |
| 2018 | **Undergraduate Colloquium: Programming Principles**, *SPS TTU* | *Lubbock, USA* |

## Honors & Awards

| | | |
|---|---|---|
| 2017 – 2021 | **Texas Tech University Presidential Scholarship** | *Lubbock, TX, USA* |
| 2017 – 2021 | **Dean's Honor List**, *TTU* | *Lubbock, TX, USA* |
| 2020 | **Certification of Quantum Excellence**, *IBM Qiskit* | *International* |
| 2020 | **TrUE Undergraduate Scholar Project Fund**, *Center for Transformative Undergraduate Experiences, TTU* | *Lubbock, TX, USA* |
| 2020 | **Second Place for Best Undergraduate Presenter**, *Department of Physics and Astronomy, TTU* | *Lubbock, TX, USA* |
| 2020 | **C.C. Schmidt and Alma K. Schmidt Award in Physics**, *Physics and Astronomy Department, TTU* | *Lubbock, TX, USA* |
| 2018-2019 | **Bucy Undergraduate Scholarship Physics Award**, *Physics and Astronomy Department, TTU* | *Lubbock, TX, USA* |
| 2018-2019 | **Raiders Who Rock: Pursuit of Excellence Award**, *Office of Engagement and Transition, TTU* | *Lubbock, TX, USA* |
| 2019 | **Outstanding Student Presenter**, *Texas Section of APS* | *Texas, USA* |
| 2019 | **Best Poster Presenter**, *Department of Physics and Astronomy, TTU* | *Lubbock, TX, USA* |
| 2019 | **Certified Tutor, Level II**, *College Readiness and Learning Association (CRLA)* | *International* |
| 2019 | **Honorable Mention: Best Undergraduate Poster Presenter**, *Far West Section of APS, Stanford University* | *Stanford, CA, USA* |
| 2019 | **TrUE Undergraduate Scholar Project Fund**, *Center for Transformative Undergraduate Experiences, TTU* | *Lubbock, TX, USA* |
| 2019 | **TrUE Travel Funds Award**, *Center for Transformative Undergraduate Experiences, TTU* | *Lubbock, TX, USA* |
| 2018 | **Silver Medal**, *University Physics Competition (UPhysC)* | *International* |
| 2017 | **Gangapadhaya Physics Scholarship Award**, *Department of Physics and Astronomy, TTU* | *Lubbock, TX, USA* |
| 2017 | **Glen Mann Physics Scholarship Award**, *Department of Physics and Astronomy, TTU* | *Lubbock, TX, USA* |

## Leadership & Involvement

**Sigma Pi Sigma Physics Honor Society** — *North America*
Member — *2020-Present*

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

**PrivaC Female Only Virtual Hackathon** — *Bangladesh*
Team Mentor — *2020*

**RaiderHacks** — *Texas, USA*
Member and Representative — *2019*

**National Science Foundation (NSD) Regional Innovation Corporations (I-Corps) Program** — *Texas, USA*
Entrepreurial Lead — *2019*

**Free Market Institute** — *Texas, USA*
McLane Political Economy Scholar — *2018 - 2019*

**College of Arts & Sciences, TTU** — *Lubbock, USA*
Student Ambassador — *2018-2019*

**Society of Physics Students (SPS)** — *Lubbock, USA*
Public Relations Officer (TTU Chapter) & Member — *2017-2019*

**The Quark Newsletter, SPS** — *Lubbock, USA*
Officer in Charge — *2018-2019*

**Alpha Lambda Delta & Phi Eta Sigma Honor Society (ALD/PES)** — *Lubbock, USA*
Social Coordinator Officer (TTU Chapter) — *2018-2019*

**Undergraduate Colloquium Series, SPS** — *Lubbock, USA*
Initiator and Organizer — *2018*

**Red Raider Orientation, TTU** — *Lubbock, USA*
Orientation Crew Leader — *2018*

**Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS)** — *Lubbock, USA*
Vice President (TTU Chapter), Recruitment Chair & Member — *2017-2018*

# Projects

### Senior Capstone Project: Quantum Optimization Algorithms

*Lubbock, TX, USA*

**Research Project** *Apr. 2020 – Present*

- Conducting research work done under the supervision of Dr. Ismael Regis de-Farias in collaboration with National Laboratory of Scientific Computing (LNCC) of Brazil
- Implemented methods to calculate Hilbert-Schmidt-Product and decompose any given square matrix into sum of Pauli matrices
- Created a computational framework for testing Variational Quantum Eigensolver (VQE) Algorithms
- Initiated a study to explore the dynamics of changing each component - *Hermitian matrix type, variational form, circuit depth* and *optimizer* - used in the VQE routine by conducting sensitivity analyses on two performance metrics – time taken to solve the problem and accuracy of the solution
- Presently conducting literature review of Quantum Computing applied to Chemistry

### Setting Up *Kim* Lab and FDTD Analysis of Silicon Carbide (SiC) Permittivity

*Lubbock, TX, USA*

**Research Project** *Nov. 2019 – Apr. 2020*

- Collaborated with University of Texas, Rio Grande Valley to conduct experiments and record the permeability value of SiC
- Verified the recorded data by simulating a 2D FDTD implementation of the experimental condition
- Volunteered in setting up *Kim* lab for Infrared optics & polarimetry for novel quantum system and nanostructures
- Supervisor: Myoung-Hwan Kim, PhD.

### Geometric Optics: Modelling Scalar Irradiance of light sources under water

*Lubbock, TX, USA*

**Research Project** *Aug. 2018 – May. 2019*

- Assisted Masud (Math PhD candidate) with his thesis by accepting to take on one of his problems as my project
- Created a mathematical model for the downwards scalar irradiance of light from first principles
- Discovered that the derived model is exponentially more accurate than the traditional model of Lambert-Beer at optical densities greater than 0.4 in the context of water bodies.

### Web Application for a Health Care System

*Lubbock, TX, USA*

**Academic Project:** ***Software Engineering 1*** *Sept. 2020 – Present*

- Developed the static model for the healthcare system
- Documented the interaction model that depicts objects participating in each use case and the sequence of interactions among the objects
- Designed database tables to store information about appointments, patient charts, payments, and reports in the healthcare system.
- Implemented the program in JAVA using XXX libraries

### Design and Implementation of AI used in Bang! The Dice Game

*Lubbock, TX, USA*

**Academic Project:** ***Object Oriented Programming*** *Apr. 2020 - May 2020*

- Utilized ideas of Probabilistic State Vectors and Unitary Evolutions from Quantum Mechanics to model AI behavior for Bang! the Dice Game
- Implemented concepts Markov Decision Processes (MDP) to simulate AI gameplay with a Human user
- Documented, debugged and conducted various test cases to ensure AI reliability and robustness

### Dynamics of a laser propelled nanocraft on a fly by mission to Proxima Centauri B

*Lubbock, TX, USA*

**Physics Competition Project** *Nov. 2018*

- Modelled the design and trajectory needed for a light sail propelled nanocraft to the nearest star system Alpha Centauri in order to perform a flyby of Proxima Centauri b subject to various constraints defined by the University Physics Competition Committee
- Co-authored a research paper addressing the problem uder 48 hours as per the guidelines of the competition
- Won the Silver Medal for our efforts

# Technological Skills and Languages

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|---|---|
| **Human Spoken Languages** | Bengali (native), English (bilingual), Hindi (intermediate), Urdu (intermediate) |
| **Programming** | Python, C++, C, JAVA, Mathematica, Matlab, R, Julia, Bash, TEX, Dart, Swift |
| **Operating System** | MAC OS, Linux, Raspbian, Windows 10 |
| **Data Analysis** | Numpy, Scipy, SymPy, Matplotlib, Ray, Vaex, Modin, Pandas, StatsModels, Seaborn, BeautifulSoup |
| **Machine Learning** | Tensorflow, Keras, SciKit Learn, Pytorch, Open AI Gym |
| **Quantum Computing** | Qiskit, PyQuil, PennyLane, Microsoft QDK, Forest SDK |
| **High-Energy/Particle Physics** | CERN Geant4, CERN Root, PyROOT, CAMAC System Analysis |
| **Digital Electronics** | LTspice, Vivado Design Suite, KiCad |
| **Microcontrollers** | Arduino, Raspberry Pi, Basys 3, Iconikal Rockchip RK3328 |
| **3D Modelling** | Inventor, Blender |
| **Database** | SQLite, MySQL |
| **Management** | Git, Yarn/NPM, Apache |
| **Web** | HTML5, CSS, JS (React), nodeJS |

# Training

## Summer schools

| | | |
|---|---|---|
| Sept. 2020 | **Summer School on Machine Learning and Big Data with Quantum Computing (SMBQ)**, University of Porto & Polytechnic Institute of Porto | *Virtual* |
| Jun. - Aug. 2020 | **Lunch and Learn Lecture Series**, Cyber-Phyical Systems Virtual Organisation (CPS VO) | *Tennessee, USA* |
| Jul. 2020 | **Qiskit Global Summer School**, IBM | *International* |

## Workshops

| | | |
|---|---|---|
| In Process | **ALD Leads Certified: Leadership Program**, Alpha Lambda Delta Honor Society | *Virtual* |
| Nov. 2020 | **Quantum Week of Fun**, Cambridge Quantum Computing | *Virtual* |
| Sept. 2020 | **Introduction to Parallel Computing**, TTU High Performance Computing Center (HPCC) | *Texas, USA* |
| Sept. 2020 | **Basic Programming for Quantum Machine Learning**, National Institute for Theoretical Physics | *Virtual* |
| Virtual | **A Progress Report from the Wolfram Physics Frontier**, Neural Engineering Research Venture (NERV) | |
| Jul. 2020 Jun. 2020 | **Cybersecurity Basics Training**, TTU | *Texas, USA* |
| Nov. 2019 | **Career in Physics Workshop**, Stanford University | *California, USA* |
| Oct. 2020 | **Customer Discovery and the Business Model Canvas for STEM innovations**, TTU Innovation Hub | *Texas, USA* |
| Oct. 2018 | **Red Raider Startup Program**, TTU Innovation Hub | *Texas, USA* |

## Hackathons

| | | |
|---|---|---|
| Mar. 2020 | **Hacklahoma 2020**, Major League Hacking (MLH) | *Oklahoma, USA* |

# Outreach & Community Service

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|---|---|---|
| 2020 - Present | **Training and Professional Development Workshops**, WiP | *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* |
| 2019 | **Research Carnival Presentation**, APDL | *Lubbock, TX, USA* |
| 2019 | **College of Arts & Sciences Events**, Student Ambassador | *Lubbock, TX, USA* |
| 2017 - 2019 | **Multiple Fund Raisers**, SPS | *Lubbock, TX, USA* |
| 2018-2019 | **Multible Member Social Events**, ALD/PES | *Lubbock, TX, USA* |
| 2018-2019 | **Study Hall Monitoring and Organizing**, ALD/PES | *Lubbock, TX, USA* |
| 2017 - 2018 | **Volunteering at the Science Spectrum and OMNI Theatre**, SACNAS | *Lubbock, TX, USA* |
| 2017 - 2018 | **Astronomy Day at the Moody Planetarium**, SPS | *Lubbock, TX, USA* |
| 2018 | **Fund Raiser at Top Tier Catering**, SACNAS | *Lubbock, TX, USA* |
| 2018 | **Undergraduate Colloquium Organizing**, SPS | *Lubbock, TX, USA* |
| 2018 | **Grad Students 2 Undergrad Research Party Organizing**, SACNAS | *Lubbock, TX, USA* |