The Quantum Age
Technological Opportunities

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ETSI / IQC Quantum Safe Workshop

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• Health, wellbeing, security & resilience

• Knowledge translated to economic advantage

• The right science for emergencies

• Underpinning policy with evidence

• Advocacy and leadership for science
Why Quantum?

- Potential to disrupt huge market sectors
- Global cyber security predicted to be worth £164 billion by 2021
- Global GPS navigation currently worth £21 billion
- UK Photonics industry growing 8% pa (2015), currently worth £10.5 billion
In 2013, £270M investment announced for over 5 years … … but now more than £385M investment over 2014-2019
The UK is not alone in recognising the value of quantum technology

Blackett Reviews

Mark Walport: The Quantum Age
Why Blackett?

- WW II chief advisor on Navy operational research
- Nobel Prize in physics for research on cosmic rays
- Professor of physics at Imperial College London

Patrick Maynard Stuart Blackett
(1897 – 1974)
There is a strong case for continuing the UK National Quantum Technologies Programme with matched private sector investment.

Establish innovation centres involving the co-location of academic and industrial partners.

The programme partners should establish a body to co-ordinate activities across the programme more effectively.
• Timekeeping technology has enabled economic advances in the past - 1714 the UK Parliament passed the Longitude Act.

• Today, timing is more important than ever. Atomic clocks are so accurate that they have been used as a standard of time for nearly half a century.

• A new generation of quantum clocks could be several orders of magnitude more accurate still.

• These clocks will have a wide range of prospective applications across sectors including finance, transport, telecommunications and energy.
• New quantum imaging system that change the way in which we can see the world:

  • One that builds a picture of the environment as viewed from where a laser beam falls.

  • Another system can create a 3D image by measuring the time it takes each photon to travel to and from objects in the scene.

• Such technologies will find uses beyond the obvious military and law enforcement applications.

By harnessing quantum effects such as superposition, new quantum sensors can offer higher sensitivity, accuracy and speed of use than current technologies, particularly for gravity and magnetic fields.

Quantum sensors will enable:
- quick and accurate gravity mapping to reveal underground features.
- improved sensing of magnetic fields and easier ways to screen for diseases such as dementia, and the early detection of cancer and heart conditions.
Computing and Simulation

- Potential problem solvers and modellers that can tackle and analyse problems inaccessible by conventional computers.

- There are two very important tasks that a quantum computer is expected to be able to do much more efficiently than conventional computers:
  - Factorise large numbers - security implications.
  - Search unstructured data quickly, offering new possibilities in data analytics and fundamental science.
Cryptography underpins the security of our financial, business, government and personal communications.

Current encryptions are vulnerable to quantum computers, so we need new methods of securing digital information:

- post-quantum cryptography (PQC) is as hard to solve for a quantum computer as for a classical computer.
- Quantum Key Distribution (QKD) uses the quantum properties of light to share a key which hackers can’t use without revealing
Blackett Recommendations

- Ten recommendations including:

  - A strong case for continuing the UK National Quantum Technologies Programme.
  - The need to review the critical services that are dependent on GNSS timing signals.
  - Support for the development of standards for GNSS-resilient timing infrastructure
  - Optical fibre networks for the purposes of timing and frequency distribution.
  - Flexible regulation and standards.
  - Innovation centres and funding.

  Plus recommendations specific to securing our communications…
• **Recommendation 7**: The National Quantum Technologies Programme should fund collaborative work between UK quantum communications and cryptography research groups, leading to joint technical developments of both QKD and PQC.

• **Recommendation 8**: The National Cyber Security Centre should support a pilot trial of QKD using realistic data in a realistic environment, with the facilities for the trial being provided by the Quantum Communications Hub.

• **Recommendation 9**: The National Physical Laboratory, the National Cyber Security Centre and academia should form a partnership to perform conformance tests and issue accreditation certificates. This process could lead to the establishment of an independent national facility.
Progress To Date

- £270 million value of UK National Quantum Technology programme.
- 4 Quantum Technology Hubs working on computing, enhanced imaging, communications and sensors.
- 3 Centres for Doctoral Training in quantum technologies.
- 27 bids from companies working with academia via the UK Quantum Technologies Innovation Fund.
• Funding joint research on QKD and PQC between Quantum Hubs, the National Physical Laboratory and the National Cyber Security Centre.

• The National Cyber Security Centre is in discussions about supporting a pilot trial of QKD in realistic conditions.

• The National Physical Laboratory and the National Cyber Security Centre to potentially perform conformance and vulnerability tests.
Future Progress

• A second phase for the UK National Quantum Technologies Programme, addressing the Blackett recommendations.

• The Government’s Industrial Strategy offers opportunities to support projects involving industry and academia.
The 2017 National Quantum Technologies Showcase is on 22 November 2017 in London.

For your free ticket and further details, please register at:

https://2017qtshowcase.eventbrite.co.uk
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www.gov.uk/go-science

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