

# Nicholas Sale

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Swansea University, Wales. SA1 8EN

**Research interests** Topological Data Analysis, Data Science, Phase Transitions, Statistical Physics, Lattice Field Theory, Complex Systems, Machine Learning

**Employment** **Swansea University** Swansea, UK  
Postdoctoral Research Assistant in Mathematics Oct 2022 – Present

**Education** **Swansea University** Swansea, UK  
PhD in Mathematics Oct 2019 – Sep 2022  
Supervisors: Prof. Jeff Giansiracusa, Prof. Biagio Lucini  
Title: Applications of Topological Data Analysis to Statistical Physics and Quantum Field Theories

**University of Oxford** New College, Oxford, UK  
MMathCompsci Mathematics & Computer Science Oct 2015 – Jul 2019  
Parts A & B: First Class; Part C: First Class

**Scholarships** Swansea University Research Excellence Scholarship 2019-2022  
Undergraduate Scholarship (New College, Oxford) 2016-2019  
CyberFirst Bursary (UK Civil Service) 2015-2019  
Arkwright Engineering Scholarship (Arkwright Foundation) 2013-2015

**Prizes and awards** Swansea University Rowland Wilson Prize for best PhD paper Jul 2022  
SIAM Student Travel Award (to attend SIAM AG21) Aug 2021  
Winner of TopFlavours Gongshow Jun 2021  
2<sup>nd</sup> place in Welsh Mathematics 3-Minute Thesis Competition Mar 2021

**Publications** **Quantitative analysis of phase transitions in two-dimensional XY models using persistent homology**  
Nicholas Sale, Jeffrey Giansiracusa, Biagio Lucini.  
*Phys. Rev. E* 105, 024121 – Published 14 February 2022

**Preprints** **Probing center vortices and deconfinement in SU(2) lattice gauge theory with persistent homology**  
Nicholas Sale, Biagio Lucini, Jeffrey Giansiracusa.  
*arXiv:2207.13392* – Submitted 27 July 2022

Invited Talks	<b>Applications of topological data analysis to condensed matter and high energy physics</b>	May 2022
	aQa Seminar, Leiden University	
	<b>Detecting vortices with persistent homology</b>	Feb 2022
	UK Centre for TDA, University of Oxford (hybrid)	
	<b>Quantitative analysis of phase transitions in two-dimensional XY models using persistent homology</b>	Sep 2021
Contributed Talks	Machine Learning for High Energy Physics, On and Off the Lattice	
	ECT* Trento (hybrid)	
	<b>Persistent homology for phase transitions</b>	Nov 2020
	UK Centre for TDA, University of Oxford (online)	
	<b>Probing center vortices and deconfinement in SU(2) lattice gauge theory with persistent homology</b>	Aug 2022
Teaching experience	Lattice 2022, University of Bonn	
	<b>Detecting vortices with persistent homology</b>	Jul 2022
	Young Topologists Meeting 2022, Copenhagen University	
	<b>Quantitative analysis of phase transitions in two-dimensional XY models using persistent homology</b>	Aug 2021
	SIAM Conference on Applied Algebraic Geometry 2021 (online)	
Other Service	<b>Persistent homology and phase transitions</b>	Jun 2021
	TopFlavours 2021, University of Warwick (online)	
	<b>Teaching assistant, Department of Mathematics (Swansea University)</b>	
	MA-282: Game Theory and Optimization	Lent Term 2022
	MA-006: Fundamental Mathematics	Michaelmas Term 2021
Research experience	MA-308: Machine Learning	Lent Term 2021
	MA-131: Geometry, Logic, and Communication	Michaelmas Term 2020
	MA-262: Numerical Methods	Lent Term 2020
	MA-121 Methods of Algebra and Calculus	Michaelmas Term 2019
	<b>Organiser of Swansea Maths PhD Seminar</b>	Jun 2021 - Jun 2022
Research experience	<b>Co-organised minisymposium for SIAM AG21</b>	Aug 2021
	Invited speakers for and hosted a 7-speaker minisymposium on Persistent Homology for Phase Transitions, co-organised with Quoc Hoan Tran.	
	<b>Assisted with the LMS Undergraduate Summer School</b>	Jul 2021
	<b>Applied Research Summer Placement</b>	
	UK Civil Service	Jul 2018 – Sep 2018
Research experience	An 11-week placement researching how machine learning and other data science techniques could be applied to aid my team with data annotation.	
	<b>Applied Research Summer Placement</b>	
	UK Civil Service	Jul 2017 – Sep 2017

An 11-week placement researching the feasibility of using data science techniques to identify certain types of network devices based on limited information about their traffic.

#### Technical skills

##### **Programming**

Python (numpy, scipy, sci-kit learn, pandas), Java, C#, C(++), Javascript

##### **Cluster Computing**

#### Non-academic positions

##### **New College Boat Club Committee**

New College, Oxford

President

2018-2019

Secretary

2017-2018

Lower Boats Captain

2016-2017

Women's 3<sup>rd</sup> Boat Coach

2018-2019