QuARC

History, Current State, and Future Prospects

Carlos A. Perez-Delgado, May 2026

What is QuARC

Goals, Activities & Aspirations

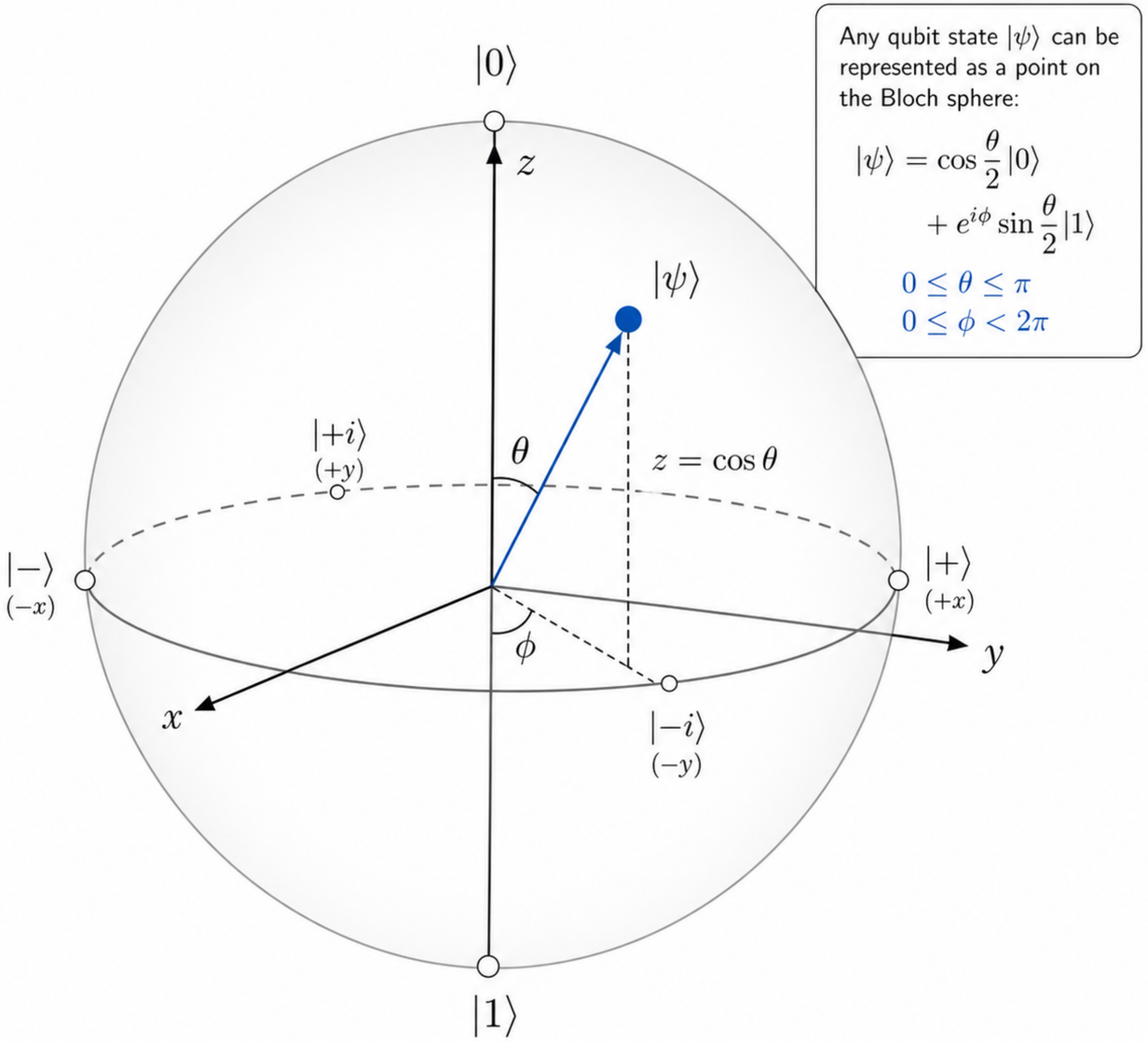
- For years, a few us of have been building a network for inter-disciplinary collaboration around quantum technologies, in research, teaching, and outreach.

- QuARC creates a mechanism to extend this benefit to many more members and research groups...

Why is QuARC

Goals, Activities & Aspirations

- Quantum physics teaches us that reality, and what we perceive as reality, are not the same
- Classical reality is, literally, a projection, or shadow, of quantum reality
- By accessing the greater quantum “dimension" we can find shortcuts or *advantages,* in multiple areas, including:
  - Computation, Communication (more secure, faster), Measurements, Energy (efficiency)...*and others?*



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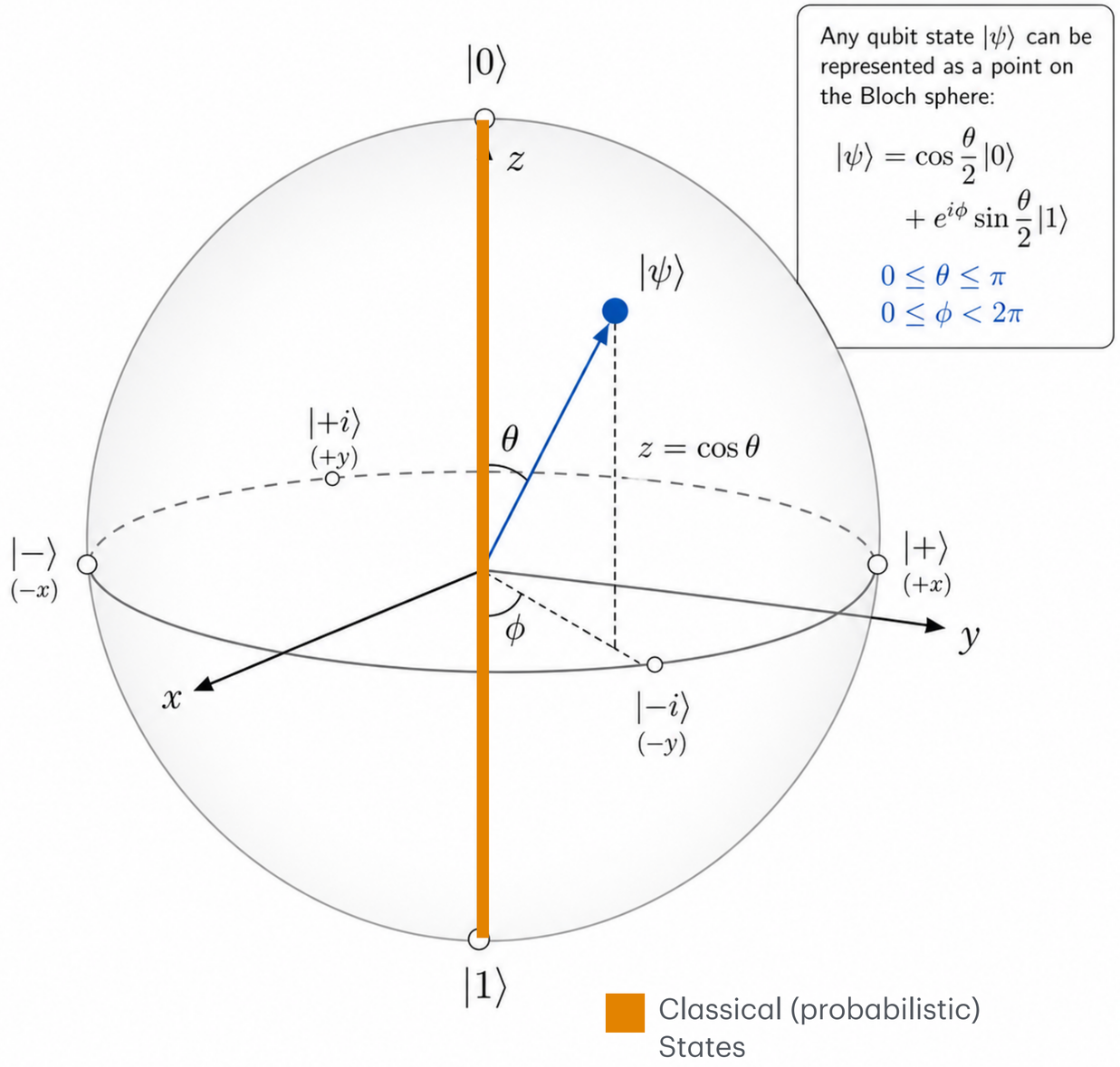

Who is QuARC

QuARC Leadership

- Director: Jorge Quintanilla

  Over 25 years' experience in condensed matter theory and quantum technologies, including unconventional superconductivity, quantum materials, optical lattices, spin ice, machine learning, and applications of quantum computing to condensed matter and operational research problems. Previous affiliations include the University of Bristol, ISIS Neutron Source at Rutherford Appleton Laboratory, and St Catherine's College, Oxford. Founding group leader of the PQM Research Group, chair of the SEPnet Atomic and Condensed Matter research theme.

- Deputy-Director: Carlos Perez-Delgado

  20 years experience working in multiple areas of quantum technologies, including quantum computation, algorithms, and data-structures; quantum cryptography and cybersecurity; quantum software engineering; quantum metrology and imaging. Previous affiliations include the Institute for Quantum Computing at the University of Waterloo, Perimeter Institute, and the Centre for Quantum Technologies at National University of Singapore.

Who is QuARC

QuARC Core Faculty Members

- Dr Sanjay Bhattacherjee - Computing
- Professor Alex Freitas - Computing
- Dr Stuart Gibson - Physics
- Professor Andy Hone - Maths
- Dr Steffen Krusch - Maths
- Professor Nigel Mason - Physics
- Dr Gunnar Möller - Physics
- Professor Tri-Dung Nguyen - Business
- Dr Marco Paviotti - Computing
- Professor Adrian Podoleanu - Physics
- Professor Paul Strange - Physics
- Dr Chao Wang - Engineering
- Professor Frank Wang - Computing
- Dr Huiling Zhu - Engineering

Who is QuARC

QuARC Research Students

- Lee Armstrong - Computing
- Elizabeth Chipperfield - Physics
- Diksha Diwakar Gautam - Computing
- Joshua Tucker - Physics
- Tatiana Vlassi - Physics
- Christopher Weeks - Physics

The Proto-QuARC

Qiskit Club

- A weekly symposium / seminar / informal gathering of researchers
- Both faculty and students
- Across (currently) two schools in Kent: Physics and Computing
- Occasional external guests
- Meant to foster and accelerate interdisciplinary collaboration, and research
- Running for over a year now
- Extremely successful!

QuARC Activities

COMP7006: Introduction to Quantum Computing & Quantum Cryptography

- Running for over four years.
- Module offered to both Physics and Computing students (both undergraduate and graduate).
- Offers an approachable introduction to the topic
- Proven jumping-board towards a research career in the field

QuARC Activities

PHYS7014: Quantum Materials

- New module this year
- Merges condensed matter physics and quantum information theory / technologies.
- A more advanced module that builds on COMP7006

QuARC Activities

Research

- **(Post-)Quantum Cybersecurity**
  - **Quantum Cryptography:** CP
    - PRL 114 (22), 220502, PRA 90 (5), 050303, PRL 111 (23), 230502
  - **Blockchains/Cryptocurrencies:** Jorge Quintanilla, Lee Armstrong, Diksha Gautam, CP
    - Array 10, 100065, Array 15, 100225, arXiv:2410.16965
- **Quantum Computation:** CP
    - NJP 23 (12), 123015, PRA 100 (3), 032331
- **Quantum Algorithms & Data Structures:** CP
    - Array 10, 100065, Array 15, 100225, arXiv:2410.16965
- **Quantum Collaborative Games**
  - **Graph Domination:** Jorge Quintanilla, Chris Weeks, Paul Strange
    - arXiv:2511.15802
  - **Graph Rendezvous:** Jorge Quintanilla, Josh Tucker, Paul Strange, CP
    - arXiv:2405.14951
  - **Interstellar Missions:** Jorge Quintanilla, Tatiana Vlassi

QuARC Activities

Research

- **Quantum Operational Research:** Jorge Quintanilla, Tri-Dung Nguyen, CP
- **Quantum Software Engineering**
  - **Software Modelling Languages:** CP
    - Proc. 42nd ICSE, pp. 442–444 (2020); Quantum Software Engineering, Springer (2022), pp. 103-119
  - **Software Metrics:** CP
    - arXiv:2402.08505
- **Quantum Magnets** Jorge Quintanilla
    - PRL 123 (6), 067204; PRB 96 (22), 224408
  - **Neutron-Scattering quantum computer simulations:** Jorge Quintanilla, Lizzy Chipperfield
- **Superconductors:** Jorge Quintanilla
    - PRL 102 (11), 117007; PRB 82 (4), 045110; PRB 102 (2), 020503; NPJ Quantum Materials 7 (1), 35
- **VR:** Lee Armstrong

QuARC Activities

Research

- **Quantum Metrology**
  - **Fundamental Limits:** CP
    - PRL 105 (18), 180402; PRA 90 (5), 050303
  - **State Tomography with Neutrons:** Jorge Quintanilla
    - PRB 106, 104435
  - **Quantum Imaging:** CP
    - PRL 109 (12), 123601
  - **Algorithmic Techniques:** CP
    - PRL 97 (10), 100501

- **Strongly correlated quantum systems** Jorge Quintanilla
    - PRBB 82, 174511; PRB 74, 115126; PRL 93, 080404
- **Neutron-Scattering quantum computer simulations:** Jorge Quintanilla, Lizzy Chipperfield
- **Data analysis w. machine learning :** Jorge Quintanilla, Lizzy Chipperfield, Chris Weeeks
    - PRL 102 (11), 117007; PRB 82 (4), 045110; PRB 102 (2), 020503; NPJ Quantum Materials 7 (1), 35
- **Optical Lattices :** Jorge Quintanilla,
    - PRL 93 (8) 080404; PRA 79 (3), 031601;

QuARC Activities

Funding

- **Quantum Communications Hub**
  - ESPRC. CP (co-I, PI for Kent), £900K
- **Quantum Advantage in Blockchains**
  - Casper Assc. CP (PI), £360K
- **Unconventional Superconductors**
  - EPSRC. Jorge Quintanilla (PI), £850K

- **NQCC-Funded research grants:**
  - **Graph Domination:** Jorge Quintanilla, Chris Weeks
  - **Graph Rendezvous:** Jorge Quintanilla, Josh Tucker,
  - **Quantum Bitcoin Mining:** CP, Lee Armstrong
  - **Neutron-Scattering quantum computer simulations:** Jorge Quintanilla, Lizzy Chipperfield
  - **Genetic Algorithms & Graph Domination:** Jorge Quintanilla, Chris Weeks

QuARC Activities

Outreach

- **Secondary School Engagement**
  - Josh Tucker, Lee Armstrong, CP
- **VR for Teaching**
  - Lee Armstrong
- **Youtube, Podcasts, News,**
  - CP
- **TV,**
  - Jorge Quintanilla

NewScientist

Technology

Quantum com slash the energy use of cryptocurrencies

Mining uld be done using quantum computers, cutting ent

Forb veals 'huge' savings in energy with Quantum mining

rchers at the University of Kent found quantum ns to be much more energy efficient for mining blockchain compared to an ASIC miner

QuARC Activities

Today

- **Seek to jumpstart new collaborations and discussions on:**
  - Research
  - Funding
  - Teaching
  - Outreach