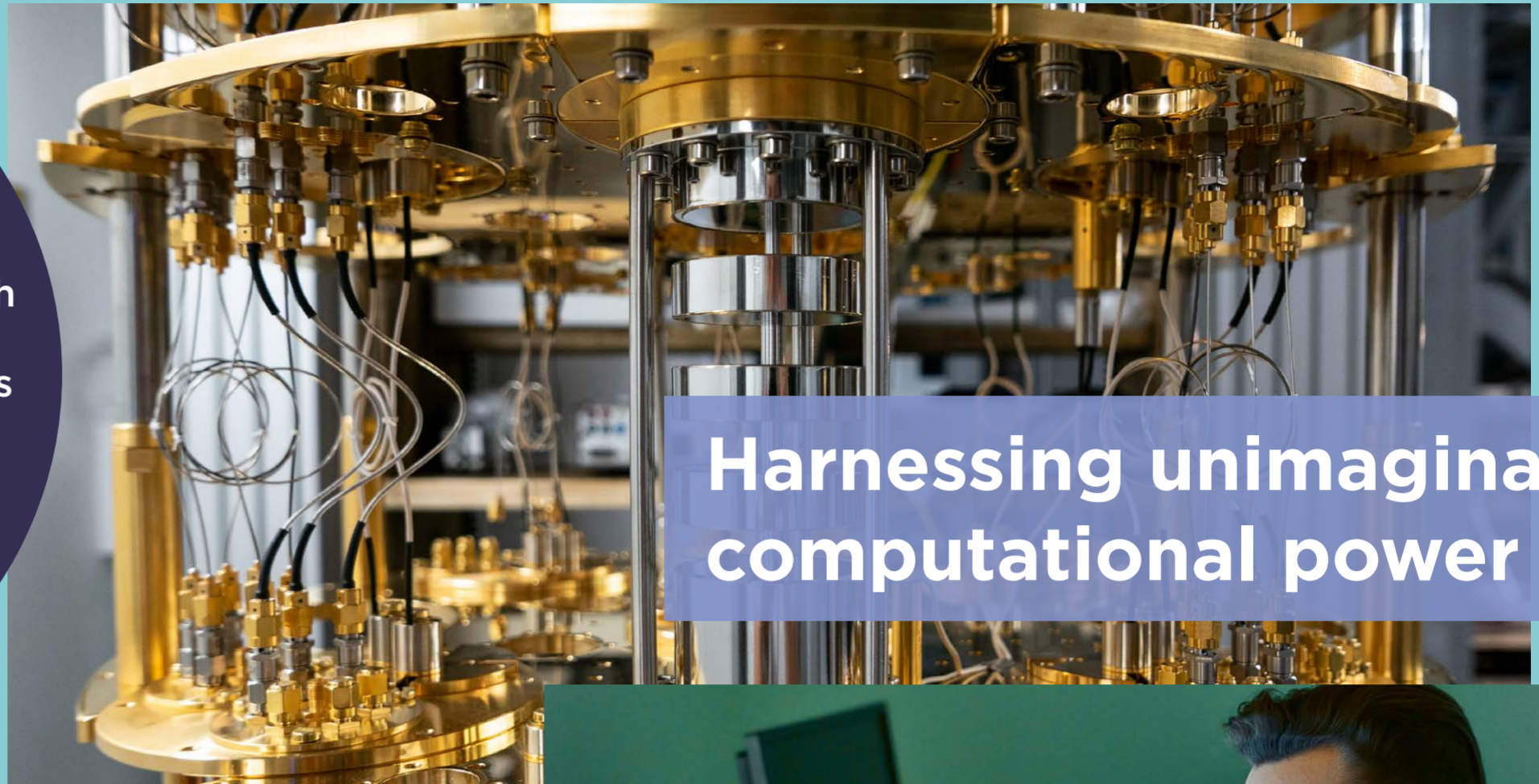


# 5 amazing ways quantum tech could improve your world

## What is quantum tech?

Quantum technologies harness quantum physics to gain a functionality or performance which is otherwise unattainable - the functions of quantum technologies are derived from science that cannot be explained by classical physics, such as Newton's Laws of motion, thermodynamics, or Maxwell's equations of electromagnetism.



Harnessing unimaginable computational power



Future proofing communications



Making the invisible visible



Revolutionising sensing



Measuring with quantum

## Want to be a part of the quantum revolution?

There are many different routes that can lead to a career in the field of quantum, however, studying subjects such as Maths, Physics, IT/Computer Science, Design and Technology/Product Design in further and higher education is often a great first step!

To find out more about the wide variety of jobs in the field of quantum and what they entail, visit the Quantum City website to read interviews with a diverse range of people working in the field.

[www.quantumcity.org.uk](http://www.quantumcity.org.uk)

## What is the UK National Quantum Technologies Programme?

A ten-year, £1 billion public and private investment established by the UK Government, to ensure the successful translation of quantum science from laboratory to everyday applications and products. Along with the growing technologies markets, investment is rapidly increasing and career opportunities within the field of quantum technologies globally are expanding exponentially. The National Programme has four Quantum Technology Hubs and several other partners driving forward UK quantum technology capability.

# Amazing ways quantum tech could improve your world in computing

## Now

### How

Do 10,000,000,000 calculations each second in strict order using just the numbers one and zero, but with increasing numbers of computers consuming increasing amounts of energy and resources.

### What

They're everywhere, not just PCs, but phones, internet, cars, washing machines, lightbulbs...



## In your lifetime

### How

Using **superposition\*** and **entanglement\*** it will be possible for faster calculations to be carried out simultaneously, using ones, zeros, and ones and zeros at the same time!

### What

- Incredible reduction in environmental impact of processing power
- Faster development of new drugs, with the possibility of tailoring medicines to an individual's DNA
- Creating cleverer AI, by accelerating machine learning and helping machines better understand the real world
- Developing new materials e.g. for advanced electric car batteries, stronger building materials, or more efficient energy generation
- Reducing environmental impact by optimising energy networks, calculating extremely efficient transport routes, and developing cleaner industrial processes
- Better weather forecasting, as well as potentially saving lives with more accurate long-term warnings of extreme weather events



**\*Superposition:** the principle describing the ability of a quantum system to be in two or more states at the same time – imagine a coin that is heads and tails side up at the same time! It enables quantum computers to have bits that are 1 and 0 at the same time.

**\*Entanglement:** the property that gives correlations – stronger than any we are familiar in everyday life – between two or more quantum systems, even when separated by large distances.

# Amazing ways quantum tech could improve your world in communications

## Now

### How

By wire or microwave in phones, Wi-Fi, Bluetooth

### What

Text messages, phone calls, Zoom, YouTube, Social Media, IOT (internet of things).



## In your lifetime

### How

Using **superposition\***, **uncertainty\*** and **entanglement\*** guaranteed unhackable communications will be feasible on a global scale!

### What

- Secure communications between handheld devices such as mobile phones and laptops
- Secure cloud storage of your personal information and images
- Wireless secure connection to your bank, healthcare provider, government services like voting
- Secure connections between towns and cities for transfer of confidential data
- Global secure communications thanks to quantum technologies being deployed in space on board satellites



**\*Superposition:** the principle describing the ability of a quantum system to be in two or more states at the same time – imagine a coin that is heads and tails side up at the same time!

**\*Entanglement:** the property that gives correlations – stronger than any we are familiar in everyday life – between two or more quantum systems, even when separated by large distances.

**\*Uncertainty:** the values of two complementary properties of the system (such as the position and momentum of a particle) cannot both be measured precisely at the same time.

# Amazing ways quantum tech could improve your world in imaging

## Now

### How

Cameras using light and parts of the electromagnetic spectrum that we can't see.

### What

Photos, video, satellites, phones, medical and security.



## In your lifetime

### How

Using entanglement\*, imaging will be revolutionized. Increased performance and previously invisible things will be made visible!

### What

- Crystal clear images from underwater, through smoke, fog, rain, snow and solid surfaces (e.g. walls)
- Cameras to visualise gas leaks
- Cameras looking round corners by detecting low light levels
- Super sensitive gravity mapping to 'see' underground
- Medical imaging devices will be able to see incredible detail 'inside' people without entering the body



**\*Entanglement:** the property that gives correlations – stronger than any we are familiar in everyday life – between two or more quantum systems, even when separated by large distances.

# Amazing ways quantum tech could improve your world in sensing

## Now

### How

5 human senses, plus others like electrical, magnetic, chemical and others.

### What

Monitoring in manufacture, safety, medical, robotics, burglar alarms and vehicle parking sensors etc.



## In your lifetime

### How

Harnessing **superposition\*** and **entanglement\*** quantum sensors could be more sensitive, cheaper, lighter, smaller, and more energy-efficient than conventional sensors!

### What

- Light, wearable brain scanners to diagnose many diseases easier
- Quantum gravity sensors to see what lies underground
- Sensors for autonomous vehicles enabling driverless cars to be safe
- Atomic clocks with very high precision for use in radar systems
- Magnetic field sensors that perform just like GPS but without needing GPS signals so working in remote places, underground and undersea



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# Amazing ways quantum tech could improve your world in measurement

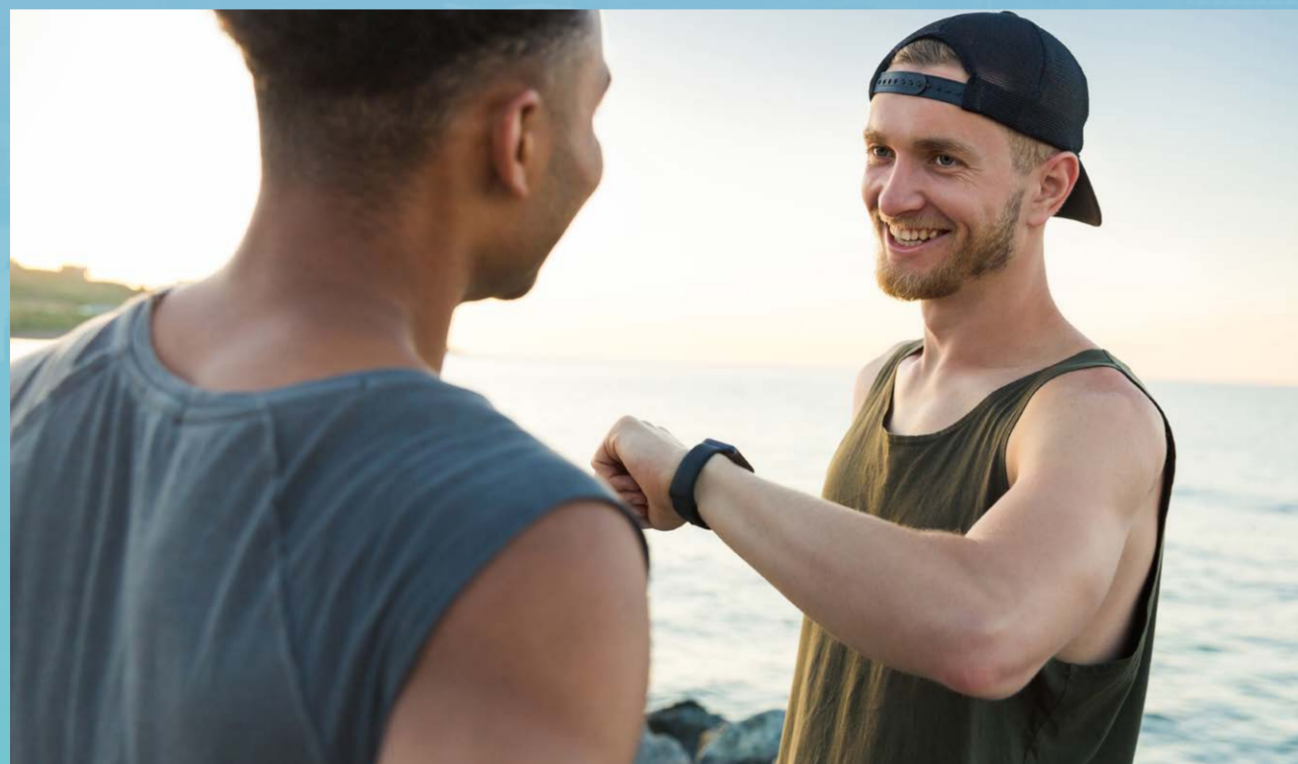
## Now

### How

Changes in properties of materials help us measure other properties like temperature.

### What

Each day billions of measurements make everything happen from medicine to safety, science, engineering, trade and leisure. Since 1950's quantum science has enabled atomic clocks.



## In your lifetime

### How

Quantum steps\* in nature enable the most accurate measurements of time, electric current and other quantities.

### What

- The National Physical Laboratory (NPL) uses **quantum steps** to make extraordinarily consistent clock 'ticks' in atomic timekeeping to give increasing precision, perhaps soon to the equivalent of measuring the lifetime of the universe with an accuracy of one second.
- Quantum science enables high precision measurements of the magnetic fields from the brain and locating materials using gravity sensors.
- More precise clocks will lead to more accurate navigation systems for locating autonomous cars, autonomous ships, drones and other transport systems.
- Better quantum measurements improve secure communications and quantum computing.



\***Quantum Steps:** In nature, properties like energy possessed by electrons cannot take any value, rather, there are discrete steps in values they can take. Science can use these well understood steps to fix points precisely on measurement scales (e.g. for time).