

Rob Verheyen

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KNOWLEDGE & RESEARCH INTERESTS

- Deep Generative Models

Normalizing flows; Variational autoencoders; Variational inference; Applications in particle physics

- Machine Learning in Particle Physics

Anomaly detection and event classification with graph neural networks and transformers

- Computing

Monte Carlo techniques; High-performance computing; Algorithm optimization

WORK EXPERIENCE

Co-Owner & Data Scientist

Jan 2023 - present

[Deconcern](#), The Netherlands

- Development of multimodal document understanding models to automate legislative audits of companies that use hazardous chemical compounds.
- Solely responsible for the complete pipeline of data collection and preprocessing, model development, training and deployment on cloud services like AWS and Azure.

Postdoctoral Researcher Theoretical high energy physics

Oct 2019 - Dec 2022

[University College London](#) / [University of Oxford \(visitor\)](#), United Kingdom

- Author and developer in the [PanScales](#) collaboration, a project involving leading QCD theorists that aim to improve theoretical accuracy of Monte Carlo event generators.
- Research on deep generative models, anomaly detection and event classification with models such as normalizing flows, graph neural networks and transformers.
- Experience with high-performance computing and algorithmic optimization.

EDUCATION

PhD Theoretical high energy physics

2015 - Mar 2020

[Radboud University Nijmegen](#), the Netherlands

- Current author and developer in the [PYTHIA](#) collaboration, the leading particle physics Monte Carlo event generator and the most widely-used and cited software in the field.
- Research on deep generative models for event generation for the LHC.

MsC Theoretical high energy physics (*Summa cum laude/with highest honors*)

2013 - 2015

[Radboud University Nijmegen](#), the Netherlands

- Research with focus on numerical techniques in calculations for supersymmetric field theory.

BsC Physics and Astronomy (*Cum laude/with honors*)

2009 - 2013

[Radboud University Nijmegen](#), the Netherlands

SELECTED PROJECTS

- Autoregressive normalizing flows for sampling particle physics collision events with weighted training (with B. Stienen) [code].
- Surjective transforms in normalizing flows for sampling and anomaly detection in particle physics, with the goal of handling permutation invariance, varying number of objects and mixed discrete-continuous features [code].
- Contributed to the development of an ML algorithm for fast diagnosis of SARS-CoV-2, led to publication in [Clinical Chemistry and Laboratory Medicine](#).

SELECTED PUBLICATIONS

Full list of 25 publications on [Inspire](#) or [Google Scholar](#)

Climbing four tops with graph networks, transformers and pairwise features

L. Builtjes, S. Caron, P. Moskvitina, C. Nellist, R. Ruiz de Austri, [R. Verheyen](#), Z. Zhang, [arXiv]

Event Generation and Density Estimation with Surjective Normalizing Flows

[R. Verheyen](#), [SciPost Physics 2022](#) [arXiv] [code]

Rare and Different: Anomaly Scores from a Combination of Likelihood and Out-of-distribution Models to Detect New Physics at the LHC

S. Caron, L. Hendriks, [R. Verheyen](#), [SciPost Physics 2022](#) [arXiv] [code]

The Dark Machines Anomaly Score Challenge: Benchmark Data and Model Independent Event Classification for the Large Hadron Collider

T. Aarrestad et al.

[SciPost Physics 2022](#) [arXiv] [code]

A Comprehensive Guide to the Physics and Usage of PYTHIA 8.3

C. Bierlich, S. Chakraborty, N. Desai, L. Gellersen, I. Helenius, P. Ilten, L. Lönnblad, S. Mrenna, S. Prestel, C. Preuss, T. Sjöstrand, P. Skands, M. Uthheim, [R. Verheyen](#),

[SciPost Physics Codebases 2022](#) [arXiv] [code]

Spin Correlations in Final-state Parton Showers and Jet Observables

A. Karlberg, G. Salam, L. Scyboz, [R. Verheyen](#),

[The European Physical Journal 2021](#) [arXiv]

Event Generation and Statistical Sampling for Physics with Deep Generative Models and a Density Information Buffer

S. Otten, S. Caron, W. de Swart, M. van Beekveld, L. Hendriks, C. van Leeuwen, D. Podareanu, R. Ruiz de Austri, [R. Verheyen](#), [Nature Communications 2021](#) [arXiv]

Phase Space Sampling and Inference from Weighted Events with Autoregressive Flows

B. Stienen, [R. Verheyen](#), [SciPost Physics 2021](#) [arXiv] [code]

Competing Sudakov Veto Algorithms

R. Kleiss, [R. Verheyen](#), [The European Physical Journal 2016](#) [arXiv] [code]

SKILLS

ML frameworks	PyTorch, TensorFlow, JAX, dgl
Programming languages	C++, Python (NumPy, Pandas, Matplotlib, SciPy), Mathematica
Software	LaTeX, git, svn, slurm
Languages	Dutch (native), English (fluent)