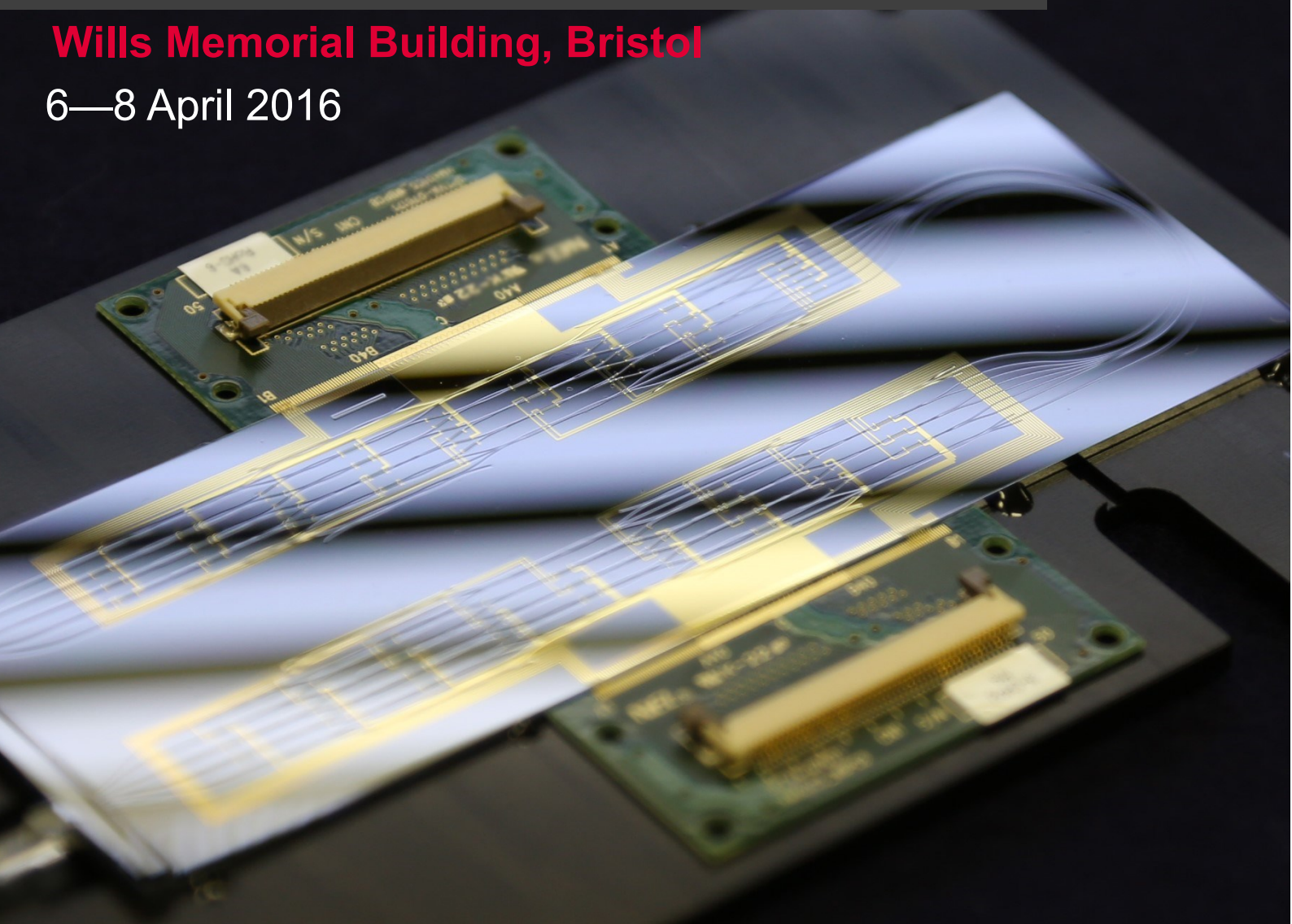


2016

# Bristol Quantum Information Technologies Workshop

Wills Memorial Building, Bristol

6—8 April 2016



# Welcome to BQIT:16

Topics of Discussion	2
Day One	3
Welcome dinner	5
Day Two	6
Day Three	8
Sponsors	10
QTEC-Bristol	11
Notes	12
Funders and Collaborators	15
Contact Us	16

## CONTENTS

**Dear Colleagues and Friends,**

On behalf of the Programme Committee, I would like to welcome you to Bristol and the 2016 Quantum Information Technologies workshop.

We have an exciting programme of presentations and panel discussions including an industry perspective session on Wednesday morning, the launch of the IOP's new journal—'Quantum Science and Technology' on Wednesday evening and a panel discussion on the ethical implications of quantum technologies on Friday afternoon.

BQIT:16 is the ideal opportunity for you to meet colleagues, establish new connections and collaborations and explore new directions. We want you to make the most of the next few days and we have a full agenda, so please take a few minutes to read through the information in this programme.

We sincerely hope you enjoy your time with us in Bristol and hope to see you back at BQIT next year from the 5-7 April 2017.

Best Wishes

**Professor Mark Thompson**

**On behalf of the Programme Committee**

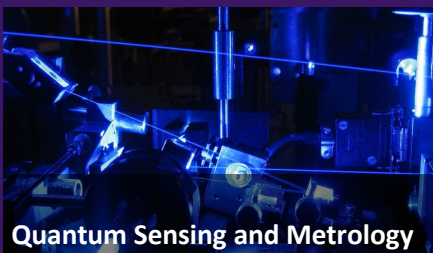
## Topics for Discussion



Quantum Algorithms



LIQUI> Tutorial



Quantum Sensing and Metrology



Hardware



Quantum Communications and Networks



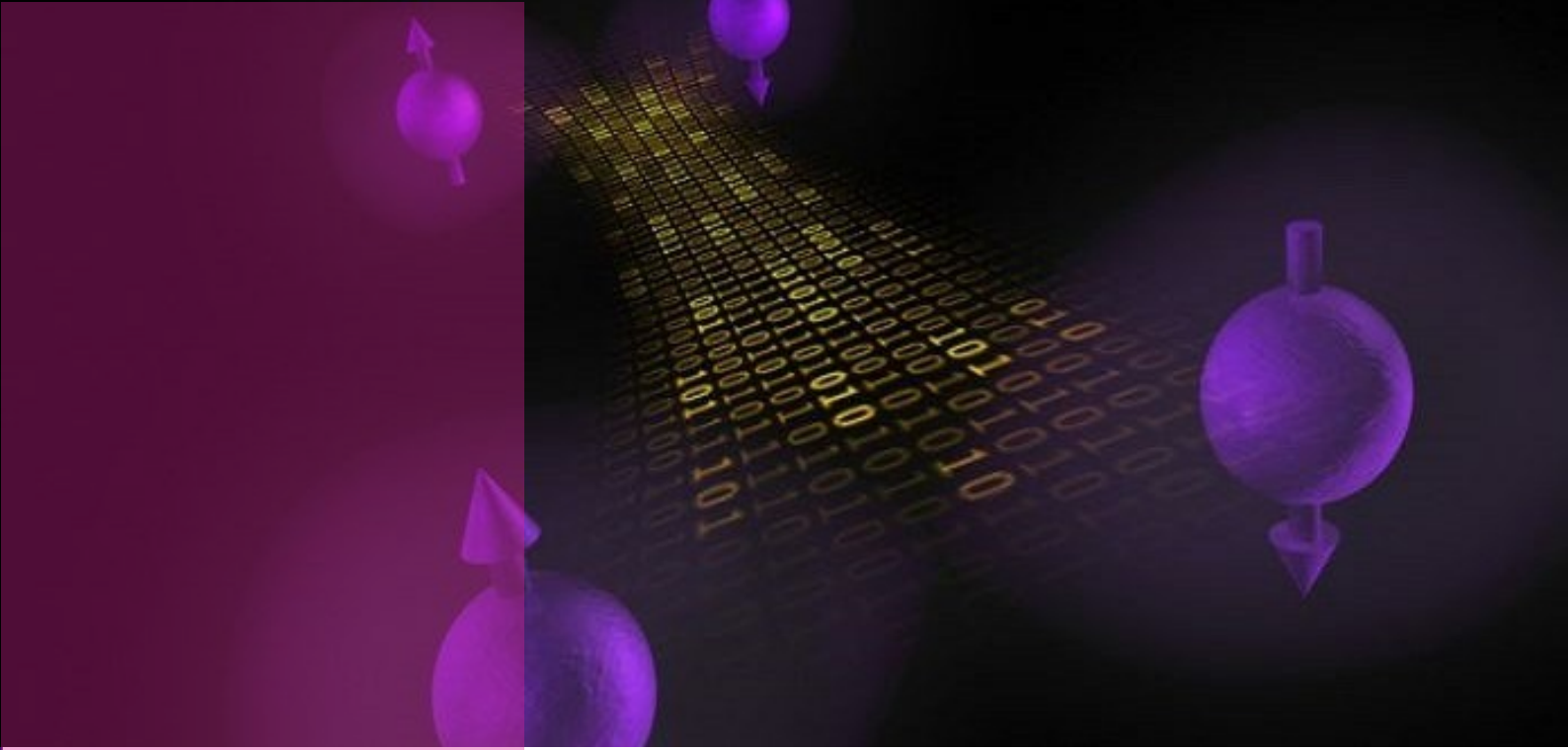
Quantum Computation and Information



1QBit demo



Ethical implications of quantum technologies



# Day One

Wednesday 6th April

Time	Event
09:30	Arrivals and Registration
10:15	Welcome by Mark Thompson
<b>Quantum Algorithms</b>	
10.20	<b>Dave Wecker</b> (Microsoft Research) <i>'Quantum Algorithms: Classical Simulation and Hardware Targeting'</i>
11.10	<b>Andru Gheorghiu</b> (University of Edinburgh) <i>'Verification of Quantum Computing - The price of Trust'</i>
11:45	<b>Short Break</b>
<b>Industry Perspective</b>	
11:55	<b>Steven Adachi</b> (Lockheed Martin Space Systems Company) <i>'Near-Term Applications of Quantum Annealing'</i>
12:40	<b>Panel Members:</b> <ul style="list-style-type: none"><li>• Dave Wecker (Microsoft Research) (chair)</li><li>• Steven Adachi (Lockheed Martin Space Systems Company)</li><li>• Jeff Hunt (Boeing)</li><li>• Richard Murray (Innovate UK)</li><li>• Chris Snelling (ICEOxford)</li></ul>
13:15	<b>Lunch</b>

Continued on next page

# Day One cont....

Time	Event
<b>LIQUI &gt; Tutorial</b>	
14:15	<b>Dave Wecker</b> ( <i>Microsoft Research</i> )
15:45	Questions
16:00	<i>Coffee Break</i>
<b>Quantum Metrology and Sensing</b>	
16:15	<b>Morgan Mitchell</b> (ICFO)
16:55	<b>Paul Knott</b> (University of Sussex) <i>'The role of quantum correlations in optical quantum metrology'</i>
17:25	<b>Panel Members:</b> <ul style="list-style-type: none"><li>• Jonathan Matthews (University of Bristol) (chair)</li><li>• Vincent Boyer (University of Oxford)</li><li>• Barry Garraway (University of Sussex)</li><li>• Paul Knott (University of Sussex)</li><li>• Morgan Mitchell (ICFO)</li><li>• John Rarity (University of Bristol)</li></ul>
18:00	<b>Move next door to the Bristol Museum and Art Gallery for drinks reception and dinner</b> <i>(Please be aware that PhD students are unable to attend this evening's event)</i>

## Day 1 : Drinks Reception

Launch of the IOP Quantum Science and Technology Journal

Our drinks reception has been sponsored by the Institute of Physics who will be launching their new multidisciplinary, electronic-only journal *Quantum Science and Technology* at our event.

Their journal is devoted to publishing research of the highest quality and impact covering theoretical and experimental advances in the fundamental science and application of all quantum-enabled technologies.

We have two speakers at the reception who will tell you more about the journal itself; the Editor-in-Chief **Rob Thew** and **Jamie Hutchins** the Publishing Director.

We are also joined by several IOP staff who will be able to answer any questions you may have.

## Quantum Science and Technology

NEW FOR  
2016

[iopscience.org/qst](http://iopscience.org/qst)

*Quantum Science and Technology*™ (QST) is a new multidisciplinary, electronic-only journal, publishing breakthrough research on the fundamental science and application of all quantum-enabled technologies.



To find out more about publishing your research in QST, visit [iopscience.org/qst](http://iopscience.org/qst)



# Welcome Dinner

Bristol Museum and Art Gallery



Our welcome dinner takes place in the Bristol Museum and Art Gallery. An impressive building in its own right, Bristol's City Museum and Art Gallery is a treasure trove of art and history located in the heart of the city's tourist trail.

This museum was originally created to be the Bristol Institution for the Advancement of Science and Art in 1823. The neoclassical building was designed by Sir Charles Robert Cockerell (1788–1863), who was later to complete the Fitzwilliam Museum in Cambridge and build St. George's Hall in Liverpool.

Originally owned by philanthropist and tobacco tycoon Sir William H Wills, it was gifted to the city of Bristol to compete with other major cities such as Birmingham and Manchester.

The old part of the museum building was gutted by fire following a bomb hit on the night of 24–25 November 1940, during the Bristol Blitz. Over 17,000 of the natural history specimens were lost during the fire. Nevertheless, the Art Gallery partially reopened in February 1941, now also housing some of the Museum's surviving material on a 'temporary' basis. It has since been extensively renovated and was reopened in the late 1970s as the building you see today.

***During the drinks reception you will have free time to explore the Egypt and Assyria exhibits should you wish to look around.***



# Day Two

Thursday 7th April

Time	Event
09:00	Tea and Coffee
<b>Quantum Algorithms Panel</b>	
09:30	<b>Panel Members:</b> <ul style="list-style-type: none"><li>• Ashley Montanaro (chair) (University of Bristol)</li><li>• Robin Blume-Kohout (Sandia Laboratories)</li><li>• Viv Kendon (University of Durham)</li><li>• Dave Wecker (Microsoft Research)</li></ul>
10:30	Short Break
<b>Hardware (part 1)</b>	
10:45	<b>Thaddeus Ladd</b> ( <i>HRL Laboratories</i> ) <i>'Semiconductor Qubits for Quantum Networks'</i>
11:30	<b>Sae Woo Nam</b> ( <i>NIST</i> ) <i>'Hardware for Loophole-free Bell Tests using Photons'</i>
12:15	Lunch
<b>Hardware (part 2)</b>	
13:15	<b>Andrew Dzurak</b> ( <i>University of New South Wales</i> ) <i>'One- and two-qubit logic using silicon-MOS quantum dots'</i>
14:00	<b>Panel Members:</b> <ul style="list-style-type: none"><li>• Jorge Barreto (University of Bristol) (chair)</li><li>• Andrew Dzurak (University of New South Wales)</li><li>• Thaddeus Ladd (HRL Laboratories)</li><li>• Sae Woo Nam (NIST)</li></ul>

# Day Two cont....

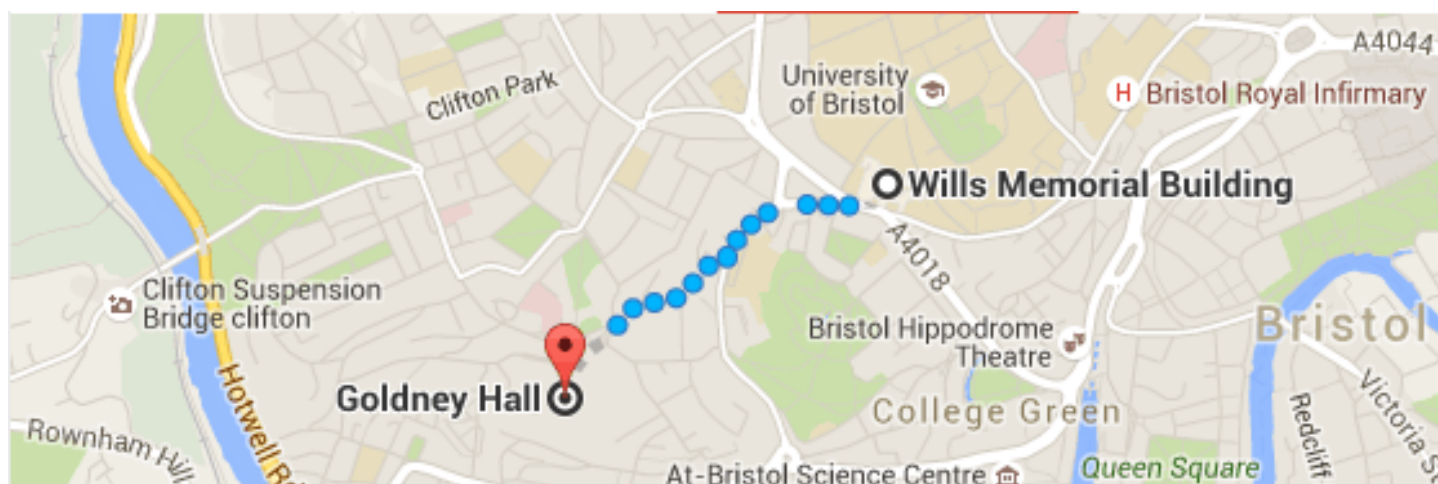
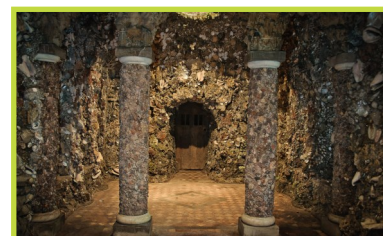
14:45	Coffee Break
<b>Quantum Communications and Networks</b>	
15:00	<b>Rob Thew</b> (University of Geneva) 'Quantum Communication: Technologies and Ideas '
15:35	<b>Chris Erven</b> (University of Bristol) 'Quantum Communications and Networks in Bristol'
16:00	<b>Panel Members:</b> <ul style="list-style-type: none"><li>• John Rarity (chair) (University of Bristol)</li><li>• Chris Erven (University of Bristol)</li><li>• Rob Thew (University of Geneva)</li><li>• Jeff Hunt (Boeing)</li></ul>
16.35	<b>Free time</b>
17:45	There are taxis from the conference venue to tonight's restaurant. If you would like to book a place for a taxi please speak to one of our helpers at the main desk in the Foyer.
18:00	<b>Evening event at Goldney Hall</b> (Please be aware that PhD students are unable to attend this evening's event)

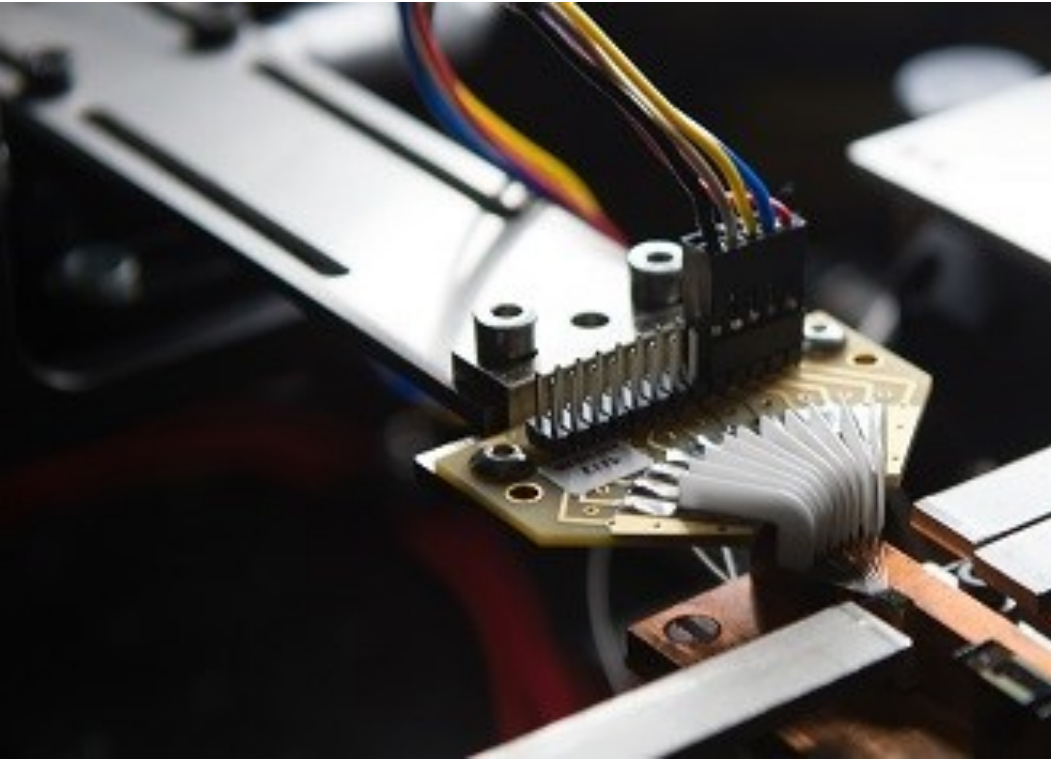
## Day 2 : Dinner and Drinks Reception

Goldney Hall, Bristol

The orangery at Goldney Hall, University of Bristol forms part of a building that was constructed in 1724 by the Goldney family. Goldney Hall has undergone numerous changes and renovations through out its existence and features several unusual features in both the building and surrounding gardens. You will see the ornamental canal glimpsed outside the orangery in The Sign of Three, the grounds also contain a shell-lined grotto that was constructed between 1737 and 1764, filled with over 200 different species of shell, statues and quartz crystal encrusted pillars. It is notable as the only grotto in the United Kingdom to feature the shell decoration and running water.

***This is an 11 minute walk from our conference venue.***





# Day Three

Friday 8th April

Time	Event
09:00	Tea and Coffee
<b>Quantum Information and Computation (part 1)</b>	
09:30	<b>Seth Lloyd (MIT)</b> <i>'Quantum algorithms for topological analysis of data'</i>
10:15	<b>John Morton (UCL)</b> <i>'Coupling donor spins in silicon to microwave cavities'</i>
10:50	<i>Short Break</i>
<b>1QBit Demonstration</b>	
11:10	<b>Daniel Crawford (1Qbit)</b>
12:00	<b>Lunch</b>
<b>Quantum Information and Computation (part 2)</b>	
13:00	<b>Andrea Morello (University of New South Wales)</b> <i>'Operation and scale-up of donor-based silicon quantum processors'</i>
13:45	<b>Robin Blume-Kohout (Sandia National Laboratories)</b> <i>'Characterizing real quantum information processors'</i>
14:10	<b>Panel:</b> <ul style="list-style-type: none"> <li>• Andrew Dzurak (chair) (University of New South Wales)</li> <li>• Robin Blume-Kohout (Sandia National Laboratories)</li> <li>• Viv Kendon (University of Durham)</li> <li>• Seth Lloyd (MIT)</li> <li>• Andrea Morello (University of New South Wales)</li> <li>• John Morton (UCL)</li> </ul>



Time	Event
14:55	<i>Short Break</i>
<b>Ethics of Quantum Technologies</b>	
15:10	<b>Panel:</b> Marina Jirotko (chair) (University of Oxford) Seth Lloyd (co-chair) (MIT) Liam Blackwell (EPSRC) Patricia Charlton (London Knowledge Lab) Landon Downs (1QBit) Thaddeus Ladd (HRL Laboratories) Daniel Shepherd (CESG)
16:10	<i>Close by John Rarity</i>
16:15	<b>End of Conference</b>

Please remember to add BQIT:17 into your calendar: 5—7 April 2017

## Our Sponsors

We are grateful to a number of organisations who have provided funding for our event. The additional funding provided by these organisations helped fund our programmes and evening activities; enabling us to make BQIT:16 our best yet. Thank you to:



**Institute of Physics  
Quantum Optics, Quantum  
Information and Quantum  
Control Group**





# quTAG



## Fastest Time Tagger in the Solar System

### Specifications

Resolution (RMS): < 10 ps  
Bin Width: 1 ps  
Max Rate: 100 Mcps



[www.qutools.com](http://www.qutools.com)

# Advertisements

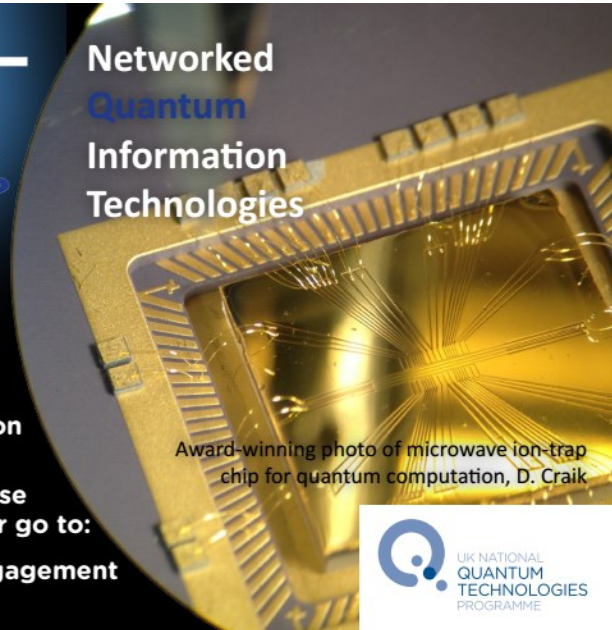


## Networked Quantum Information Technologies

We have Partnership Funding available to support promising quantum technology projects that have early commercialisation potential.

To find out more, please visit our NQIT stand or go to:

[nqit.ox.ac.uk/user-engagement](http://nqit.ox.ac.uk/user-engagement)



Award-winning photo of microwave ion-trap chip for quantum computation, D. Craik



## BUILDING BLOCKS FOR QUANTUM INNOVATION

### High Performance



ENTANGLED PHOTON SOURCE

- Complete system
- Telecom wavelengths
- High brightness



PHOTON COUNTING MODULE

- All-in-one & easy to use
- High QE & very low DCR
- Built-in time correlator



TIME CORRELATION SOFTWARE

- LabVIEW & C++ dll
- High resolution
- USB port

[www.aureatechnology.com](http://www.aureatechnology.com)

AUREA Technology, 18 rue Alain Savary, 25000 Besançon - France

If you are interested in sponsoring BQIT:17 and want to find out more about the packages we have available then email us at [bqit-admin@bristol.ac.uk](mailto:bqit-admin@bristol.ac.uk)



## Best-in-Class Performance

## Single-Photon Counters



### New Ultra-low noise ID230 Infrared Series

- Free-running at 900-1700nm
- 100Hz dark count rate @ 20% quantum efficiency
- 100ps timing resolution

[www.idquantique.com](http://www.idquantique.com)  
visible and infrared single-photon counters

# QET Labs | > QTEC



## Quantum Technology Enterprise Centre (QTEC)

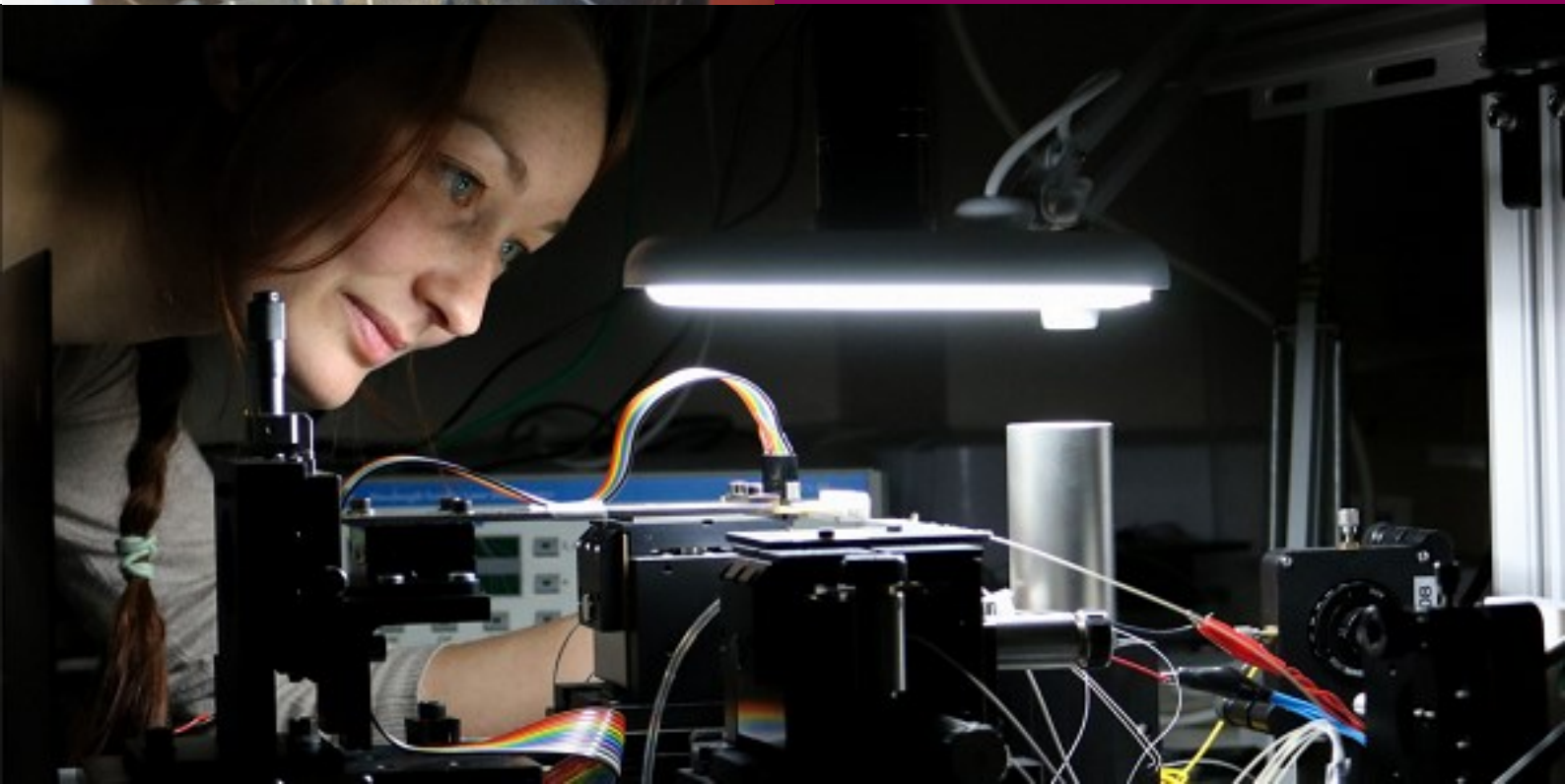
In partnership with Cranfield University, we have created a world-class training programme for entrepreneurially minded quantum systems engineers.

QTEC supports postgraduate qualified individuals through the Quantum Enterprise Fellowship Programme and connects them with the National Quantum Technology (QT) Programme. Focussing on:

- Quantum Technologies
- Systems Engineering
- Design, Enterprise, Entrepreneurship and Innovation
- Connectivity and Networks

**For more information about the course and how to apply:**

[www.bristol.ac.uk/qtec](http://www.bristol.ac.uk/qtec)



# Notes

# Notes

# Notes

QET Labs would like to thank our funders and collaborators



University of BRISTOL

**EPSRC**

Pioneering research and skills



European Research Council  
Established by the European Commission



ROYAL ACADEMY OF ENGINEERING



The Leverhulme Trust



# Contact Us

For general enquiries or to receive our monthly newsletter, please email [cqp-enquiries@bristol.ac.uk](mailto:cqp-enquiries@bristol.ac.uk) or call **0117 394 0112**.

Contact details for team members can be found on our website at [bristol.ac.uk/physics/research/quantum/people](http://bristol.ac.uk/physics/research/quantum/people)

If you have any feedback about our workshop please contact us at [bqit-admin@bristol.ac.uk](mailto:bqit-admin@bristol.ac.uk)

**We look forward to welcoming you back to Bristol next year—5-7 April 2016.**



---

## Quantum Engineering Technology Labs

HH Wills Physics Laboratory,  
Tyndall Avenue,  
Bristol,  
BS8 1TL

