Luke Shingles, PhD

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Personal Statement

I am an experienced researcher with skills in scientific software development, data analysis, and visualisation. I would be particularly interested in opportunities to apply GPU hardware, image processing, and machine learning algorithms. I have:

- Over four years full-time paid experience developing numerically-intensive software for scientific research (C/C++)

- Expertise with multithreading and parallel algorithms (OpenMP, MPI, and CUDA)

- Expertise with debugging, performance profiling, and optimisation (gdb, perf)

- Experience with collaborative development using version control (Git), continuous integration, and automated testing

- Over eight years experience in scientific research with publications in peer-reviewed journals

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

- Expertise in statistics, differential equations, and linear algebra (machine learning fundamentals)

Employment History

Aug 2015 - Mar 2021

Astrophysicist and Software Engineer
Queen's University Belfast, Northern Ireland

- Lead developer of a photon-transport code for large-scale simulations (∼50k core-hour) and an associated set of analysis/plotting tools for use by a group of researchers.

- Implemented several matrix-based numerical solvers and Monte Carlo statistical estimators to model the relevant plasma conditions and radiation transport physics.

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

- Other tasks included giving conference presentations and lectures, writing research papers, reports, and grant applications, supervision of Masters and PhD students, and volunteering as the Postdoctoral Representative for the School of Mathematics & Physics.

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

Education

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.

- Paid work as 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

- **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).