

Joshua Pollin

Curriculum Vitae

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Education

PhD. Astrophysics

Oct 2022 - Present

Queen's University Belfast

Thesis Title: "Exploring the Origins of Type Ia Supernovae with Monte Carlo Radiative Transfer Simulations"

Supervisor: Professor Stuart Sim

Co-supervisor: Dr Matt Nicholl

MSci. Physics

Sep 2018 - Jun 2022

Queen's University Belfast

First Class Honours

Skills & Expertise

- Expertise in carrying out theoretical simulations of Type Ia supernovae, in particular the development and application of Monte Carlo radiative transfer calculations for interpreting spectra and light curves, using the 3D, time dependent, radiative transfer code ARTIS.
- I am skilled at using both C++ and Python programming languages (NumPy, Matplotlib, pandas) and am an active contributor to the repository for the ARTIS code on GitHub. This has given me valuable experience in collaboration, version control, and continuous integration. I also have experience with shell scripting in Bash, along with other programming languages such as C.
- I have three years of experience handling observational datasets — including photometric, spectroscopic, and polarimetric data — and comparing them with their synthetic equivalent.
- I am a proficient user of multiple high-performance computing facilities, having carried out suites of simulations using resources in the UK and Germany, typically consuming around 7 million CPU hours per year.
- I am highly proficient in presenting scientific results, both orally and in writing, having delivered five conference talks, authored one first-author paper, and contributed to two co-authored publications all within the past 24 months.
- I use hydrodynamic explosion models as inputs for my radiative transfer simulations, giving me insight into how these models are made and their relevance to the nature of Type Ia Supernova progenitors.
- I have experience conducting parameter space investigations of hydrodynamic explosion models using the radiative transfer code TARDIS.
- I am an active member of multiple scientific collaborations working with researchers based at Heidelberg Institute for Theoretical Studies and Max Planck Institute for Astrophysics.

Current Projects

Multidimensional Nebular Phase Radiative Transfer Calculations

Sep 2023 - Present

Investigating how multidimensional explosion models can be used to understand the diversity of Type Ia supernovae nebular spectra. The primary focus is on dynamical mergers of white dwarfs from [Pakmor, \(2022\)](#), with potential expansion to other explosion models.

Parameter Space investigation of Dynamical Merger Models

Apr 2024 - Present

Building on the findings of my first publication, it has become clear that further simulations are necessary to explore how different helium shell and mass configurations impact the observable characteristics of explosion models.

Polarisation Signals Of Dynamical Mergers

Jul 2024 - Present

Investigating the polarisation of dynamical merger models to determine how asymmetries compare to observational constraints, aiming to support or rule out progenitor pathways.

ARTIS Code Comparison

Jun 2024 - Present

Following on from [Blondin \(2022\)](#), I am currently co-leading an internal investigation comparing ARTIS and CMFGEN radiative transfer codes.

Publication List

First Author

J. M. Pollin, S. A. Sim, R. Pakmor et al., Published, *On the fate of the secondary white dwarf in double-degenerate double-detonation Type Ia supernovae - II. 3D synthetic observables*, 2024, [MNRAS](#)

J. M. Pollin, S. A. Sim, R. Pakmor et al., In prep, *On the fate of the secondary white dwarf in double-degenerate double-detonation Type Ia supernovae - III. 3D Nebular Phase synthetic observables*

Co-authored

F. P. Callan et al., **Incl J. M. Pollin**, In Prep, *Exploring the multidimensional effect and impact of helium in the spectra of double-detonation models for Type Ia supernovae*, 2024,

I provided significant technical support in regards to memory optimisation and contributed to discussions around the implications of surface helium in the context 2D NLTE double-detonation calculations.

F. P. Callan et al., **Incl J. M. Pollin**, In Review, *Exploring the range of impacts of helium in the spectra of double detonation models for Type Ia supernovae*, 2024, [Preprint](#)

Provided both scientific and technical expertise regarding the impact of surface helium in isolated 1D White Dwarf double-detonation NLTE simulations.

S. Srivastav et al., **Incl J. M. Pollin**, *Unprecedented Early Flux Excess in the Hybrid 02es-like Type Ia Supernova 2022ywc Indicates Interaction with Circumstellar Material*, 2023, [ApJ Letters](#), 956, L34

I contributed to discussions around the possible physical processes driving the early light curve excess and compared observations to theoretical explosion models.

Upcoming Conferences & workshop contributed talks

National Astronomical Meeting

Jul 2025

I am a member of the Scientific Organising Committee which proposed three transient blocks at the UK 2025 National Astronomy Meeting at Durham, and our proposal has been accepted.

Invited Talk - Trinity College Dublin

Mar 2025

I will present my research on how nebular-phase line profiles from multidimensional explosion models can be used to test our understanding of progenitor models.

Conference & workshop contributed talks

18th Wuerzburg Winter Workshop

Dec 2023

Presented 3D nebular-phase and preliminary polarisation calculations for the dynamical merger models.

RAS Specialist Discussion Meeting

Nov 2024

Presented multidimensional nebular phase radiative transfer results at the Progress in Astrophysics with Type Ia Supernovae third meeting.

Oxford Transients Meeting*Jul 2024*

Presented radiative transfer calculations for both the photospheric (Pollin, 2024) and nebular phases of dynamical merger models developed by Pakmor (2022), highlighting the importance of multidimensional effects.

23rd European Workshop on White Dwarfs*Jul 2024*

Presented 3D nebular radiative transfer calculations for the dynamical merger models, focusing on how orientation effects can be used to understand observational data at early and late phases.

17th Wuerzburg Winter Workshop*Dec 2023*

Presented 1D radiative transfer simulations of the dynamical merger models, highlighting the importance of photoionisation in the nebular phase.

National Astronomical Meeting*Jul 2023*

Presented finalised 3D photospheric radiative transfer calculations of the dynamical merger models.

16th Wuerzburg Winter Workshop*Dec 2022*

Presented preliminary findings from 3D photospheric phase simulations of the dynamical merger models, emphasising the importance of multidimensional effects in understanding helium shell detonations.

Other Conferences, workshops & training attended

DiRAC Foundation HPC-Skills Course*Apr 2023*

Participated in a workshop designed to help researchers use large scale HPC systems and develop better coding practices through the incorporation of Git into HPC workflows.

ARCHER2 Software Carpentry workshop*Dec 2022*

Participated in a workshop designed to develop better coding practices through both the use of correct Program Design, Version Control through Git and the Unix Shell.

STFC Astronomy Summer School*Aug 2022*

Attended a 5 day summer school consisting of introductory lectures on a wide range of astrophysical topics and how to communicate scientific results to the public.

Successful Proposals

DiRAC HPC proposal (UK)*Apr 2024 - Apr 2027*

Co-authored a DiRAC proposal for supercomputer time, which was awarded a total of ~36 Million CPU hours over 3 years. I currently lead one of the two science cases for this proposal. The awarded time for my science case will lead to the development of two publications.

JUWELS HPC proposal (Germany)*Apr 2023 - Apr 2024 - Apr 2025*

Co-authored two successful JUWELS proposals for supercomputer time, led by our key collaborators at the Heidelberg Institute for Theoretical Studies, which were awarded a total of 21 million CPU hours. I currently lead one of the sub-projects in these proposals.

DiRAC HPC proposal (UK)*Apr 2023 - Apr 2024*

Co-authored a DiRAC proposal for supercomputer time, which was awarded a total of 3 Million CPU hours. I led the science case for this proposal which resulted in a publication.

Outreach, Science Communication, & Diversity Initiatives

EquiTea Committee*Jul 2023 - Present*

Queen's University Belfast

Active member of the EquiTea initiative, led by PhD students at my home institution, addressing and raising awareness on equity and inclusion issues within the academic community.

DiRAC HPC Science Highlights*Mar 2024*

Created a summary of photospheric phase simulations for the DiRAC science highlight.

NI Science Festival*Feb 2024*

Queen's University Belfast

I delivered a presentation for the general public on how astronomers use light to explore the universe. Additionally, I assisted at multiple booths and contributed to the event's organisation.

Irish Astronomical Society*Jan 2024*

I gave an invited talk to the Irish Astronomical Society, where I spoke on the importance of Type Ia supernovae and how theoretical modelling of supernovae can improve our understanding in several different astrophysical research areas.

Pathway Opportunity Programme (POP)*Jul 2023, Jul 2024*

Queen's University Belfast

The Pathway Opportunity Programme allows secondary students under 18 to study their chosen subject on campus for a day. I guided small groups through a computational experiment on the expanding universe.

Girls in Maths and Physics*Jun 2023, Jun 2024*

Queen's University Belfast

This event was designed to inspire young female physics and maths students and showcase different aspects of the degrees offered by Queen's University Belfast. I gave several talks to small groups of participants about an exoplanet-themed experiment and subsequently helped them perform the experiment.

Teaching & Mentorship Experience**Supervision Of Summer Research Project***Jun 2024 - Aug 2024*

Queen's University Belfast

I supervised a summer student's research, which examined how changes in detailed microphysics impact the nebular phase simulations of Type Ia supernovae.

Supporting of Masters Students*Sep 2023 - Jan 2024*

Queen's University Belfast

I assisted Master's students by providing technical and scientific support for their research projects.

Graduate Teaching Assistant*Sep 2023 - Present*

Queen's University Belfast

Teaching assistant for first-year undergraduate mathematics which involves leading small group teaching.

Undergraduate Peer Mentor*2019 - 2020*

Queen's University Belfast

Peer mentor for new undergraduate students, helping them adjust to university.

Professional Activities**Teaching Fellowship Scheme***Sep 2023 - Present*

Queen's University Belfast

This scheme develops teaching skills in early career researchers and PhD students through structured training, practice, and mentorship. Upon completion, I will receive professional accreditation in teaching.

Scholarships**Emily Sarah Montgomery Travel Scholarship***2024*

I was awarded a £400 scholarship for travel to the 23rd European Workshop on White Dwarfs to present my work on 3D Nebular Phase Radiative Transfer simulations.

Personal References**Dr. Stuart Sim**

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Dr. Matt Nicholl

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Dr. Friedrich Röpke

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