

JACK COLLINS

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EMPLOYMENT

2019 – ... **Research Associate**, SLAC National Accelerator Laboratory, Stanford University
2016 – 2019 **Postdoctoral Researcher**, University of Maryland, College Park & Johns Hopkins University
2008 **Research Placement**, Defence Science and Technology Laboratory (dstl), Porton Down

PROJECTS

Representation Learning

- Built a variational autoencoder (VAE) using Python, TensorFlow, and TensorFlow Probability for generative modelling of collider physics events, represented as weighted point clouds. This VAE uses a novel optimal-transport based reconstruction loss which closely reflects the generative processes that give rise to the data.
- Introduced and studied novel probes of the information complexity of the learnt representations as a function of the resolution at which the data is probed, and how this relates to the underlying generative processes.

Anomaly Detection

- Introduced new strategies for searching for signatures of new physics in data from the Large Hadron Collider experiments. One strategy involved the training of classifiers on data with extremely noisy labels for which I investigated specialized techniques, tested empirically on simulated data which I generated using Monte-Carlo simulators. Coding was done using Python, Keras, and TensorFlow.
- My method was implemented in a search for new particles by the ATLAS experiment.

New Physics Searches at the LHC

- Used statistical techniques such as maximum likelihood estimation and hypothesis testing to constrain the existence of new particles and forces using data from the LHC and other experiments.
- Built mathematical models for such potential new particles and forces, and generated corresponding Monte-Carlo data for analysis using C++, Fortran, and Python.
- Tools used: Mathematica, C++, Fortran, Python.

EDUCATION

2011 – 2016 **Doctor of Philosophy (Ph.D.) in Physics**, Cornell University

2007 – 2011 **B.A./M.Sci. Natural Sciences (Experimental and Theoretical Physics)**, University of Cambridge

SKILLS

Languages: Python, C++, LaTeX

Libraries: Numpy, Scipy, Scikit-learn, TensorFlow & TF Probability, Keras

Software and tools: Mathematica, Git

SELECTED PUBLICATIONS

- [1] J.H. Collins, “*An Exploration of Learnt Representations of W Jets*”, Deep Generative Models for Highly Structured Data Workshop at the 10th International Conference on Learning Representations (2022), [arXiv:2109.10919]
- [2] J.H. Collins, K. Howe, B. Nachman, “*Anomaly Detection for Resonant New Physics with Machine Learning*”, Phys. Rev. Lett. (2018) 24, 241803, [arXiv:1805.02664].
- [3] J.A. Aguilar-Saavedra, J.H. Collins, R.K. Mishra, “*A Generic Anti-QCD Jet Tagger*”, JHEP 1711 (2017) 163, [arXiv:1709.01087].
- [4] A. Anandakrishnan, J.H. Collins, M. Farina, E. Kuflik, M. Perelstein, “*Odd Top Partners at the LHC*”, Phys. Rev. D93 (2016) 075009, [arXiv:1506.05130].