Sam Foreman

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Education

PhD. Physics — University of Iowa
Learning Better Physics: A Machine Learning Approach to Lattice Gauge Theory — *2015—2019*

B.S. Engineering Physics, B.S. Applied Mathematics — Univ. of Illinois at Urbana-Champaign
Energy Storage in Quantum Resonators — *2010—2015*

Experience

Argonne National Laboratory — Leadership Computing Facility (ALCF)
Postdoctoral Research Associate — *2019 — Current*

- Data science group
  - Responsible for building, testing, and documenting current ML frameworks and libraries on modern HPC infrastructures
  - Presentation on **Hyperparameter Search Using DeepHyper on Theta** @ *ALCF: Simulation, Data, and Learning Workshop*
  - Presentation on **Scaling Deep Learning Applications** *(recording)* @ *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 for simple models

Argonne National Laboratory — Computational Sciences Division
Graduate Research Fellow — *2018 — 2019*

- Recipient of the DOE Office of Science Graduate Student Research Program
- Software development focused on applying machine learning models to help improve the efficiency of Hybrid Monte Carlo simulations
- Developed techniques for efficiently scaling ML models on next generation HPC infrastructures

University of Iowa — Department of Physics & Astronomy
Research Assistant — *2016 — 2017*

- Software and hardware development for HaloSat, a nanosatellite built to help the missing baryon problem
- Implemented a variety of in-flight optimization algorithms to maximize the signal-to-noise ratio while in operation
- Helped to write and test telemetry system using VERILOG and XILINX.

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"
- Constructed a model capable of describing the energy density and self-discharge time of nanoscale capacitors

Publications & Talks

- **S. Foreman,** invited talk on **Accelerated Sampling Methods for Lattice Gauge Theory** at BNL-HET & RBRC Joint Workshop "DWQ @ 25", Dec 2021
- **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