

Lee J. O’Riordan

BSc. (Hons), Ph.D

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EXPERIENCE

Xanadu Quantum Technologies Inc., Toronto, Canada.

Senior Quantum Software Developer | 2022 - Present

Software Developer - Scientific Computing | 2021 - 2022

- I currently lead the PennyLane Performance Team, guiding the team & aiding with library design & development, to ensure the best performance on HPC and commodity hardware.
- I provide architecture, design and development support for all current HPC CPU architectures (x86, ARM, PowerPC), as well as accelerators (NVIDIA, AMD) for [PennyLane’s Lightning simulator suite](#).
- Developed & extended the GPU support for the [JET](#) tensor-network simulator, showing significant performance improvements over CPU-only execution. Additionally, through extensive performance analysis, identified the best problem configurations to make efficient use of both Intel Xeon and AMD Epyc processors for CPU-only systems.
- I build distributed HPC workflows using PennyLane & the above tooling, allowing users to make extensive use of the heterogeneous nature for research projects. This work recently demonstrated a quantum circuit optimization problem over 128 GPUs on NERSCs Perlmutter supercomputer.
- I regularly hold discussions with researchers and stake-holders (NVIDIA, AWS, various HPC centres) to ensure PennyLane is the most performant quantum software stack on their systems.

Irish Centre for High-End Computing (ICHEC), Ireland.

Senior computational scientist | 2020 - 2021

Research computational scientist | 2019 - 2020

- Designed, led and published the first demonstration of hybrid [classical-quantum NLP](#) tasks on a quantum simulator, using **Python**, **C++**, **PyBind11**, **Catch2**, **Docker**, **OpenMP**, **MPI** and backed by Intel’s Quantum Simulator (**Intel-QS**).
- Designed and implemented a modular software translation framework for composing and mapping quantum circuit problems to backend-agnostic operations using **Julia**, enabling multiple targets for quantum simulation. Work undertaken as part of [QuantEx](#) Team. Overall project available at [Github:JuliaOX](#)
- Co-designed and co-delivered the first training programme for Julia within Ireland for academics, SMEs and MNCs under the ICHEC national training directive.
- Working with senior management, specified requirements for and oversaw the acquisition of a national training and education hardware platform for quantum technologies (**Atos QLM**) with direct state funding, alongside developing training modules for professionals to leverage this technology.
- In partnership with a leading MNC, designed and led the team implementing a scalable quantum chemistry molecular analysis orchestration toolkit, using **Python**, **MPI**, **Dask**, and the Irish national HPC system, Kay. Project available at [Github:ICHEC/QPFAS](#).

Lawrence Berkeley National Laboratory (LBL), CA, USA.

Postdoctoral fellow | 2017 - 2018

- Enabled the study of a previously intractable X-ray crystallographic data resulting in publication [Acta Cryst. \(2018\). D74, 877-894](#), by improving algorithmic constant factors and complexity for a given analysis algorithm from $O(n^2)$ to $O(n \log n)$, enabled by creating **C++** extensions to existing **Python** modules. This work was integrated into the [DIALS](#) framework.
- Prevented a 6-12 month delay in data collection during a [SLAC LCLS](#) experiment, by moving the entire

real-time data analysis pipeline from the insufficient on-premises systems to NERSCs **Cori** supercomputer, allowing for sub 10 minute data quality checks. These experiments have led to the publication of the manuscript [PNAS \(2020\) 117 \(1\) 300-307](#).

- Developed and deployed a portable and more scalable analysis software pipeline through containerisation with **Docker**, reducing start-up overhead to approx. **25%** of original duration. This was by targeting optimisations supported for the **AVX2** & **AVX512** instruction set architectures of NERSC's Cori supercomputer, and selective pre-caching and pipelining of the environment.

IBM, Dublin Software Labs, Ireland.

Graduate software developer | 2010 - 2011

- Developed components in and for the IBM WebSphere Portal Solution Installer, a tool to enable automated installation of customised software solutions atop WebSphere Portal Server. My contributions included internationalisation (**i18n**) support, **XLST** parsing and transformation and **Java** classes for aiding with installation and removal across all supported platforms.
- Developed tooling for cross-compilation of **C/C++** projects to build on **x86** and deploy on **PowerPC**, allowing testing and development of a customised ***nix** environment toolkit. The tooling was built using **C**, **Python**, and **Bash**.

Education

Okinawa Institute of Science and Technology Graduate University (OIST), Japan.

Research assistant & PhD student, Quantum Systems Unit | 2012 - 2017

- Designed and wrote the fastest simulation code for nonlinear quantum dynamics ([GPUE](#)), allowing for an extensive number of publications, collaborations, talks, and subsequent roles. The software tools were written using **C/C++**, **CUDA** and **Python**, targeting Nvidia M2090 and K80 GPUs.
- Enabled research team to fully utilise computational resources of the university by providing software development, design and best-practices training for HPC system use.
- Helped to develop the Student's Council at the university from an early-stage organisation, to a fully fledged university group. Elected as Chair from 2015-2016.

Waterford Institute of Technology (WIT), Ireland.

BSc (Hons) Physics with Computing, First class honours (1.1) | 2006 - 2010.

- Awarded *School of Science Student of the Year, 2010*, for my research on developing GPU-enabled numerical integration techniques for physical system modelling, using **C** & **OpenCL**, targeting AMD Cypress generation GPUs.

Certifications & awards

Certified ScrumMaster (CSM), *Scrum Alliance*, Badge ID: [1196787](#) | Issued: 2020 - Expired: 2022.

Fundamentals of deep learning for multiple data types, *Nvidia Deep Learning Institute*, Cert ID: [8b6ae0d5a56247dfb7bf9d5e94f2f965](#) | Issued: 2020.

Fundamentals of deep learning for multi-GPUs, *Nvidia Deep Learning Institute*, Cert ID: [324c5275980847ae93789110ee02478c](#) | Issued: 2019.

Government of Ireland Postdoctoral Fellowship, *Trinity College Dublin* | 2017.
Declined fellowship to pursue postdoctoral role in Berkeley, USA.

Euraxess Links Japan Science Slam 1st runner-up, *Tokyo Institute of Technology, Japan* | 2013.

School of Science Student of the Year, *Waterford Institute of Technology, Ireland* | 2010.