An Evening of QUANTUM *Discovery*

October 2017

NQIT Networked Quantum Information Technologies

Department of Physics

UNIVERSITY OF OXFORD

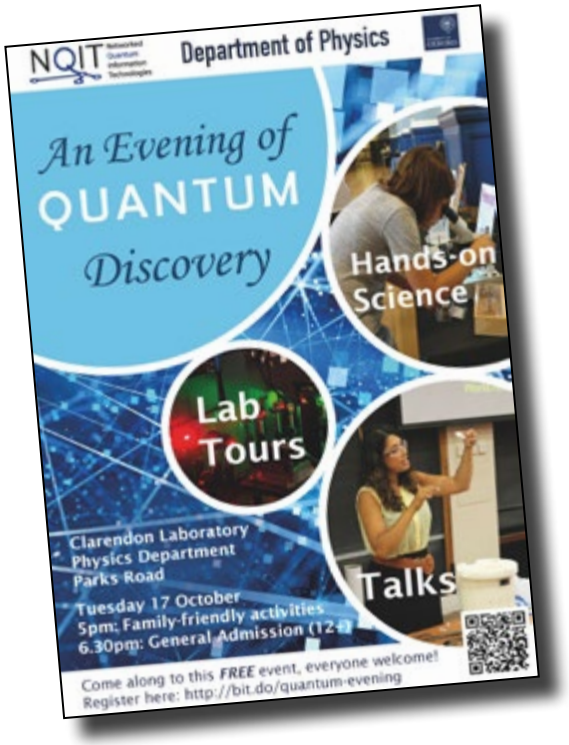
An Evening of Quantum Discovery

"An Evening of Quantum Discovery" was a public outreach event in the Physics Department in Oxford held on October 17 2017 from 5pm to 8.30pm.

It was co-organised by the Physics Department Outreach Officer, the NQIT Communications Manager and the Quantum Materials Outreach Officer.

The event was divided into a family-friendly set of activities from 5pm to 6.30pm and then activities for a general 12+ audience from 6.30pm to 8.30pm.

The quantum theme included a wide range of physics topics such as quantum computing, photonics, quantum materials, and superconductivity.



Activities included:

- 20-minute talks by members of the Physics Department
- Guided lab tours in 6 labs
- A hands-on science fair with 7 stalls
- A "Quantum Story Corner" for children
- Voting for your favourite image in a Quantum Photography Competition

The Event in Numbers

280 tickets sold

45 people on waiting list

150 people turned up on the night

17 part of a public dialogue on quantum technologies

families, adult groups, school parties

36 volunteers from the Physics Department

helped with lab tours, science fair, talks, stewards, welcome

20 lab tours in **6** different labs

Superconductors: Why It's Cool to be Repulsive

The evening began with a family-friendly demonstration of superconductors in action from graduate student Fran Kirschner.

She explored the low temperatures we need to make them work, and how we can use superconductors for levitating trains.

When something superconducts, it behaves as a magnetic mirror, so will be repelled from magnetic fields. We can use this property to float a superconductor above a bed of magnets. However, for this to work, the superconductor has to be very cold.

Fran used liquid nitrogen to cool some superconductors (among other things) and show what they can do. Along the way, she explained some of the history and uses of these amazing materials.

A video of this talk is available to watch online:
http://www.podcasts.ox.ac.uk/superconductors-why-its-cool-be-repulsive

Quantum Story Corner

NQIT researchers Nathan Walk, Matty Hoban and Helen Chrzanowski invented their “Quantraption” to describe the basic quantum phenomena of entanglement and uncertainty.

It was first rolled out in the Oxford Botanic Gardens during the Curiosity Carnival in September 2017 and we were lucky enough to witness its reappearance at our Evening of Quantum Discovery.

The “Quantraption” at the Curiosity Carnival
Photo by Ian Wallman

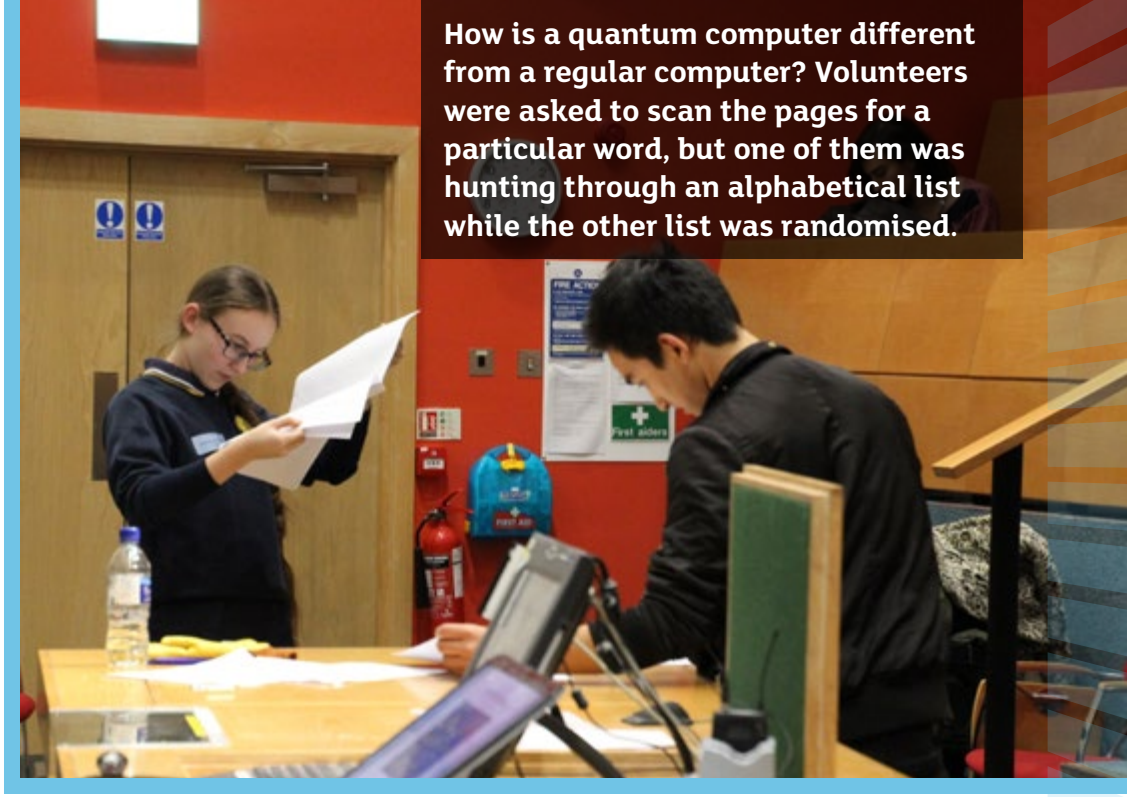
When you put your hand in the device, you will either encounter a bowl of sweets or a bowl of custard. Just like with a quantum particle, until you measure it (by putting your hand in the box) you won’t know whether you’ll get sweets or custard.

As different combinations of sweets and custard are explored, children build up a picture of how quantum randomness can be manifested.

You can also have two children put their hands in and, because the holes are “entangled”, one person can put their hand in one hole and then perfectly predict what will happen with the other one.

Quantum Physics and the Nature of Computing

In this talk, Dr Jelmer Renema introduced conceptual problems that sit at the intersection between quantum physics, computer science and complexity theory. How can we show that a quantum computer can outperform an ordinary computer? How can we test a quantum computer?



How is a quantum computer different from a regular computer? Volunteers were asked to scan the pages for a particular word, but one of them was hunting through an alphabetical list while the other list was randomised.

Jelmer explored some of the theoretical puzzles of this field and how we can investigate them with experimental physics.

A video of this talk is available to watch online:
http://www.nqit.ox.ac.uk/video/quantum-physics-and-nature-computing

Hands-on Science Fair

The Hands-on Science Fair comprised seven interactive stalls covering quantum computing and its applications, the quantum behaviour of photons, what quantum materials are and why they're useful, how superconductivity works and what really strong electromagnets look like.

On the NQIT stand (top right and bottom left), visitors could find out how we're building a quantum computer and what it will be able to do.

On the Oxford Optics & Photonics Student Society (OxOPS) stand (bottom middle and right), we explained how photons travel through water and what polarisation means.

Hands-on Science Fair

Right: showing some of the sample crystals grown in the department, for quantum materials researchers to study in detail

Bottom: a demonstration of some of the properties of superconductors, including their ability to levitate in a magnetic field

Top right: understanding the basics of magnetism, one of the best-known quantum phenomena

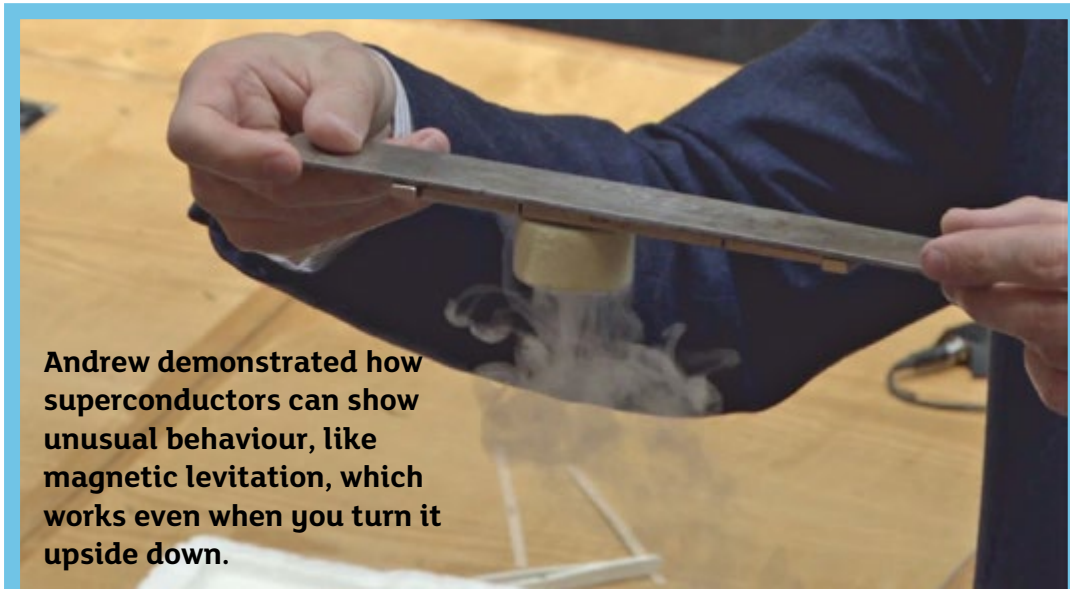
Bottom right: Exploring magnetic vortices with interactive models

Superconductors: Miracle Materials

In this talk, illustrated with practical demonstrations, Professor Andrew Boothroyd recounted the long history of superconductivity and gave simple explanations for how superconductors work and what they are useful for.

This was an introduction to the fascinating world of superconductors and the many surprising phenomena they exhibit, from zero resistance to quantum levitation.

A video of this talk is available to watch online:
http://www.podcasts.ox.ac.uk/superconductors-miracle-materials



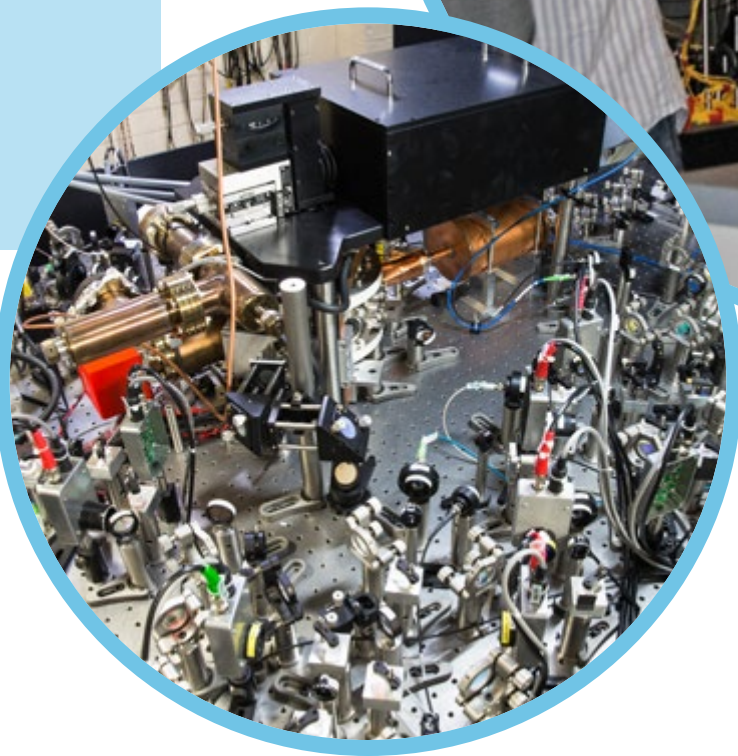
Andrew demonstrated how superconductors can show unusual behaviour, like magnetic levitation, which works even when you turn it upside down.

Lab Tours

Visitors were given exclusive access to six labs around the Physics Department.

In guided tours in small groups, they were shown around the Photonics Lab (bottom left), Trapped Ion Lab (bottom centre), Centre for Applied Superconductivity, Nicholas Kurti Magnetic Field Laboratory, Solar Cells and Superconducting Quantum Devices (bottom right).

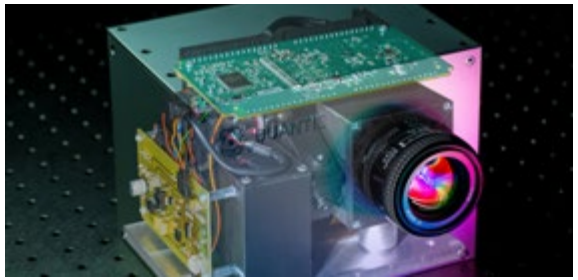
Photos of labs by Stuart Bebb & David Fisher.

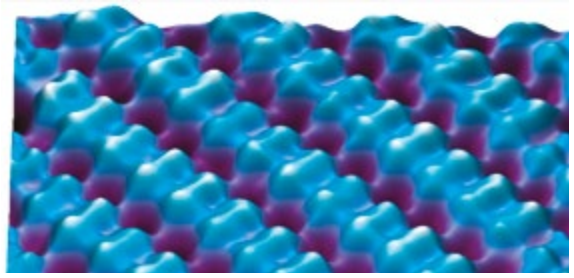


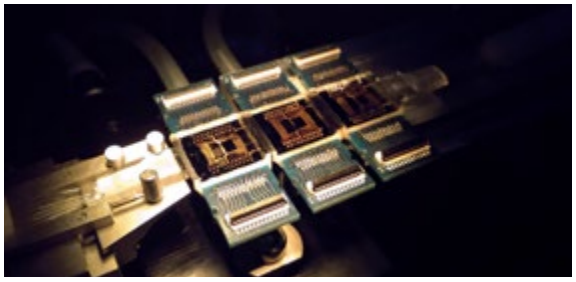
Quantum Photography Competition

Visitors were asked to vote for their favourite image from a selection of nine submissions from the Quantum Photography Competition, which ran for the two months before the Evening of Quantum Discovery.

Researchers were asked to send us their most visually stunning images of quantum research and technology development, along with a description that explains what the image is of and puts it into context.







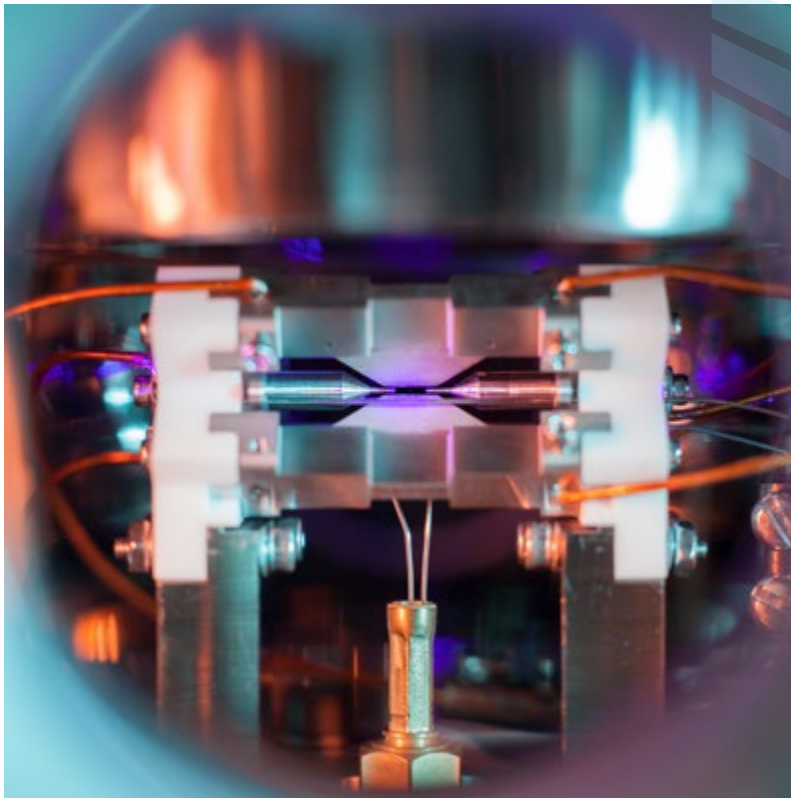
Other submissions included images of the single pixel camera from QuantIC in Glasgow, Scotland, optical fibres, silicon atoms for quantum computing and quantum photonic chips.

View these and the rest of the submissions on the NQIT website:
http://www.nqit.ox.ac.uk/content/nqit-quantum-photography-competition-round-one

Following the voting, a clear winner emerged: this beautiful photo of a single atom in an ion trap by graduate student David Nadlinger.

In the centre of the picture, a small bright dot is visible - a single positively-charged strontium atom. It is held nearly motionless by electric fields emanating from the metal electrodes surrounding it. (The distance between the small needle tips is about two millimetres.)

Laser-cooled atomic ions provide a pristine platform for exploring and harnessing the unique properties of quantum physics. They are used as building blocks for future quantum computers, which could tackle problems that stymie even today's largest supercomputers.



What Did People Think?

I really enjoyed the set-up of the evening - especially the mix of talks/stalls/quantum story time. I also liked the combination of different areas of quantum research - it was cool to be able to meet outreachers from across the Department. I really think this is an event we should do again.

I wish more university departments did this sort of thing as it is mutually beneficial

Interactive, amazing, not one bit was boring and completely captivated my children's minds and my own, wish it was that interesting at school

We thoroughly enjoyed the evening and thank everyone for all the work they put into making it such an interesting and stimulating event.

97% said they enjoyed the event *

88% said that their understanding of quantum physics had improved "a lot" or "a little" from this event

93% said they would recommend the event to someone they knew

84% said they were inspired to learn more about quantum physics

*** 59 people completed our feedback form, so these figures represent 40% of attendees**

What did you enjoy the most and why?

"The lab tour, because the info given, although difficult to understand, was interesting."

"Getting a sense of the work being done in this area, felt like an insight to things that are shaping the future of our world."

"Practical demonstrations and lab tours, it was easier to understand the harder topics"

"Chatting with Andy one of your scientists, because he was genuinely interested in giving us good answers and listened to us."

"The presentation in the lecture theatre about super conductors, it had wow factor and engaged the children."

"Laboratory tour, visiting laboratories cannot be done everyday or on internet!"

"The lecture, very interesting and well balanced for non-scientist."

"That the future of physics research is in safe and enthusiastic hands!"

What Next?

Find Out About Future Events

To sign up for monthly notifications about upcoming events in the Physics Department, please complete this short web form:

http://www2.physics.ox.ac.uk/my-forms/email-list

Coming up in 2018:

Oxford Physics at the ATOM Festival

Dates: 10 - 18 March 2018

Venue: Various in Abingdon, Oxfordshire

Please visit the website for more details:

http://www2.physics.ox.ac.uk/events/2018/03/10/oxford-physics-at-the-atom-festival

Quantum Technologies at the Cheltenham Science Festival

Dates: 5 - 10 June 2018

Please visit http://www.nqit.ox.ac.uk/content/events soon for more details!

For more details about events taking place in and around the Oxford Physics Department, please visit our website:

http://www2.physics.ox.ac.uk/events

Find Out More

Department of Physics Research
http://www2.physics.ox.ac.uk/research

Oxford Quantum Materials
https://www2.physics.ox.ac.uk/research/quantum-materials

Networked Quantum Information Technologies (NQIT) Hub
http://www.nqit.ox.ac.uk

Oxford Quantum
http://oxfordquantum.org/

National UK Quantum Technologies Programme
http://uknqt.epsrc.ac.uk/

Follow Us!

Department of Physics:

@OxfordPhysics

PhysicsOxford

Podcasts & Videos

Networked Quantum Information Technologies (NQIT) Hub:

@NQIT_QTHub

Thank you!

Thank you to all the students and researchers who put their time and effort into making this such a successful event, we couldn't do it without you!

Design, content and layout by Hannah Rowlands, Sian Tedaldi & Kathryn Boast
Photography by Olga Brecht unless otherwise credited