Muhammad Asaduzzaman
Email: masaduzz@syr.edu, Cell: +13154364229

EDUCATION

Syracuse University, Syracuse, NY, 13210, US.

- Ph.D. candidate, Department of Physics, August 2016 to present.
  - GPA: 3.89/4.0
  - Thesis supervisor: Dr. Simon Catterall

University of Dhaka, Dhaka, Bangladesh.

- M.Sc., department of theoretical Physics, March, 2016.
  - GPA: 3.53/4.0
  - Thesis supervisor: Dr. Golam Mohammed Bhuiyan

Bangladesh University of Engineering & Technology, Dhaka.

- B.Sc., Electrical and Electronic Engineering, February 2013.
  - GPA: 3.80/4.0

INTERNSHIP EXPERIENCE

- **Argonne National Lab** (**ANL**), Research Aide, computational science division
  - May 25 to August 14, 2020.
  - Supervisor: Xiao-Yong Jin, James C. Osborn
- **CERN**, ALICE collaboration
  - June 29 to August 21, 2015.
  - Supervisor: Andreas Morsch

SELECTED TALKS

- Scalar fields on fluctuating hyperbolic geometries
  - APS April meeting, 2021.
- Fields in fluctuating hyperbolic space
  - Lattice 2021, the 38th Symposium on the lattice field theory

TEACHING EXPERIENCES

- Part-time faculty: Physics 211- General Physics-I., Summer-2017 session, department of Physics, Syracuse University.
- Teaching assistant, department of Physics, Syracuse University, Fall 16-20, Spring 17-19.
- Lecturer, *January 2014 to July 2016*, Dept. of Electrical and Electronics Engineering, Presidency University, Dhaka, Bangladesh.

ACADEMIC HONORS

- **Research Excellence Doctoral Funding** (REDF) fellowship, academic year 2021-2022, Syracuse University
- 2017 Levinstein Fellowship for **outstanding junior graduate student**, department of physics, Syracuse University
- Completed undergraduate studies with honors
- 'Dean's List Scholarship' during undergraduate studies
- 'University Merit Scholarship' for the first year in the undergraduate study

COMPUTER SKILLS

- **C & C++**: I have been working on discrete models for quantum gravity based on dynamical triangulations for more than two years. The idea is to approximate a path integral for the 4D metrics using an ensemble of 4D simplicial complexes. I developed C++ code implementing cluster Monte Carlo algorithm and Metropolis algorithm, which can be used in arbitrary dimensions. I also wrote a C code for large sparse matrix inversion using CHOLMOD. In addition, I used these programming languages in multiple projects during my undergraduate, for example, in digital communication laboratory and microprocessor and interfacing laboratory.

- **HT condor:** I performed high-throughput (HT condor) computing for my 4D gravity project and lattice holography projects.

- **Bash and Python scripting**: I have been using scripting extensively in different graduate research projects, including the holography projects and the lattice quantum gravity project. For example, I have written a Python routine to extract geometry information of the hyperbolic tessellations, a routine for correlated data-fitting, and a matrix inversion routine.

- **Mathematica**: I used Mathematica for Fisher zero analysis for finite-size scaling of a 2d gauge theory formulation of gravity, for the quantum information science project during my internship at ANL and for the project in the 'mathematical methods' course during my Ph.D.

- **QISKIT**: I gained preliminary knowledge of quantum circuit simulation during my summer internship at ANL. I am currently implementing quantum circuits for a SO(4) invariant fermionic model.

- **Java**: I have some experience working with java code. I wrote some parts of a java code that shows an animation of the evolution of the geometry in the dynamical triangulation simulation of the manifolds.

- **Logic design**: I have experience in working with digital logic design circuits. Designed a 4-bit computer that was capable of doing more than ten logic and arithmetic operations. The project was assigned in the Microprocessor and Interfacing course in my undergraduate studies.

- **MATLAB**: I have experience in MATLAB scripting and using the different toolbox of MATLAB, including filter design for electric circuits. Among several projects, one of them was to calculate the potential of a 2d surface for a shielded microstrip line using Finite Element Methods for the Numerical Methods Laboratory course during my undergraduate studies. I also implemented several error correction algorithms in the digital communication course.

RESEARCH INTERESTS

- quantum computation of fermionic and gauge theory models: currently investigating SO(4) invariant fermionic model with four fermi interaction
- tensor network renormalization algorithms
- quantum many-body physics
- open quantum systems, quantum error correction, quantum simulation with Rydberg atoms
- high energy physics application of quantum information science
- non-perturbative quantization of gravity, AdS-CFT correspondence
- standard model, physics beyond standard model

PUBLICATION

Orcid-ID 0000-0001-7559-3873

1. **Tensor network formulation of two-dimensional gravity**; Muhammad Asaduzzaman, Simon Catterall and Judah Unmuth-Yockey; Phys. Rev. D 102, 054510 (September, 2020) https://link.aps.org/doi/10.1103/PhysRevD.102.054510
2. **Holography on tessellations of hyperbolic space**; Muhammad Asaduzzaman, Simon Catterall, Jay Hubisz, Roice Nelson and Judah Unmuth-Yockey; Phys. Rev. D 102, 034511 (August, 2020) https://link.aps.org/doi/10.1103/PhysRevD.102.034511
3. **Lattice Gauge Theory and Two Dimensional Quantum Gravity** Muhammad Asaduzzaman, Simon Catterall,and Judah Unmuth-Yockey; PoS LATTICE2019 (2020), 043. https://pos.sissa.it/363/043
4. **Holography for Ising spins on the hyperbolic plane**; Muhammad Asaduzzaman, Simon Catterall, Jay Hubisz, Roice Nelson and Judah Unmuth-Yockey; arXiv:2112.00184 [hep-lat]. https://arxiv.org/abs/2112.00184
5. **Scalar fields on fluctuating hyperbolic geometries** Muhammad Asaduzzaman, Simon Catterall; prepared for lattice proceedings, 2021; arXiv: 2112.00927 [hep-lat]. https://arxiv.org/abs/2112.00184
6. **4D gravity with combinatorial triangulation**; Muhammad Asaduzzaman, Simon Catterall; *Under preparation*

THESIS

- M.Sc. Thesis: *Thermodynamic Properties of Bose Gas Under Mean Field Potential in d-Dimension*
- B.Sc. Thesis: *A Density Functional theory study of strain induced bandgap tuning in Bilayer Graphene Nanoribbon and Schottky Barrier Formation in Carbon Nanotube-Pd Metal Contact*

RELEVANT WORKSHOPS

- Snowmass 2021 Workshop on Quantum Computing for High-Energy Physics, Dec 1-3, 2021.
- Quantum Simulation of Strong Interactions (QuaSI) Workshop 2 : Implementation Strategies for Gauge Theories, June 01-07,2021.
- Tensor Networks: from Simulations to Holography III, Nov 11-16, 2020

GRANT WRITING EXPERIENCE

- Azure Quantum Credits Program, project: "Investigation of SO(4) Four Fermi model"

MEMBERSHIP AND LEADERSHIP EXPERIENCE

- Graduate student member, American Physical Society, July 2017-August 2022
- Member, Foundation of quantum computing for gauge theories and quantum gravity, The QuLat Collaboration, July 2020-present.
- President, Satyen Bose Science Club, Bangladesh University of Engineering & Technology, 2011 (6 months).
- Founder and former lecturer of 'Matrix', an organization to train up students at higher secondary schools for Mathematics Olympiad in Bangladesh

REFERENCES

Dr. Simon Catterall
Department of Physics
Syracuse University
Crouse Dr, Syracuse, NY 13210
smcatter@syr.edu, smcatterall@gmail.com

Dr. Yannick Meurice
Department of Physics & Astronomy
University of Iowa
203 Van Allen Hall Iowa City, Iowa 52242-1479
yannick-meurice@uiowa.edu

Dr. Jay Hubisz
Department of Physics
Syracuse University
Crouse Dr, Syracuse, NY 13210
jhubisz@syr.edu