Sam Foreman

samforeman.me | saforem2 | Sam Foreman

Education

University of Iowa
Iowa City, IA

PhD. Physics — *2015—2019*

- Dissertation: ***Learning Better Physics: A Machine Learning Approach to Lattice Gauge Theory***

University of Illinois at Urbana-Champaign
Champaign, IL

B.S. Engineering Physics — *2010—2015*

- Dissertation: ***Energy Storage in Quantum Resonators***

University of Illinois at Urbana-Champaign
Champaign, IL

B.S. Applied Mathematics — *2010—2015*

Experience

Argonne National Laboratory
Leadership Computing Facility (ALCF)

Postdoctoral Research Associate — *2019 – Current*

- Active member of the data science group
  - Responsible for building, testing, documenting, and maintaing current ML frameworks and libraries across LCF's various supercomputing clusters (e.g. **Theta/ThetaGPU**)
  - Presentation on **Hyperparameter Search Using DeepHyper on Theta** at the *ALCF: Simulation, Data, and Learning Workshop for AI*
  - Presentation on **Scaling Deep Learning Applications** *(recording)* at the the *2021 Computational Performance Workshop*
  - Lead and contribute to discussions in our journal club, most recently presented on **Switch Transformers**
- Designed and implemented novel network architectures to improve current sampling techniques for Lattice QCD
- Extensive development (sole author) on **l2hmc-qcd**, a python library for distributed, data-parallel training, tracking, and testing of different generative models for sampling in lattice gauge models
  - Shown to provide **~100** $\times$ speedup compared to current methods
  - Ongoing work to scale up to full Lattice QCD

Argonne National Laboratory
Computational Sciences Division

Graduate Research Fellow — *2018 — 2019*

- Software development focused on applying machine learning models to help improve the efficiency of Hybrid Monte Carlo simulations and their use in Lattice QCD
- Built and deployed custom ML models on some of the world's fastest supercomputers (Theta/ThetaGPU) using state-of-the-art high-performance computing techniques

University of Iowa
Department of Physics & Astronomy

Research Assistant — *2016 — 2017*

- Software and hardware development for HaloSat, a nanosatellite built with the goal of better understanding the missing baryon problem
- Implemented a variety of in-flight optimization algorithms aimed at maximizing the incoming X-ray signals (by minimizing background noise) while in operation

University of Illinois
Center for Complex Systems Research

Research Assistant — *2011 — 2015*

- Actively maintained the legacy code base (C++ / MATLAB) for our research group and was in charge of quality analysis of new contributions
  - Co-inventor on a patent (pending) titled "Energy Storage in Quantum Resonators"

Publications & Talks

- **S. Foreman,** invited talk on **Training Topological Samplers for Lattice Gauge Theories** at ML for HEP, on and off the Lattice ECT*–Trento, Sep 2021
- **S. Foreman,** X.Y. Jin, & J.C. Osborn, **LeapFrogLayers: A Trainable Framework for Effective Topological Sampling**, *Lattice*, 2021
- **S. Foreman,** L. Jin, X.Y. Jin, A. Tomiya, J.C. Osborn, & T. Izubuchi, **HMC with Normalizing Flows**, *38th Intl. Symposium on Lattice Field Theory*, 2021
- **S. Foreman,** invited talk on `l2hmc-qcd` at the *MIT Lattice Group Seminar*, 2021
- **S. Foreman,** invited talk on **Deep Learning HMC for Improved Gauge Generation** to the *Machine Learning Techniques in Lattice QCD Workshop,* 2021
- **S. Foreman,** X.Y. Jin & J.C. Osborn, **Deep Learning Hamiltonian Monte Carlo**, *SimDL Workshop ICLR,* 2021
- **S. Foreman,** X.Y. Jin, & J.C Osborn, **Machine Learning and Neural Networks for Field Theory** *SnowMass,* 2020
- **S. Foreman,** invited talk on **Machine Learning for Lattice QCD** at the *University of Iowa,* 2020
- **S. Foreman,** contributed talk **Machine learning inspired analysis of the Ising model transition** to *36th Intl. Symposium on Lattice Field Theory,* 2018
- **S. Foreman,** Y. Meurice, J. Giedt & J. Unmuth-Yockey, **Examples of renormalization group transformations for image sets** *Physical Review E.*, 2018
- **S. Foreman,** invited talk on **Machine Learning Analysis of Ising Worms** at *Brookhaven National Laboratory*, 2017
- **S. Foreman,** J. Giedt, Y. Meurice & J. Unmuth-Yockey, **RG inspired Machine Learning for lattice field theory** *arXiv:1710.02079,* 2017
- A. Hubler, **S. Foreman,** J. Liu, & L. Wortsmann, **Large Energy Density in Three-Plate Nanocapacitors due to Coulomb Blockade** *J. Appl. Phys*, 2018