Charlie F. Perkins

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Summary

Newcastle University theoretical physics PhD student and University of Manchester honorary research fellow. Broad research/project history - spanning high energy astrophysics and compact objects, radiation chemistry, condensed matter physics, and quantum field theory. Focused on solving complex physical systems using numerical methods. Worked with multiple research groups (MIRaCLE - Manchester Inhomogeneous Radiation Chemistry by Linear Expansion, Manchester Particle Physics Group, Manchester Theoretical Physics Group) on educational, professional, and voluntary bases. Invited to talk at UK National Ion Beam User Day 2024.

Work Experience

Honorary Research Fellow (University of Manchester) Oct 2025 - Present

– Primarily working on reaction-diffusion based models (MIRaCLE) of ion and electron induced water radiolysis at the nanoscale.

Research Support Intern (University of Manchester) Jun 2025 - Aug 2025

– Developed new models of electrons in water using MIRaCLE, benchmarked against literature. Using continuum methods to perform 'one-shot' Monte Carlo simulations.

– Reviewed and maintained MIRaCLE software codebase, ensuring correctness and stability for active research use.

– Informal supervisor on undergraduate projects related to ion/electron water radiolysis.

Voluntary Research Intern (University of Manchester) Jul 2024 - Jun 2025

– Developed groundwork simulations of ion tracks in water using MIRaCLE software package.

– Researched methods for using continuum-based descriptions of the physical and physicochemical stage of water radiolysis in simulations. Later applied to new models.

– Git Development: Reviewed code changes, assessed merge conflicts & bugs.

– Research presented at MIRaCON 11 and UK National Ion Beam Centre 2024.

Casual Technical Support Intern (Dalton Cumbrian Facility) Jul 2024 - Aug 2024

– Created Python package 'AtomForge': API for IAEA NDS, dynamic numerical solution to N-body nuclear decay, and time-dependent gamma spectrum prediction.

– Preliminary simulations of medical isotope production using IAEA MIB.

– Data validation using custom Python scripts: verify predicted post-irradiation medical isotope activity.

Summer Placement Student (Dalton Cumbrian Facility) Jul 2023 - Aug 2023

– Designed, constructed, and implemented firmware, software, and hardware components for beamline experiment automation (C#, C++, Arduino). Intended to be used to streamline radiation chemistry experiments.

– Assisted collaborators' projects (PhD students) – UV-Vis spectrometry of irradiated capsules, production of ion-penetrable caps, capsule sterilisation.

– Assisted with experimental design for irradiation of MS2 bacteriophage and MS2 RNA with He2+ ions on DAFNE particle accelerator experiments.

Projects

Ion and Electron Induced Radiation Chemistry Video

Research Support Intern and Voluntary Research Intern Project. Used MIRaCLE Julia package to simulate chemical stage of water radiolysis due to ion and electron induced irradiation. Demonstrated that simple, fast phenomenological models can predict the same as Monte Carlo within reasonable error.

Models of Compact Stars Report

Theory Computing Project. Created 'from scratch' numerical simulations of hydrostatic equilibrium of neutron stars in relativistic gravity. Used multidimensional optimisation to find energy density of a multi particle fermi gas, applied to the interior of neutron stars. White dwarfs also explored.

Witnessing Entanglement in Quantum Spin Systems

MPhys Project. Implemented linear spin-wave theory model of quantum fisher information using Sunny.jl SU(N) spin dynamics library to simulate highly entangled spin systems. Evidenced effect of noise and disorder on scale of multipartite entanglement.

Total Cross-Section of $e^+e^- \to \mu^+\mu^-$ Annihilation Report

MPhys Project. Computed 1-loop radiative corrections in QED and electroweak theory. Showed that certain radiative corrections mutually cancel under specific conditions. Non-cancellation leads to observables at TeV scale.

Education

2025 - Present	Royal Society funded PhD (Theoretical Physics) at **Newcastle University**	
2021 - 2025	MPhys (Physics with Theoretical Physics) **University of Manchester**	(2:1)

Skills

Programming	Python, Julia, C++, Git, LaTeX, Scientific Libraries (Numpy, Scipy, SymPy, Matplotlib, Boost, Multiprocessing), GNU/Linux (Multiple Distros)
Numerical Methods	Spectral Methods, Runge–Kutta, Monte Carlo, Newton–Raphson
Mathematical Methods	Differential Geometry, Complex Analysis, Linear Algebra, Green's Functions, Special Functions, Integral Transforms, Group Theory, Variational Principles
General	Technical Communication, Software Development, Research Proficiency, Academic Writing, Science Communication (Writing, PASS, YouTube, TikTok), Scientific Collaboration, Data Analysis

Awards

2021 University of Manchester Science and Engineering Achievement Scholarship

Talks and Conferences

Dec 2024	Simulating ion beam induced chemistry	University of Surrey (UKNIB User Day)
Mar 2024	Automating radiation chemistry	University of Manchester (U'grd Conference)