



Graham Van Goffrier

gwvg1e23@soton.ac.uk
+44 07838 300687

Postdoctoral Research Fellow, University of Southampton

About Me A passionate early-career research physicist studying theoretical models at the interface of particle and nuclear physics, with an emphasis on their simulation via quantum algorithms, and with broad experience across lattice and effective field theories, neutrino phenomenology, and computational statistics. Furthermore, a skillful written and spoken communicator, an animated teacher of students at all levels, and a community leader.

Education

2019 - 2023, University College London

PhD in Particle Theory

- Thesis: *Nuclear and Particle Physics Aspects of Neutrinoless Double-Beta Decay ($0\nu\beta\beta$)*
- Supervisors: Professor Frank Deppisch, Professor Keith Hamilton, Dr Matteo Agostini
- Funding: UCL Overseas Research Scholarship; STFC CDT for Data-Intensive Science
- Outreach: Postgraduate Research Representative from the MAPS Faculty (2019-2023)

2018 - 2019, Homerton College, University of Cambridge

MASt in Applied Mathematics

- Essay: *Confinement* (proposed by Professor David Skinner)

2014 - 2018, University of Maine

M.S. in Electrical Engineering, B.S. in Physics (both GPA 4.00/4.00)

- University Valedictorian
- Thesis: *Visualization of Open and Closed String Worldsheets* (with Professor Neil Comins)
- Minors: Mathematics, Electrical Engineering, Nanotechnology
- Phi Beta Kappa, Tau Beta Pi, Sigma Pi Sigma, Eta Kappa Nu

Research Employment

2023 - 2025, Postdoctoral Research Fellow, University of Southampton

- Developing specialised quantum algorithms for the simulation of quantum physical systems, such as lattice gauge theories and quantum link models.
- Member of the Cambridge-Southampton "QA for QFT" initiative
- Supervisors: Dr. Bipasha Chakraborty and Prof. Sergii Strelchuk

2022, Research Intern, Spotify AB

- Theoretical causal inference research, focused on construction of instrumental estimators for chains of confounded-mediator variables as relevant to recommender systems.
- Supervisors: Dr. Ciarán Gilligan-Lee and Dr. Lucas Maystre

2020, Research Placement, U.K. Atomic Energy Authority

- Application of machine learning and surrogate models to optimize the design of tritium-breeding fusion reactors.
- Supervisors: Dr. Jonathan Shimwell and Vignesh Gopakumar

2019, Research Placement, Department of Engineering, University of Cambridge

- Investigated extremal-eigenvalue geometry on the cone of symmetric positive-definite matrices, with application to efficient interpolation between and K-means clustering of large covariance matrices.
- Supervisors: Dr. Cyrus Mostajeran and Professor Rodolphe Sepulchre
- Funding: Cambridge Mathematics Placements (CMP) Programme

2017, Summer Research Student, ATLAS Experiment, CERN

- Applied FOAMs (iteratively discretized probability distributions) to Monte Carlo event generation for ttH Higgs production.
- Supervisors: Professor Tancredi Cardi and Dr. Alexander Held
- Funding: NSF UM-CERN-REU, supported by the University of Michigan



Publications

- [10] **G. Van Goffrier**, D. Banerjee, B. Chakraborty, E. Huffman, and S. Maiti, “Towards the phase diagram of fermions coupled with $SO(3)$ quantum links in $(2 + 1)$ -D,” Lattice 2024, proceedings in preparation (2024)
- [9] **G. Van Goffrier**, “An improved precision calculation of the $0\nu\beta\beta$ contact term within chiral effective field theory,” in preparation for PRD (2024), thesis C.4
- [8] C. Mostajeran, N. Da Costa, **G. Van Goffrier** and R. Sepulchre, “Differential geometry with extreme eigenvalues in the positive semidefinite cone,” SIAM Journal on Matrix Analysis and Applications 45.2 (2024): 1089-1113, arXiv:2304.07347 [math.DG]
- [7] J. G. Lee, C. Mostajeran and **G. Van Goffrier**, “Node-wise monotone barrier coupling law for central pattern generation,” Entropy, 26(2), 134 (2024) doi:10.3390/e26020134, arXiv:2202.02759 [eess-SY]
- [6] M Agostini, F. Deppisch and **G. Van Goffrier**, “Probing the mechanism of neutrinoless double-beta decay in multiple isotopes.” Journal of High Energy Physics 2023.2 (2023): 1-30, arXiv:2212.00045 [hep-ph]
- [5] **G. Van Goffrier**, L. Maystre, C. Gilligan-Lee, “Estimating long-term causal effects from short-term experiments in the presence of unobserved confounding,” Conference on Causal Learning and Reasoning, PMLR (2023), arXiv:2302.10625 [stat.ML]
- [4] P. Mánek, **G. Van Goffrier**, V. Gopakumar, N. Nikolaou, J. Shimwell and I. Waldmann, “Fast Regression of the Tritium Breeding Ratio in Fusion Reactors,” Accepted by Mach. Learn.: Sci. Technol. 4, 015008 (2023), doi:10.1088/2632-2153/acb2b3, arXiv:2104.04026v2 [physics.comp-ph]
- [3] C. Mostajeran, J. G. Lee, **G. Van Goffrier** and R. Sepulchre, “Target formation on the circle by monotone system design,” 2021 60th IEEE Conference on Decision and Control, pp. 7106-7111 (2021) doi:10.1109/CDC45484.2021.9683688, arXiv:2103.13913v2 [math.OC]
- [2] F. Deppisch and **G. Van Goffrier**, “Least-informative priors for $0\nu\beta\beta$ decay searches,” Phys. Rev. D, 104(5), 055040 (2021) doi:10.1103/PhysRevD.104.055040, arXiv:2103.06660v2 [hep-ph]
- [1] **G. Van Goffrier**, C. Mostajeran, R. Sepulchre, “Inductive geometric matrix midranges,” FAC-PapersOnLine 54(9), pp. 584-589 (2021) doi:10.1016/j.ifacol.2021.06.120, arXiv:2006.01508v3 [cs.LG]

Patents

- [P1] C. Gilligan-Lee, L. Maystre, **G. Van Goffrier**; Spotify AB, “System and method for estimating a long-term effect in the presence of unobserved confounding,” U.S. Patent 12 137 148, November 5, 2024



Awards

2019, *Overseas Research Scholarship, University College London*

Full funding for four-year duration of PhD research, including maintenance stipend.

2019, *NSF Graduate Research Fellow*

Declined due to acceptance of PhD position outside the U.S.

2018, *Valedictorian, University of Maine*

2017, *Goldwater Scholar*

2015-16, *Putnam Mathematical Competition, University of Maine High-Scorer*

2014, *National Merit Scholar*

Teaching Employment

2019-22, *PGTA, University College London*

- Assisted laboratory sections in Mathematica for Physics, Mathematical Methods III
- Ran problem classes and marked sets for Particle Physics

2019, *Invigilator, Homerton College, University of Cambridge*

2015-18, *Teaching Assistant, University of Maine*

- Assisted laboratory sections in Circuit Design, Electronics, etc.
- Ran laboratory sections for Intro to Electricity and Magnetism
- Hosted CV workshops and mock interviews for engineering students



Invited Talks and Conference Presentations

- Nov 2024 *SO(3) Quantum Link Models: Construction and Simulation*
Invited Talk, Theory Group Seminar, University of Exeter
- Aug 2024 *Simulating an SO(3) QLM with Dynamical Fermions in 2 + 1 Dimensions*
Parallel Talk, Lattice 2024, University of Liverpool
- Jul 2024 *Simulating an SO(3) QLM with Dynamical Fermions in 2 + 1 Dimensions*
Poster, School on Continuum Foundations of Lattice Gauge Theories, CERN
- May 2024 *Simulating Nuclear Forces on Quantum Computers*
Invited Talk, University of Maine, Orono, ME, USA
- May 2024 Short Talk, Robust and Reliable Quantum Computing (RoarQ) PDRA Event
University of Oxford, Oxford, UK
- Mar 2024 *State Preparation using Quantum Algorithms within Hamiltonian Formulations of Quantum Field Theories*
Talk, UK Lattice Field Theory Annual Meeting
University of Plymouth, Plymouth, UK
- Nov 2023 *Improved-Precision $0\nu\beta\beta$ from Chiral EFT*
Invited Talk, HEP Seminar, University College London
- Oct 2023 *Improved-Precision $0\nu\beta\beta$ from Chiral EFT*
Invited Talk, SHEP Seminar, University of Southampton
- Apr 2023 *Probing $0\nu\beta\beta$ in Multiple Isotopes*
Talk, NExT Workshop Sussex: Quo Vadis?
University of Sussex, Falmer, UK
- Nov 2022 *The Future of Nuclear Matrix Elements for $0\nu\beta\beta$*
Invited Talk, HEP Phenomenology Seminar, University of Cambridge
- Sep 2022 *Estimating Treatment Effects with Confounded Mediators (Spotify internship)*
Data-Intensive Science Annual Meeting, University College London
- May 2022 *Probing $0\nu\beta\beta$ in Multiple Isotopes*
Parallel Talk, 7th Symposium on Neutrinos and Dark Matter in Nuclear Physics
University of North Carolina, Asheville, NC, USA
- May 2022 *Theoretical Frontiers in Neutrinoless Double-Beta Decay ($0\nu\beta\beta$)*
Invited Talk, University of Maine, Orono, ME, USA
- May 2022 *Probing $0\nu\beta\beta$ in Multiple Isotopes*
Parallel Talk, 7th Phenomenology 2022 Symposium: From Virtual to Real
University of Pittsburgh, Pittsburgh, PA, USA
- Dec 2021 *Theoretical Frontiers in Neutrinoless Double-Beta Decay ($0\nu\beta\beta$)*
Talk, Young Theorists' Forum 2021
Durham University, Durham, UK
- Dec 2021 *Mechanisms of Neutrinoless Double-Beta Decay*
Talk, SEPTA Consortium Meeting at University of Sussex, Brighton, UK
- Aug 2021 *Subtleties of Majorana Neutrinos*
Project Talk, International Neutrino Summer School, CERN, Geneva, CH
- Jul 2021 *Bayesian Methods for $0\nu\beta\beta$ Decay*
Short Talk, XI NExT PhD Workshop
University of Sussex, Brighton, UK
- Mar 2021 *Chiral Perturbation Theory for $0\nu\beta\beta$ Decay*
Mini-Workshop on Chiral Perturbation Theory, University College London



Invited Talks and Conference Presentations

- Feb 2021 *Least-Informative Priors for Neutrinoless Double-Beta Decay*
Student Talk, 50th BUSSTEPP
Queen Mary University of London, London, UK
- Nov 2020 *Least-Informative Priors for Neutrinoless Double-Beta Decay*
Student Talk, UK HEP Forum 2020: Quantum leaps to the dark side
Durham University, Durham, UK
- Jul 2020 *Full Discretization of Local Gauge Invariance*
Project Talk, Wolfram Summer School, Boston, MA, USA
- Mar 2019 *Confinement*
Part III Seminar Series, DAMTP, University of Cambridge, Cambridge, UK
- Nov 2018 *Kac-Moody Algebras*
Part III Seminar Series, DAMTP, University of Cambridge, Cambridge, UK
- Aug 2017 *Using FOAMs to Approximate Probability Densities for $t\bar{t}$ Processes*
Summer Student Lecture Programme General, CERN, Geneva, CH
- May 2017 *"Investigation and Visualization of the Correlation between Minimal Surface and Relativistic String Dynamics in Bosonic String Theory"*
Poster, Center for Undergraduate Research Symposium
University of Maine, Orono, ME, USA

Software Development Expertise

- C++
- MATLAB
- Machine Learning
- Python
- Qiskit
- MCMC
- Mathematica
- Julia
- HPC (MPI)