JOHANN **BREHMER**, PHD

Machine learning and physics researcher

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EXPERIENCE

Qualcomm AI Research — from 01/2021
Deep learning research engineer, staff — Amsterdam, Netherlands

Center for Data Science, New York University — 09/2017 – 12/2020
Moore-Sloan postdoctoral researcher — New York, USA

- Developed machine learning algorithms for statistical inference in models described by computer simulations and turned them into a open-source Python library with a growing user base
- Applied this research to particle physics and astrophysics problems, enabling up to 90% more efficient measurements of the fundamental properties of nature
- Designed a new type of flow-based generative neural network that leverages the manifold structure in many datasets, improving the state-of-the-art performance
- Led interdisciplinary and international research teams, supervised students, managed projects from idea to publication / release

Heidelberg University — 07/2014 – 08/2017
Graduate research and teaching assistant — Heidelberg, Germany

- Made sensitivity forecasting, feature selection, and experimental design in particle physics experiments more efficient by developing statistical metrics based on information geometry and Monte-Carlo algorithms
- Analyzed theoretical models of the newly discovered Higgs boson
- Taught undergraduate and graduate physics students

CERN — 06/2012 – 09/2012
Summer student — Geneva, Switzerland

- Won the prestigious CERN summer student programme scholarship
- Designed and deployed a neural network-based signal-noise classifier for the LHCb experiment, which made hundreds of studies more efficient

EDUCATION

PhD (Dr. rer. nat.) in Physics	Heidelberg University, Germany	summa cum laude*	07/2014 – 08/2017
Master of Science in Physics	Heidelberg University, Germany	1.0*	02/2012 – 06/2014
Bachelor of Science in Physics	Heidelberg University, Germany	1.0*	09/2008 – 02/2012
Visiting student	Imperial College, London, UK		09/2010 – 07/2011
Abitur	Ökumenisches Gymnasium, Bremen, Germany	1.0*	06/2007

*German grading scale: from 1.0 (best) to 6.0 (worst), PhD grades from summa cum laude (best) to rite (worst)

SKILLS

Programming:	Python, git, bash, Docker, SLURM; C++ basics
Libraries:	PyTorch, scikit-learn, NumPy, SciPy, pandas, Matplotlib; JAX basics, TensorFlow basics
Machine learning:	Deep learning (convolutional neural networks, graph neural networks), probabilistic and generative models (normalizing flows, VAEs), reinforcement learning, unsupervised learning, density estimation, anomaly detection
Statistics:	Likelihood-based methods, hypothesis tests, Bayesian techniques, MCMC, variational inference
Organizational:	Team leadership, project management, workshop / seminar organization
Communication:	Technical writing, LaTeX, data visualization, presentations to experts and non-experts, teaching
Languages:	German (native), English (fluent), Dutch (beginner)

PUBLICATIONS

Summary

- 29 publications overall, cited 2000 times — see bit.ly/jb-pub
- 13 first-author publications in top peer-reviewed journals and conferences including PRL, PNAS, and NeurIPS
- 5 peer-reviewed workshop papers at NeurIPS, ICML

Selected publications

- Johann Brehmer and Kyle Cranmer:
  "Flows for simultaneous manifold learning and density estimation"
  Neural Information Processing Systems (2020), arXiv:2003.13913
- Johann Brehmer, Gilles Louppe, Juan Pavez, and Kyle Cranmer:
  "Mining gold from implicit models to improve likelihood-free inference"
  Proceedings of the National Academy of Science 117 (2020), arXiv:1805.12244
- Kyle Cranmer, Johann Brehmer, and Gilles Louppe:
  "The frontier of simulation-based inference"
  Proceedings of the National Academy of Science (2020), arXiv:1911.01429
- Johann Brehmer, Felix Kling, Irina Espejo, and Kyle Cranmer:
  "MadMiner: Machine learning–based inference for particle physics"
  Computing and Software for Big Science 4 (2020), arXiv:1907.10621
- Johann Brehmer, Siddharth Mishra-Sharma, Joeri Hermans, Gilles Louppe, and Kyle Cranmer:
  "Mining for Dark Matter substructure: Inferring subhalo population properties from strong lenses with ML"
  The Astrophysical Journal 886 (2019), arXiv:1909.02005
- Johann Brehmer, Kyle Cranmer, Gilles Louppe, and Juan Pavez:
  "Constraining Effective Field Theories with Machine Learning"
  Physical Review Letters 121 (2018), arXiv:1805.00013
- Johann Brehmer, Kyle Cranmer, Felix Kling, Tilman Plehn:
  "Better Higgs Measurements Through Information Geometry"
  Physical Review D 95 (2017), arXiv:1612.05261
- Johann Brehmer, Ayres Freitas, David Lopez-Val, Tilman Plehn:
  "Pushing Higgs Effective Theory to its Limits"
  Physical Review D 93 (2016), arXiv:1510.03443

ACCOMPLISHMENTS

Talks:	16 invited talks (28 total) at international conferences / seminars Keynote speaker at ACAT 2019	see bit.ly/jb-talk
Software:	Lead developer of the open-source Python library MadMiner	see bit.ly/jb-madm
Leadership:	Organizer of workshops and seminars with up to 150 participants	
Reviewer:	NeurIPS, ICML, Nature Communications, PRL, ...	
Awards:	Spotlight, ICML workshop on Invertible NNs, Normalizing Flows & Explicit Likelihood Models Otto Haxel prize for best MSc thesis (out of 150) Prestigious German Studienstiftung scholarship (top 0.5% of all German students)	
Press coverage:	Physics, phys.org, Frankfurter Allgemeine Zeitung	

REFERENCES

- Prof. Kyle Cranmer, New York University, USA, kyle.cranmer@nyu.edu
- Prof. Gilles Louppe, University of Liege, Belgium, g.louppe@uliege.be
- Prof. Tilman Plehn, Heidelberg University, Germany, plehn@uni-heidelberg.de