Luke Kelley

PhD Astrophysics, Harvard University

LZKelley@gmail.com | +1(510)325–5830 | www.LZKelley.com

Resume
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Professional Summary

Accomplished computational scientist and software engineer with a proven ability to engineer scalable simulation frameworks, optimize software systems, and extract insights from massive datasets. Effective communicator of complex technical concepts to audiences of engineers, executives, and non-technical stakeholders. Valued for fostering collaboration, mentoring talent, and leading cross-functional teams to achieve ambitious goals. Passionate about solving challenging & open-ended problems, and obsessed with learning & understanding complex systems.

Technical Skills

- **Simulations:** Designing & building end-to-end pipelines for the simulation of complex, multi-scale physical systems. Developing numerical solutions to coupled, non-linear differential equations (fluid dynamics, magnetohydrodynamics & semi-analytic models) w/ finite-mesh, finite-volume & Monte-Carlo discretizations.
- **Data Analysis & Visualization:** Processing high-dimensionality datasets (100+ TB) using statistical modeling, hierarchical Bayesian inference, Markov-chain Monte-Carlo.
- **Statistics:** Bayesian & frequentist, probability distributions & sampling, maximum-likelihood estimation & measurement theory, stochastic processes, causal analysis, hypothesis testing & model comparison, correlation & regression, Gaussian processes & kernel density estimation.
- **Machine Learning**: feature generation, classification, basic neural networks with TensorFlow, simulation-based inference & normalizing flows.
- **Parallelization:** multithreading & multiprocessing w/ OpenMP & Open MPI on 100s–1000s of cores.
- **Software Development:** Designing, building & optimizing large high-performance codebases closely interfaced with complex data systems. Extensive experience with version control (SVN & git), and continuous integration systems (tox, travis, jenkins, etc). Comfortable with gnu make, cmake, and conda build systems.
- **Programming Languages:** Python/Cython, C, C++; *some:* Verilog, Java, Javascript/HTML.

Selected Experience

Research Scientist, Dept. of Astronomy, UC Berkeley 2022 – present

- Awarded $2M+ in competitive grants/fellowships, including NASA and National Science Foundation (NSF), to complete research programs based on large-scale physical simulations and data-analysis pipelines.
- Completed dozens of technical projects individually and by leading cross-functional teams of engineers & scientists at career stages with 0–20 yrs experience (undergraduate, graduate, & postdoctoral).

Leader of Astrophysics Working Group, NANOGrav Scientific Collaboration 2020 – present

- Led efforts in one of four key working groups (70+ personnel) in international collaboration (300+ people).
  - Coordinated technical milestones and research deliverables as part of NSF Physics Frontier Center ($17M).
- Led flagship computational analysis of the first-ever detection of low-frequency gravitational waves.
  - Designed & engineered 10k+ line simulation/modeling/analysis pipeline, & processed 100+ TB of data.
  - Developed parallelization techniques producing 100x speedup in simulations.
  - Developed data compression and importance sampling methods reducing data volumes by 10x.

Postdoctoral Fellow, Dept. of Physics & Astronomy, Northwestern University 2018 – 2022

- Developed accurate software simulations of complex physical processes (galaxy and black-hole mergers), and analysis frameworks for causal inference of massive datasets.
  - Non-parametric reconstruction of high-dimensional distributions from sparsely sampled data,
  - Hierarchical Bayesian statistical analysis comparing experimental datasets with theoretical predictions.
- Developed computational fluid dynamic (including magnetohydrodynamic) models of accreting systems.

Leadership & Communication Skills

- **Team Leadership**: Directed multidisciplinary teams composed of graduate students, postdoctoral researchers, senior scientists, and administrators to complete objectives and achieve results on tight deadlines.
- **Strategic Vision & Organization**: Proposed, led, and delivered high-impact projects from start to finish, transforming the field. Managed multiple simultaneous projects by setting strategic benchmarks, aligning deliverables, and coordinating efforts across international teams while reporting progress to key stakeholders.
- **Technical writing**: 80+ peer-reviewed papers (8,000+ citations), including 12 first-author publications.
- **Communication**: Delivered 50+ invited talks at leading institutions (e.g., Caltech, MIT, Princeton) & 20+ international conferences. Presented results in public forums simplifying complex ideas for technical & non-technical audiences, including a televised NSF press conference. Regularly lead weekly team meetings, and present oral and written updates for collaboration executives & funding agency representatives.