Lucas Kotz

lucaskotz.com
lucas-kotz
lucaskotz
lucaskotz@protonmail.com
+1 (516) 668-1741

PROFESSIONAL SUMMARY

Data science-orientated physicist with 4+ years of doctoral experience in computational modeling, statistical analysis, and high-performance computing, seeking to apply advanced analytical and software development skills to data science roles in research-driven environments. Proficient in C++, Python, and Fortran.

- Rapidly acquired and applied expertise in complex theoretical frameworks and scientific computing tools, demonstrating adaptability across multiple programming languages and modeling domains.
- Communicated complex research findings to diverse audiences — from specialists to non-technical stakeholders — at international conferences and workshops.
- Applied advanced problem-solving and critical thinking to define research objectives, develop computational strategies, and collaborate effectively in interdisciplinary, data-driven teams.

WORK EXPERIENCE

Doctoral Researcher - Southern Methodist University (SMU)

June 2021 - May 2025

- Designed and deployed C++ tools for advanced statistical modeling, including parameter estimation, Bézier curve parameterization, uncertainty quantification.
- Validated and improved models using Bayesian inference, Hessian analysis, Monte Carlo methods, sensitivity analyses, and data visualizations.
- Presented technical research to audiences ranging from non-technical to expert, showcasing strong communication and adaptation skills.
- Independently managed projects while proactively collaborating with peers, initiating communication to ensure project alignment and progress.
- Kept up to date with emerging advances in high-energy physics by regularly reviewing recent publications, preprints, and conference proceedings to inform ongoing research.

Teaching Assistant - SMU

Aug 2019 - May 2021

Provided comprehensive support to undergraduate students with varying backgrounds and specializations who enrolled in introductory physics courses (classical mechanics, electromagnetism, cosmology) in both lab and classroom settings, including:

- Guided collaborative problem-solving and critical thinking exercises for lab groups of 3 within classes of up to 27 students.
- Instructed laboratory techniques and ensured safety for up to 27 students per lab.
- Tutored individual students and groups, and led after-hours sessions for any undergraduate students taking physics courses.
- Evaluated assignments, exams, and projects, providing detailed feedback for classes of up to 50 students.

PROJECT LIST

Advanced parameterization for uncertainty quantification

Languages: C++, Fortran, Wolfram Language — Tools: xFitter, Make, Custom Headers, Wolfram Mathematica

- Improved modeling of pion structure by engineering a C++ module for an open-source theoretical model fitting framework and implementing Bézier curve parameterizations.
- Enhanced uncertainty coverage by 50-300% compared to traditional methods by utilizing Bayesian inference to fit Bézier curves to experimental datasets.
- Validated C++ results against Wolfram Mathematica.
- Produced a published paper, and two forthcoming papers.

Analysis of dataset influence on theoretical models

Tools: mp4lhc, Data Visualization — Key Concepts: Correlation between model uncertainties and residuals

- Quantified and visualized dataset sensitivity for parton distribution function validation.
- Reduced dataset impact analysis time from weeks/months to hours by pioneering a novel approach.
- Produced a sole-author paper.

Personal machine learning examples

Languages: Python — Tools: Jupyter Notebook, pandas, numpy, TensorFlow, Sklearn, publicly available data

- **Email spam**: Trained a logistic regression model to classify emails as spam or not using publicly available datasets. Evaluated model performance with a confusion matrix. Identified top spam indicators by analyzing the model's coefficients.
- **Signal analysis**: Processed time-series data from simulated current and magnetic field sensor readings. Parameterized the current signal using curve fitting to model its behavior over time. Estimated signal gain by analyzing relationships between magnetic field measurements and modeled current. Applied data science techniques to extract meaningful features and interpret system dynamics.
- **DFW house price prediction**: Developed and evaluated predictive models—including decision trees, linear regression, and neural networks—using publicly available data to estimate average home prices based on features such as bedrooms, bathrooms, living area (sqft), and lot size. Assessed model performance and conducted comparative analysis using current housing listings.

TECHNICAL SKILLS

Programming Languages

C++, Python, Fortran, Bash scripting, Make, and LaTeX.

Statistical Modeling & Analysis

Bayesian inference, Monte Carlo simulations, chi-square minimization, Gaussian models, dataset sensitivities, parameter estimation, uncertainty quantification, machine learning, large-scale dataset analysis.

Tools & Platforms

Wolfram Mathematica, Jupyter Notebooks, SQL, CERN ROOT, MATLAB, Visual Studio Code.

Other Systems & Workflow

Linux, Git, High-Performance Computing (HPC), SLURM, debugging tools (gdb, ddd), technical documentation, recreational wargame hobbyist.

Wargaming Simulation Mechanics

Experienced in tabletop and digital/computer-based strategic wargames (e.g., Warhammer series and related spin-offs) as well as custom ruleset creation. Skilled in force composition analysis, probabilistic combat resolution, terrain and resource utilization, and scenario-based strategic decision-making.

SELECTED PUBLICATIONS

1. L. Kotz, A. Courtoy, P. Nadolsky, F. Olness and M. Ponce-Chavez, *Analysis of parton distributions in a pion with Bézier parameterizations*, *Phys. Rev. D* **109** *(2024) 074027*, [arXiv:2311.08447].
2. L. Kotz, *A study of experimental sensitivities to proton parton distributions with xFitter*, [arXiv:2401.11350].
3. L. Kotz, A. Courtoy, P. Nadolsky, and M. Ponce-Chavez, *Fantômas: epistemic and nuclear uncertainties for the parton distributions of the pion*, [arXiv:2505.13594].
4. L. Kotz, A. Courtoy, T. J. Hobbs, P. Nadolsky, F. Olness, M. Ponce-Chavez, and V. Purohit, *Fantômas Unconfined: global QCD fits with Bézier parameterizations*, [arXiv:2507.22969].

EDUCATION

Southern Methodist University (SMU), Dallas, TX

Ph.D. in Physics, *May 17 2025* — Dean's Dissertation Fellowship

M.S. in Physics, *January 2022*

University at Buffalo (UB), Buffalo, NY

B.S. in Physics, *May 2019*

REFERENCES

Can be provided upon request.