Luke Shingles, PhD

Location	Belfast, Northern Ireland, UK	**LinkedIn**	linkedin.com/in/lukeshingles
Citizenship	Australia, Ireland	**GitHub**	github.com/lukeshingles
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Personal Statement

I am an experienced researcher with skills in scientific software development, data analysis, and visualisation.

Some of my highlights in research software engineering have included writing high-performance parallel code to numerically solve systems of differential equations (to model chemical enrichment of stellar clusters and high-energy particle interactions), using matrix-based methods for solving large systems of linear equations (to determine atomic level populations), and applying Monte Carlo techniques to simulate photon interactions (radiative transfer) in three dimensions. I have also ported code to run on GPU hardware with Nvidia CUDA, contributed to open source software used by other researchers, and advocated for software engineering best-practices in collaborative projects.

I have a strong track record of obtaining scientific insights from computationally demanding theoretical work, having given over 17 scientific talks at professional conferences and institutes, and published 13 articles in peer-reviewed science journals.

I have contributed as a co-investigator on successful research grants and HPC computing time proposals for international facilities. I enjoy teaching and have chosen to gain experience tutoring and giving lectures for undergraduate physics courses, and co-supervised PhD, Master's, and Google Summer of Code students on a variety of projects in astrophysics and software development.

I have expertise in:

- Leading the development of numerically-intensive software in C/C++

- Multithreading and parallel algorithms (using OpenMP, MPI, and CUDA)

- Debugging, performance profiling, and optimisation (gdb, perf)

- Collaborative development using version control (Git), continuous integration, and automated testing

- Scientific research with publications in peer-reviewed journals

- Developing tools to process and visualise large data sets to extract meaningful insights (Python with numpy, pandas, and matplotlib)

- Statistics, differential equations, and linear algebra (machine learning fundamentals)

Education and Employment

Aug 2015– **Astrophysicist and Software Engineer (Postdoctoral Researcher)**
Sept 2021 *Queen's University Belfast, Northern Ireland*

- Lead developer on a radiative transfer code for large-scale simulations (∼50k core-hour) and associated set of analysis/visualisation tools used by a group of researchers.

- Implemented several matrix-based numerical solvers and Monte Carlo statistical estimators to model the physical conditions and radiation transport in supernovae.

- Developed an initial port of the simulation to GPU-accelerated CUDA C++ that resulted in 4-5x speedup.

- Presented conference talks and lectures, wrote research papers, reports, and grant applications, supervised Masters and PhD students, and volunteered as the Postdoctoral Representative for the School of Mathematics & Physics.

Technologies: C/C++, Git, Python (Numpy/Pandas/Matplotlib), OpenMP, MPI, CUDA

2012–2015 Doctor of Philosophy (Astrophysics)
Australian National University

Thesis: Neutron-Capture Nucleosynthesis and the Chemical Evolution of Globular Clusters
Primary Supervisor: Dr. Amanda Karakas

- Computed numerical simulations of low-mass stars on Linux-based high-performance compute clusters (NCI Raijin system).

- Developed Fortran/OpenMP code to solve a system of differential equations to model chemical production in galaxies.

- Published insights from simulation results in peer-reviewed journals with implications for the evolution of low-mass stars and the origins of chemical elements in the universe.

- Teaching assistant for courses on first-year physics, third-year astrophysics, and online courses on cosmology and exoplanets.

Technologies: Fortran, OpenMP, Git, Python (Matplotlib), Mathematica

2008–2011 Bachelor of Science with Honours (First Class)
Australian National University

Honours Thesis: The Sulfur Anomaly in Planetary Nebulae and Post-AGB Stars
Honours grade: 86% (First Class)
Majors: Astronomy & Astrophysics, Theoretical Physics, Mathematics
Course grade average: 80% (High Distinction)
Selected results:

Games, Graphs, and Machines	85% High Distinction
Maths Methods 1 Honours: Ordinary differential equations and advanced vector calculus	85% High Distinction
Maths Methods 2 Honours: Partial differential equations, Fourier analysis, and complex analysis	78% Distinction
Theoretical Physics	87% High Distinction
Applied Algebra 1 Honours: Groups rings, and advanced linear algebra	78% Distinction
Number theory and cryptography	83% High Distinction

2003-2007 **Bachelor of Information Technology**
Queensland University of Technology
Major: Software Engineering

Refereed Journal Articles

- **Nebular [Fe II] emission as a constraint on Type Ia supernova progenitors**
  L. Shingles, Stuart Sim, Andreas Floers, et al.
  Monthly Notices of the Royal Astronomical Society, (2021, in preparation).

- **The influence of line opacity treatment in STELLA on supernova light curves**
  A. Kozyreva, **L. Shingles**, Alexey Mironov, Petr Baklanov, Sergey Blinnikov
  Monthly Notices of the Royal Astronomical Society, Volume 499, Issue 3, pp.4312-4324 (2020).

- **Monte Carlo radiative transfer for the nebular phase of Type Ia supernovae**
  L. Shingles, S. A. Sim, M. Kromer, K. Maguire, M. Bulla, C. Collins, C. P. Ballance, A. S. Michel, C. A. Ramsbottom, F. K. Röpke, I. R. Seitenzahl, N. B. Tyndall
  Monthly Notices of the Royal Astronomical Society, Volume 492, Issue 2, p.2029-2043 (2020).

- **A year-long plateau in the late-time near-infrared light curves of Type Ia supernovae**
  Or Graur, Kate Maguire, Russell Ryan, Matt Nicholl, Arturo Avelino, Adam G. Riess, **Luke Shingles**, Ivo R. Seitenzahl, and Robert Fisher
  Nature Astronomy, Advanced Online Publication (2019).

- **Using late-time optical and near-infrared spectra to constrain Type Ia supernova explosion properties**
  K. Maguire, S. A. Sim, **L. Shingles**, J. Spyromilio, A. Jerkstrand, M. Sullivan, T.-W. Chen, R. Cartier, G. Dimitriadis, C. Frohmaier, L. Galbany, C. P. Gutiérrez, G. Hosseinzadeh, D. A. Howell, C. Inserra, R. Rudy, J. Sollerman
  Monthly Notices of the Royal Astronomical Society, Volume 477, Issue 3, p.3567-3582 (2018).

- **A kilonova as the electromagnetic counterpart to a gravitational-wave source**
  S. J. Smartt, T.-W. Chen, A.Jerkstrand, M. Coughlin, E. Kankare, S. A. Sim, M. Fraser, C. Inserra, K. Maguire, K. C. Chambers, M. E. Huber, T. Krühler, G. Leloudas, M. Magee, **L. J. Shingles**, and 107 additional authors
  Nature, Volume 551, Issue 7678, pp. 75-79 (2017)

- **Multi-messenger Observations of a Binary Neutron Star Merger**
  Joint-authored by several collaborations including ePESSTO (including **L. J. Shingles**)
  The Astrophysical Journal Letters, Volume 848, Issue 2, article id. L12, 59 pp. (2017).

- **A chemical signature from fast-rotating low-metallicity massive stars: ROA 276 in omega Centauri**
  David Yong, John E. Norris, Gary S. Da Costa, Laura M. Stanford, Amanda I. Karakas, **Luke J. Shingles**, Raphael Hirschi, Marco Pignatari
  The Astrophysical Journal, Volume 837, Issue 2, article id. 176, 8 pp. (2017).

- **Evolution and nucleosynthesis of helium-rich asymptotic giant branch models**
  Luke J. Shingles, Carolyn L. Doherty, Amanda I. Karakas, Richard J. Stancliffe, John C. Lattanzio, Maria Lugaro
  Monthly Notices of the Royal Astronomical Society, Volume 452, Issue 3, p.2804-2821 (2015).

- **Iron and s-element abundance variations in NGC 5286: comparison with anomalous' globular clusters and Milky Way satellites**
  A. F. Marino, A. P. Milone, A. I. Karakas, L. Casagrande, D. Yong, **L. Shingles**, G. Da Costa, J. Norris, P. B. Stetson, K. Lind, M. Asplund, R. Collet, H. Jerjen, L. Sbordone, A. Aparicio, & S. Cassisi
  Monthly Notices of the Royal Astronomical Society, Volume 450, Issue 1, p.815-845 (2015).

- **The s-process enrichment of the globular clusters M4 and M22**
  Luke J. Shingles, Amanda I. Karakas, Raphael Hirschi, Cherie K. Fishlock, David Yong, Gary S. Da Costa, & Anna F. Marino
  The Astrophysical Journal, Volume 795, Issue 1, article id. 34, 12 pp. (2014).

- **Iron and neutron-capture element abundance variations in the globular cluster M2 (NGC 7089)**
  David Yong, Ian U. Roederer, Frank Grundahl, Gary S. Da Costa, Amanda I. Karakas, John E. Norris, Wako Aoki, Cherie K. Fishlock, A. F. Marino, A. P. Milone, & **Luke J. Shingles**
  Monthly Notices of the Royal Astronomical Society, Volume 441, Issue 4, p.3396-3416 (2014).

- **Augmented reality in astrophysics**
  Frédéric Vogt & **Luke J. Shingles**
  Astrophysics and Space Science, Volume 347, Issue 1, pp.47-60 (2013).

- **Is the sulphur anomaly in planetary nebulae caused by the s-process?**
  Luke J. Shingles & Amanda I. Karakas
  Monthly Notices of the Royal Astronomical Society, Volume 431, Issue 3, p.2861-2871 (2013).