

Jake Xuereb

Curriculum Vitae

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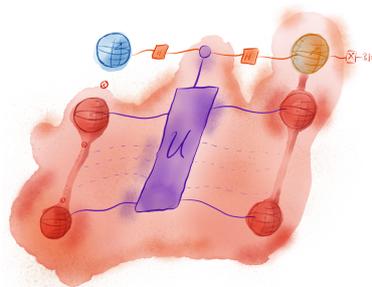


I'm interested in what fundamental truths Quantum Information can tell us about the Universe, all the way from gravity to thermodynamics. Quantum Computing can be the tool through which these truths are uncovered and our society improved.

Education

- 2021–2022 **M.Sc. Physics**, University of Malta, Msida, Malta.
Visiting student at *University College Dublin* and *Trinity College Dublin* during 2nd Semester.
Degree obtained *with distinction*, 84/100.
- 2017–2021 **B.Sc. (Hons) Mathematics and Physics**, University of Malta, Msida, Malta.
Physics Average: 74/100, *Magna Cum Laude*
- 2015–2017 **A Levels**, *De La Salle College*, Birgu, Malta.
Attained A-Levels in Mathematics, Physics & Chemistry with Intermediates in English & Philosophy.

Projects



Master's Thesis **The Thermodynamics of some Quantum Information Processes**

Supervisors Dr Steve Campbell, Prof. André Xuereb

Description During this project I studied the DQC1 complexity class of quantum algorithms as an open quantum system using the formalism of quantum channels. Here we showed that different computational inputs to algorithms like trace estimation lead to different thermodynamics experienced by the register of qubits and that that the temperature of the qubits impacts the quality of the computation. This Master's was funded by a Maltese Endeavour Scholarship and involved a long term research visit over the Winter - Spring semester of 2022 at the QuSys Group at TCD & CATS Group at UCD Dublin funded by an IPAS+ Travel Grant.

Documentation A preprint summarising the main result of this work is available at [arXiv:2209.03947](https://arxiv.org/abs/2209.03947), Xuereb et al. "**DQC1** as an Open Quantum System". The M.Sc thesis is available at <https://tinyurl.com/bdc5wxd3>.

Undergraduate **The Thermodynamics of One Qubit**
Dissertation

Supervisors Elisa Bäumer & Prof. André Xuereb

Documentation <https://tinyurl.com/yk2cffsf>

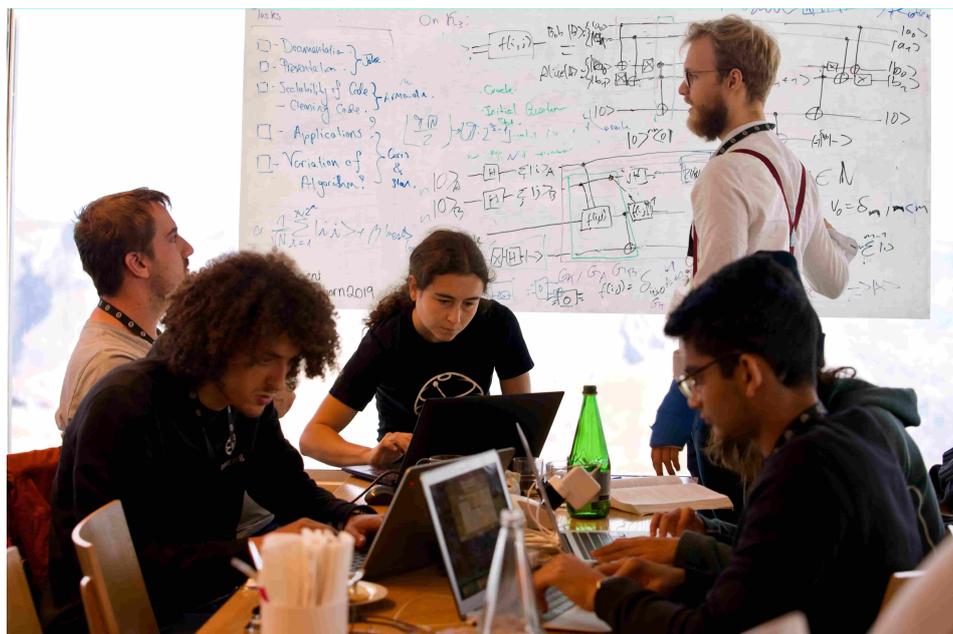
Description During the final year of my undergraduate studies I quantified the entanglement of formation generated in the trace estimation algorithm of the DQC1 complexity class using lower bounding techniques of the entanglement measure concurrence. I also started to think about how we could describe its thermodynamics in relation to the quantum resources generated. This dissertation was awarded an A+ and led to the master's research mentioned above.

Hackathon **The forced Quantum Rendezvous Problem**
Project

Supervisors Almudena Carrera Vazquez

Repository <https://tinyurl.com/y2brttzy>

Description I was invited by IBM to attend the 2019 QISKIT Hackathon at Schilthorn and chose to present the idea of working on a quantum approach to the Rendezvous problem from combinatorics. I led a team of 4 people (2 PhD students, 1 M. Sc. student and an undergrad). The algorithm was based on Grover Iteration but for more information please visit the repository. This was my first experience working on a quantum information problem with other people and really cemented my wish to continue working in the field. An image of the team is shown below.





Learnd

Supervisors Dr Jean Paul Ebejer & Josef Said

Website www.learnd.com

Description Having been extremely frustrated with the state of private education in Malta my friend Luke Collins and I, under the guidance of Dr. Jean Paul Ebejer, pursued the University of Malta's 2017 Seed Fund Award for Start Ups and won €13,500 to build a mobile app. We called this mobile app Learnd and its purpose was to connect university students with younger students that need help in their studies. After two years of working on the idea alone we sold a majority of the shareholding to a private entity which has been able to better finance and support the idea. Throughout all of this I led this project, having had a team of 5-10 people and amassed around €60,000 in funding.

Grants & Awards

2021-2022 **IPAS+ Research Travel Grant** - €5000

Funding Body Malta Council for Science & Technology

Description Together with my supervisor Prof André Xuereb, I applied to fund a research trip to collaborate with Dr. Steve Campbell and Prof John Goold in Ireland for the second semester of my masters. This grant will also fund Prof Goold and Dr. Campbell to give a series of lectures in Malta in Summer 2022. The project is entitled *MITIQ - Quantum Information and Thermodynamics in Ireland & Malta* and was ranked 1st by the grant selection committee from 30+ applications.

2021-2022 **Endeavour Scholarship** - €5200

Funding Body Ministry of Education & European Social Fund

Description This scholarship is awarded to Maltese postgraduate students to fund their Master's studies. My application was ranked 20th from 160 applications.

2017-2018 **Take Off Seed Fund Award** - €13500

Funding Body Take Off Incubator

Description One of 7 start-ups awarded from 50+ applicants.

Community Services

Founder **Qalypso Summer Schools on Quantum Science**

Description In Sept 2022 I organised a Summer School on Quantum Computation & Open Quantum Systems on the Maltese island of Gozo. The 5 day Summer School featured 11 guest speakers from Universities like Trinity College Dublin, EPFL, IQOQI Vienna, University of Helsinki, University of Palermo and industry like Algorithmiq, Quantinuum & IBM and 85 students from 40+ different Universities. For this school I raised €35,000 in government and industry sponsorships managing a total budget of approximately €45,000. With the response we've received, we look forward to this school being a yearly event that supports and encourages the young Mediterranean physics community as well as the fields of Quantum Thermodynamics & Information

Documentation More information about this Summer school is available at qalypso.info and the lectures from the first edition may be viewed at [texthttps://tinyurl.com/2pmbuwss](https://tinyurl.com/2pmbuwss)

Referee Reviewed 5-10 manuscripts for **Physical Review Letters & Physical Review Letters A**

Talks, Conferences & Visits



8 - 14 Aug 2022 I was invited to visit the group of Marcin Wieśniak and gave a guest seminar at the International Centre for Theory of Quantum Technologies in Gdansk, Poland.

1 - 5 Aug 2022 I was selected to be one of the two Maltese representatives at the Quantum Future Academy held by the EU Quantum Flagship and the German Ministry for Education & Research.

14 - 21 Mar 2022 Invited to visit the group of Marcus Huber at the Atominstut in Vienna.

12 Dec 2021 I was invited to give a *Quantum Lightning Talk* about my research to over 300 high school students attending the Qubit by Qubit Virtual School. Video available at <https://tinyurl.com/4wvwwk9rf>

28 Sep 2021 Guest lecture given as part of *EBI3085* at the University of Malta on Entrepreneurship.

20 Sept 2021 Gave talk entitled *The Haar Measure & Solovay-Kitaev Theorem* as a student lecture at the end of the Malta Mathematical Society Summer Lecture Series on Differential Geometry conveying the importance of these mathematical tools in Quantum Information. - Talk notes

- 16 Jun 2021 Gave talk entitled *The Thermodynamics of some Quantum Information Processes* summarising my research as part of a workshop between Quantumalita and the International Center for Theoretical Quantum Technologies.
- 14 Apr 2021 Gave virtual public talk to international audience, entitled *Quantum Pastizzi* as part of Maltese effort for World Quantum Day. Video available at <https://tinyurl.com/b6z42dkz>
- 5 Mar 2021 Participated in public debate entitled *Is Mathematics Invented or Discovered?* organised by the Malta Mathematical Society. Video available at <https://tinyurl.com/5xu4zsvk>
- 18 Nov 2020 I gave a short talk entitled *What do entangled states and Steiner trees have in common?* at a Malta Mathematical Society meeting about how NP-Hardness connects the Quantum Separability problem and Soap Bubbles finding Steiner trees together.
- 20 Oct 2020 Guest lecture given as part of *EBI3085* at the University of Malta on Entrepreneurship.
- 21 Feb 2020 I gave an hour long talk entitled *Tensor Networks - Visual Proofs and some Quantum Mechanics* at one of the Malta Mathematical Society meetings introducing the attendants to the graphical formalism of tensor networks. Showing their ubiquity in proof and visualisation of circuits. - Notes.
- 9 Oct 2019 I gave a short talk entitled *What do pentagons and baryons have in common?* at the first meeting of the reinstated Malta Mathematical society about how the Euler characteristic of objects determines their properties like how the Euler number of a truncated icosahedron leads to footballs having 12 pentagonal faces and the Euler number of Tian-Yau manifolds could explain the generations of matter particles. - Slides.
- 24 Sep 2019 Guest lecture given as part of *EBI3085* at the University of Malta on Entrepreneurship.
- 12-14 Sep 2019 Attended QISKIT Camp 2019 at Schilthorn and formed part of Team Quantum Rendezvous with Almudena Carrera Vazquez as coach. Presented results on behalf of Team. - Slides
- 9-12 Sep 2019 Attended *Quantum Information for Developers 2019* a quantum computing summer school and hackathon held at and organised by ETH Zürich.
- 12th Apr 2019 Delivered talk at the 2019 S^3 Annual Science Conference entitled *Can stitching up Spacetime differently give different Quantum Mechanics.* - Slides.
- 12 October 2018 People's Choice Award winning pitch delivered on behalf of LearnD at the Malta Innovation Summit.
- 9th Oct 2018 Guest lecture given as part of *EBI3085* at the University of Malta on Entrepreneurship.
- 11-14th Sep 2018 Attended *Quantum Information for Developers 2018* a quantum computing summer school and hackathon held at and organised by ETH Zürich.

Programming Languages

- Basic JAVASCRIPT
- Intermediate HTML, CSS, Linux
- Advanced PYTHON, \LaTeX

Quantum Computing Frameworks

- Basic Project Q, Q#
- Intermediate Cirq
- Advanced QISKIT, QASM

Natural Languages

English **Mother tongue**
Maltese **Mother tongue**
French **Intermediate**
Italian **Basic**

Conversationally fluent
Words & Phrases

Interests



Malta Mathematical Society In an effort to kindle a sense of community amongst the students in the Departments of Mathematics and Physics, some fellow students and I reinstated the Malta Mathematical Society and have been hosting biweekly talks since the start of the 2019 academic year. The talks vary from number theory, applied mathematics to how to study effectively. I have formed part of the executive for the past two years.

Science Communication For two years now I have had the opportunity to visit schools with other undergraduates and try to communicate why we love Physics so much and what it really is about. In these settings I typically talk to students about where the colours of objects come from and use this as a spring board to then get them to think about why the sky is blue.

- Wrote an article entitled *Information is hot* about the dual nature of entropy and a shorter article on why I think *Building a teleporter* is physically impossible, for the Times of Malta, published August 8th 2021. You can read the articles [here](#).
- Wrote an article entitled *What is Quantum?* for the Times of Malta, published November 17th 2019. You can read the article [here](#).
- I like to write threads about my research and things I'm thinking about in Quantum Information on Twitter accompanied by some drawings and sketches I make. You can find these [@curlyqubit](#).

Education Reform in Malta This year I led an initiative to get a group of academics together to issue a number of suggestions on education reform in STEM to the government of Malta. An open letter was signed by 40+ academics. Times of Malta Article about this initiative - <https://tinyurl.com/mu3c6k7u>

L^AT_EX Note Taking For my own benefit when studying and for the benefit of students to come after me, I have often written notes for units I would have taken. - Sample - Notes on Introductory Real Analysis - <https://tinyurl.com/3dy85fc6>

Running I run ≈ 25 km a week, mostly trails, and recently completed the Gozo 21km *XTERRA* Trail Run which involves running the island of Gozo from tip to tip.

Brazilian Jiu Jitsu In 2020 I started practicing this grappling sport and am currently a measly three stripe white belt.

Guitar I have been playing guitar for 10 years and am avid listener of music. I enjoy listening to and playing anything from Bach's Solo Cello Concerto to music by the Japanese progressive rock band Toe.

Scouting I was an active member of the Cospicua Scouts Group from 2010-2015, even having the privilege of being chairman of the venture scouts unit for the year 2014.

Additional Information

Date & Place of Birth 5th March 1999, Pietá, Malta.

Nationality Maltese (EU Passport).

Miscellaneous Prof. André Xuereb and I, whilst sharing the same surname, are not related by family.

Note This document contains hyperlinks for extra documentation. Important documentation has a *tinyurl* but some links are associated to words such as "Slides" which are accessible through the *pdf* of this document. If you are seeing a printed version of this document, head to www.jakexuereb.com/cv_long.pdf to access a digital version.