Applications of topology to Weyl semimetals and quantum computing

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Curriculum Vitæ

I was born on the 18th of November 1990 in Otahuhu, Auckland, New Zealand. In 1996, I emigrated with my parents to Wollongong, Australia, where I remained for the rest of my childhood.

In 2009, I began attending the University of Wollongong, graduating in 2012 with a Bachelor of Science (Chemistry and Physics) and a Bachelor of Mathematics (Advanced). During this time I undertook research projects in biochemistry (under Prof. Nicholas Dixon), physical chemistry (under Prof. Adam Trevitt), algebraic topology (under Prof. David Pask), and theoretical condensed matter physics (under Dr. Anthony Wright and Prof. Chao Zhang). In 2013, I shifted to the University of Queensland, Australia, to study for an BSc(Honours)(Physics) for a year, taking on a project studying Majorana bound states (under Dr. Wright) in strongly correlated systems, and graduating first in this class. In 2014, I was accepted into the Perimeter Insitute's PSI Master's program, in Waterloo, Canada. As part of this 9-month intensive program I wrote my Master's thesis on numerical investigations of many-body localization under the tutelage of Prof. Guifre Vidal, Prof. Dmitry Abanin, and Dr. Zlatko Papic.

In 2015, I was accepted for a PhD position in the group of Prof. Carlo Beenakker at Leiden University on a project with QuTech in Delft funded by a Synergy grant from the European Research Council. I began in August 2015, studying transport properties of Weyl semimetals, but towards the end of that year I took on an additional project; to provide theoretical assistance to the IARPA project of Prof. Leonardo DiCarlo (Delft University of Technology) on quantum error correction in superconducting transmon qubits. Collaboration on this quantum error correction project continues actively to this day, and both this and the Weyl project play a large role in this thesis. In 2017, with Prof. DiCarlo, Prof. Lieven Vandersypen (Delft University of Technology), and industry partners, I applied for and successfully obtained an NWA Start-Impuls grant from the Dutch National Science Foundation, to hire a postdoctoral fellow for three years to study quantum chemistry on a quantum computer. This project was the seed for a collaboration with Shell Research that will occupy me for the next several years.

List of publications

- T. E. O'Brien, B. Senjean, R. Sagastizabal, X. Bonet-Monroig, A. Dutkiewicz, F. Buda, L. DiCarlo, and L. Visscher. *Calculating energy derivatives for quantum chemistry on a quantum computer.* ArXiv:1905.03742 (2019).

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- T. E. O'Brien, C. Zhang, and A. R. Wright. *Universal geometric classification of armchair honeycomb nanoribbons by their properties in a staggered sublattice potential.* Applied Physics Letters **103** (17), 171608 (2013).
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