

# TREVOR VINCENT, PHD

trevorvincent.com  $\diamond$  trevor.j.vincent@gmail.com

## EXPERIENCE

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### **Xanadu Quantum Technologies**

Dec. 2019 - Now

*High Performance Computing Specialist*

- Developed high performance, parallel C++ codes to simulate massive quantum circuits.
- Helped optimize C++ and python code in several Xanadu libraries: PennyLane, PennyLane-Lightning, PennyLane-Lightning-GPU, TheWalrus, Jet.
- Lead Inventor (pending patent) of the task-based tensor network simulator Jet.
- Lead HPC researcher for the Borealis Quantum advantage demonstration. Contributed supporting theoretical calculations and supercomputer simulations.

### **Canadian Institute for Theoretical Astrophysics**

Sept. 2013 - Aug. 2019

*PhD Researcher in Computational Astrophysics*

- Developed next generation numerical methods for solving the Einstein field equations (a non-linear set of partial differential equations) on supercomputers and implemented them in a  $\sim 100,000$ -line code available on GitHub.
- Worked on a team (10+developers) to develop a task-based parallelism framework for numerical relativity called SpECTRE, available on GitHub.
- Member of the LIGO collaboration, working on extracting neutrino and matter emission properties from gravitational wave and electromagnetic counterpart signals of binary neutron star mergers.

### **University of Winnipeg**

2009-2013

*Summer Research Scientist*

- Developed a state-of-art GPU-accelerated (via CUDA) C++ code for the diffusion and collision of water molecules around randomly oriented axons in 3d brain-matter. This was coupled with a numerical solve of the Bloch partial differential equations to obtain the magnetic resonance imaging signal in realistic environments.
- Developed a semi-analytical model for estimating axon distribution properties from magnetic resonance imaging signals.
- Used image-segmentation techniques to study brain changes in mice with different Alzheimer-based gene modifications.

## EDUCATION

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### **University of Toronto, Toronto, ON**

*Sept. 2013 - August 2019*

PhD in Physics, specializing in computational astrophysics. PhD work was funded by an NSERC CGSD scholarship (\$105,000) and a NSERC CGSM scholarship (\$30,000).

Advisor: Prof. Harald Pfeiffer

### **University of Winnipeg, Winnipeg, MB**

*Sept 2008 - Sept 2013*

Bachelors of Science in Physics. Undergraduate work was funded by 15 scholarships. Winner of the Governor Generals Academic Medal for highest graduating GPA in the university.

## PUBLICATIONS

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Lars S. Madsen, Fabian Laudenbach, Mohsen Falamarzi Askarani, Fabien Rortais, Trevor Vincent, et al. Quantum computational advantage with a programmable photonic processor. *Nature* 606, 7581 (2022).

Trevor Vincent, Lee J. O’Riordan, Mikhail Andrenkov, Jack Brown, Nathan Killoran, Haoyu Qi, and Ish Dhand. ”Jet: Fast quantum circuit simulations with parallel task-based tensor-network contraction.” Published in *Quantum* (2022). arXiv:2107.09793v3

Abhinav Deshpande, Arthur Mehta, Trevor Vincent, Nicolas Quesada, Marcel Hinsche, Marios Ioannou, Lars Madsen et al. ”Quantum Computational Supremacy via High-Dimensional Gaussian Boson Sampling.” Published in *Science Advances* (2021). arXiv:2102.12474

Nicolas Quesada, Juan Miguel Arrazola, Trevor Vincent, Haoyu Qi, and Ral Garca-Patrñ. ”Quadratic speedup for simulating Gaussian boson sampling.” Preprint. (2020). arXiv:2010.15595.

Trevor Vincent, Francois Foucart, Matthew D. Duez, Roland Haas, Lawrence E. Kidder, Harald P. Pfeiffer, and Mark A. Scheel. ”Unequal mass binary neutron star simulations with neutrino transport: Ejecta and neutrino emission.” *Physical Review D* 101, no. 4 (2020): 044053. arXiv:1908.00655.

Trevor Vincent, Harald P. Pfeiffer, and Nils L. Fischer. ”hp-adaptive discontinuous Galerkin solver for elliptic equations in numerical relativity.” *Physical Review D* 100, no. 8 (2019): 084052. arXiv:1907.01572.

Tanja Hinderer, Samaya Nissanke, Francois Foucart, Kenta Hotokezaka, Trevor Vincent, Mansi Kasliwal, Patricia Schmidt et al. ”Distinguishing the nature of comparable-mass neutron star binary systems with multimessenger observations: GW170817 case study.” *Physical Review D* 100, no. 6 (2019): 063021. arXiv:1808.03836.

Lawrence E. Kidder, Scott E. Field, Francois Foucart, Erik Schnetter, Saul A. Teukolsky, Andy Bohn, Trevor Vincent et al. ”SpECTRE: A task-based discontinuous Galerkin code for relativistic astrophysics.” *Journal of Computational Physics* 335 (2017): 84-114.

Morgan Mercredi, Trevor J. Vincent, Christopher P. Bidinosti, and Melanie Martin. ”Assessing the accuracy of using oscillating gradient spin echo sequences with AxCaliber to infer micron-sized axon diameters.” *Magnetic Resonance Materials in Physics, Biology and Medicine* 30, no. 1 (2017): 1-14.

Kerrie Hayes, Richard Buist, Trevor J. Vincent, Jonathan D. Thiessen, Yanbo Zhang, Handi Zhang, Junhui Wang et al. ”Comparison of manual and semi-automated segmentation methods to evaluate hippocampus volume in APP and PS1 transgenic mice obtained via in vivo magnetic resonance imaging.” *Journal of neuroscience methods* 221 (2014): 103-111.

Jonathan D. Thiessen, Trevor J. Vincent, Sheryl L. Herrera, and Melanie Martin. ”Diffusion Tensor Metric Measurements as a Function of Diffusion Time in the Rat central nervous system.” *Magnetic Resonance Insights* 5 (2012): MRI-S10692. 5:3747.

Trevor J. Vincent, Jonathan D. Thiessen, Laryssa M. Kurjewicz, Shelley L. Gernscheid, Allan J. Turner, Peter Zhilkin, Murray E. Alexander, and Melanie Martin. ”Longitudinal brain size measurements in APP/PS1 transgenic mice.” *Magnetic Resonance Insights* 4 (2010): MRI-S5885.

## SELECTED AWARDS

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NSERC CGSD Scholarship (\$105000)	<i>2015</i>
NSERC CGSM Scholarship (\$30000)	<i>2014</i>
Governor General's Academic Medal	<i>2013</i>
CIHR Undergraduate Research Award (\$5000)	<i>2013</i>
NSERC Undergraduate Research Award (\$5000)	<i>2012</i>
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