Jake Horder

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Summary

I am passionate about quantum technologies and the key role that single photon sources can play. I believe that the emerging development of these technologies for industrial and commercial applications will have a profound influence on computation, sensing and material development. By leveraging my background as a structural design engineer and mathematics educator I am aiming to establish a new career as a quantum engineer.

Education

University of Technology Sydney Ultimo, NSW • Doctor of Philosophy 2022-2025

• Research focus

Quantum Optics · Nanophotonics · Cryogenic Spectroscopy · Experimental Design · Data Processing · Data Analysis · Team Management

Australian National University Acton, ACT • Master of Science (Quantum Technology (Advanced)) 2020-2021 *with Commendation*

• Selected Coursework:

Quantum Computing · Quantum Information · Quantum Sensing · Optical Physics · Control Systems · Rapid Prototyping · Machine Learning · Software Defined Radio

University of Sydney Darlington, NSW • Bachelor of Engineering (Civil (Environmental)) 2008-2012 *with Honours*

• Selected Coursework:

Engineering Structural Mechanics · Fluid Mechanics · Scientific Computing · Project Management

Mathematics Calculus · Differential Equations · Linear Algebra · Mathematical Models · Statistics

Shore School North Sydney, NSW • 2001-2006

Awards

- UTS MaPS HDR Student of the Year, 2024
- UTS SEED Funding recipient, November 2024
- Member of Australian Delegation to 73rd Lindau Nobel Laureate Meeting (Physics), Lindau Germany, July 2024
- Finalist, Australian Institute of Physics NSW Postgraduate Awards, November 2023
- UTS MaPS Paper of the Month, December 2022
- UTS competitive RTP scholarship, 2022-2025
- Finalist, Vision30 Leading Australian Young Innovators, Warren Centre for Advanced Engineering, November 2013

Doctoral Research

Published Works

1. *Coherence Properties of Electron-Beam-Activated Emitters in Hexagonal Boron Nitride Under Resonant Excitation* (Editor's Suggestion).

   Jake Horder, Simon J.U. White, Angus Gale, Chi Li, Kenji Watanabe, Takashi Taniguchi, Mehran Kianinia, Igor Aharonovich, and Milos Toth.

   Physical Review Applied 18, 064021 – Published 8 December 2022

2. *Photophysics of blue quantum emitters in hexagonal boron nitride.*

   Ivan Zhigulin, Karin Yamamura, Viktor Ivdy, Angus Gale, **Jake Horder**, Charlene J Lobo, Mehran Kianinia, Milos Toth, and Igor Aharonovich.

   Materials for Quantum Technology 3, 1, 015002 – Published 7 March 2023

3. *Stark Effect of Blue Quantum Emitters in Hexagonal Boron Nitride.*

   Ivan Zhigulin*, **Jake Horder***, Viktor Ivady, Simon J.U. White, Angus Gale, Chi Li, Charlene J. Lobo, Milos Toth, Igor Aharonovich, and Mehran Kianinia.

   * These authors contributed equally.

   Physical Review Applied 19, 044011 – Published 5 April 2023

4. *Deterministic Fabrication of a Coupled Cavity-Emitter System in Hexagonal Boron Nitride.*

   Milad Nonahal*, **Jake Horder***, Angus Gale*, Lu Ding, Chi Li, Madeline Hennessey, Son Tung Ha, Milos Toth, and Igor Aharonovich.

   * These authors contributed equally.

   Nano Letters 23, 14, 6645-6650 – Published 7 July 2023

5. *Annealing of blue quantum emitters in carbon-doped hexagonal boron nitride.*
   Yongliang Chen, Angus Gale, Karin Yamamura, **Jake Horder**, Alexander Condos, Kenji Watanabe, Takashi Taniguchi, Milos Toth, and Igor Aharonovich.
   Applied Physics Letters 123, 041902 – Published 24 July 2023
6. *Monolithic integration of single quantum emitters in hBN bullseye cavities.*
   Lesley Spencer, **Jake Horder**, Sejeong Kim, Milos Toth, and Igor Aharonovich.
   ACS Photonics 10, 12, 4417-4424 – Published 17 November 2023
7. *Scalable bright and pure single photon sources by droplet epitaxy on InP nanowire arrays.*
   Xiaoying Huang, **Jake Horder**, Wei Wen Wong, Naiyin Wang, Yue Bian, Karin Yamamura, Igor Aharonovich, Chennupati Jagadish, and Hark Hoe Tan.
   ACS Nano 18, 7, 5581-5589 – Published 4 February 2024
8. *Engineering quantum light sources with flat optics.* (Invited review)
   Jinyong Ma, Jihua Zhang, **Jake Horder**, Andrey A. Sukhorukov, Milos Toth, Dragomir N. Neshev, and Igor Aharonovich.
   Advanced Materials 2313589 – Published 13 March 2024
9. *Optical manipulation of spin resonance in gallium nitride.* (News and Views)
   Jake Horder and Igor Aharonovich.
   Nature Photonics 18, 309-310 – Published 5 April 2024
10. *Near-coherent quantum emitters in hexagonal boron nitride with discrete polarization axes*
    Jake Horder, Dominic Scognamiglio, Adam Ganyecz, Viktor Ivady, Nathan Coste, Mehran Kianinia, Milos Toth, and Igor Aharonovich
    ACS Photonics 11, 10, 3954?3959 – Published 23 September 2024
11. *Narrowband Electroluminescence from Color Centers in Hexagonal Boron Nitride*
    Gyuna Park, Ivan Zhigulin, Hoyoung Jung, **Jake Horder**, Karin Yamamura, Yerin Han, Kenji Watanabe, Takashi Taniguchi, Igor Aharonovich, and Jonghwan Kim
    Nano Letters 24, 48, 15268?15274 – Published 21 October 2024
12. *Double Etch Method for the Fabrication of Nanophotonic Devices from Van der Waals Materials*
    Otto Cranwell Schaeper, Lesley Spencer, Dominic Scognamiglio, Waleed El-Sayed, Benjamin Whitefield, **Jake Horder**, Nathan Coste, Paul Barclay, Milos Toth, Anastasiia Zalogina, Igor Aharonovich
    ACS Photonics 11, 12, 5446?5452 – Published 20 November 2024
13. *Optical Coherence of B Center Quantum Emitters in Hexagonal Boron Nitride*
    Jake Horder*, Dominic Scognamiglio*, Nathan Coste, Angus Gale, Kenji Watanabe, Takashi Taniguchi, Mehran Kianinia, Milos Toth and Igor Aharonovich
    * These authors contributed equally
    ACS Photonics 12, 3, 1284-1290 – Published 13 January 2025
14. *Quantum Emitters in Flux Grown hBN*
    Evan Williams, Angus Gale, **Jake Horder**, Dominic Scognamiglio, Milos Toth and Igor Aharonovich
    Crystal Growth & Design 25, 7, 2083-2089 – Published 18 March 2025
15. *Bottom-up Single Quantum Dots in Microring Resonators for On-Chip Integrated Single Emitters*
    Xiaoying Huang, **Jake Horder**, Karin Yamamura, Wei Wen Wong, Igor Aharonovich, Naiyin Wang, Chennupati Jagadish, and Hark Hoe Tan
    Nano Letters 25, 5, 6318-6324 – Published 7 April 2025
16. *Quantum Emitters in Rhombohedral Boron Nitride*
    Angus Gale, **Jake Horder**, Milos Toth and Igor Aharonovich
    Submitted

Conference Presentations

1. *Resonant Spectroscopy of Blue Quantum Emitters in Hexagonal Boron Nitride*
   Australian Institute of Physics Congress, Adelaide SA Australia – Presented 13 December 2022
2. *Resonant Spectroscopy of Blue Quantum Emitters in Hexagonal Boron Nitride*
   CLEO: Conference on Lasers and Electro-Optics, San Jose CA USA – Presented 8 May 2023

3. *Quantum Light in Flatland: sourcing indigo photons from nanostructures in hexagonal boron nitride*
   Australian Institute of Physics NSW Postgraduate Awards, Sydney NSW Australia – Presented 14 November 2023
4. *Quantum Technologies with Single Photon Emitters in Hexagonal Boron Nitride*
   ARC Centre of Excellence for Transformative Meta-Optical Systems (TMOS) Meta Together Conference, Moreton Island QLD Australia – Presented 13 December 2023
5. *Near-coherent quantum emitters in hexagonal boron nitride with discrete polarization axes*
   ARC Centre of Excellence for Transformative Meta-Optical Systems (TMOS) Science Tuesdays, UTS and online, Sydney NSW Australia – Presented 27 February 2024
6. *Near-coherent quantum emitters in hexagonal boron nitride with discrete polarization axes*
   (accepted Post Deadline)
   CLEO: Conference on Lasers and Electro-Optics, Charlotte NC USA – Presented 9 May 2024
7. *Near-coherent quantum emitters in hexagonal boron nitride with discrete polarization axes* (Poster)
   Boron Nitride Workshop, UTS, Sydney NSW Australia – Presented 22 May 2024
8. *Near-coherent quantum emitters in hexagonal boron nitride with discrete polarization axes*
   Attocube 2D Materials Conference, Munich Germany – Presented 6 June 2024
9. *The B Centre in hBN: a Promising Source of Near-Coherent Single Photons with Discrete Polarisation* Axes (Poster)
   Defects in Solids for Quantum Technologies, Budapest Hungary – Presented 12 June 2024
10. *The B Centre in hBN: a Promising Source of Near-Coherent Single Photons with Discrete Polarisation Axes* (Poster)
    Australian Institute of Physics Congress, Melbourne VIC Australia – Presented 2 December 2024

Other Research

Masters Research Project: Straintronics in 2D TMDs (2021)
- Investigated the optical characteristics of nanobubbles induced in bulk TMDs via plasma irradiation
- Liaised with university staff across departments to organise access to specific facilities for novel purposes.
- Held ongoing discussions with plasma facility specialists to identify controllable experiment parameters.
- Designed plasma treatment regime to efficiently explore the parameter space of the experiment.
- Prepared TMD samples using mechanical exfoliation.
- Examined sample quality and preliminary results using optical microscope.
- Maintained clean laboratory benchwork and sample storage protocols to ensure highly organised project workflow.

Quantum Sensor Fusion Study (2021)
- Analysed the advantages and constraining features of atom interferometer quantum accelerometers.
- Investigated data fusion methods that combine GPS location data with MEMs-based classical accelerometer data to improve positioning.
- Designed a hybrid inertial measurement algorithm that fused quantum and classical accelerometer sensing data in real time.
- Critically analysed the performance of the algorithm using simulations of diverse measurement scenarios.

Topological Quantum Computation Study (2020)
- Explored the status of TQC in the context of the DiVincenzo criteria.
- Examined a range of anyon models based on different specifications of braid statistics.
- Identified how universal gates would be implemented using Fibonacci anyons.
- Reviewed the discussions in the literature relating to the possible observation of Majorana zero modes.

LIGO Optics Study (2020)
- Surveyed the catalogue of noise sources that limit the sensitivity of the Advanced LIGO detectors.
- Examined the mode cleaning and frequency stabilisation methods implemented at the laser source.
- Analyse the significance of implementing squeezed light at the laser output.

Conference Phosphorus Sustainability Study (2013)
- Discussed options for removal and recovery of non-mineral phosphorus from municipal wastewater.
- Presented at the Vision30 Conference for The Warren Centre For Advanced Engineering.
- Named as a competition finalist and Leading Young Australian Innovator.

Undergraduate Honours Thesis (2012)
- Investigated the sensitivity of grassland soil respiration to different patterns of rainfall precipitation events.
- Used parallel processing to run high level mechanistic code ToughReact.
- Prepared and post-processed data using Regex and Matlab.

Work History

Mathspace (2016 - 2019)
Mathematics Education Specialist

- Created and curated a fully interactive digital learning resource for students studying mathematics in primary school, high school and university.
- Discussed established pedagogy theory and the most promising ideas in the recent research.
- Greatly improved my teaching skills, learning skills, and my capacity to explain complex concepts to a variety of audiences.
- Wrote best practice documentation to formalise my team's approach to writing style and register and definitions of notoriously ambiguous mathematics terminology.
- Received consistently high praise for written lessons and exploratory blog articles.
- Engaged with students and teachers at conferences, school visits, and online to constantly improve my understanding of how our product was being used and how it could improve.
- Communicated with other internal teams to improve the workflow and tools available to the mathematicians.
- Organised and facilitated training of new team members and sustained an ongoing mentorship role.

OnQ Engineering & Design (2015 - 2016)
Structural Design Engineer

- Used knowledge of continuum mechanics and dynamics to design the structural components of tilt-up concrete warehouses in Western Sydney.
- Developed designs using a combination of hand-calculation methods and proprietary FEA software.
- Created a custom built computer program to determine beam and column selection based on theoretical considerations and the specifications outlined in the Australian Standards for Steel Structures Design.
- Produced detailed engineering drawings using CAD drafting software.
- Liaised with clients and colleagues to manage project delivery.
- Coordinated site inspections to supervise construction and to discuss with builders ways to improve design efficiency.

Darling Irrigation (2013 - 2014)
Service Technician

- Assisted in construction and service of large lateral irrigation machines used on wheat and cotton farms in regional NSW.
- Developed practical knowledge of the physics of high powered pumps.
- Gained a greater appreciation for the economic and environmental intricacies of farming and water industry.

References

Professor Igor Aharonovich
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Dr Simon White
Centre for Quantum Dynamics, Griffith University
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