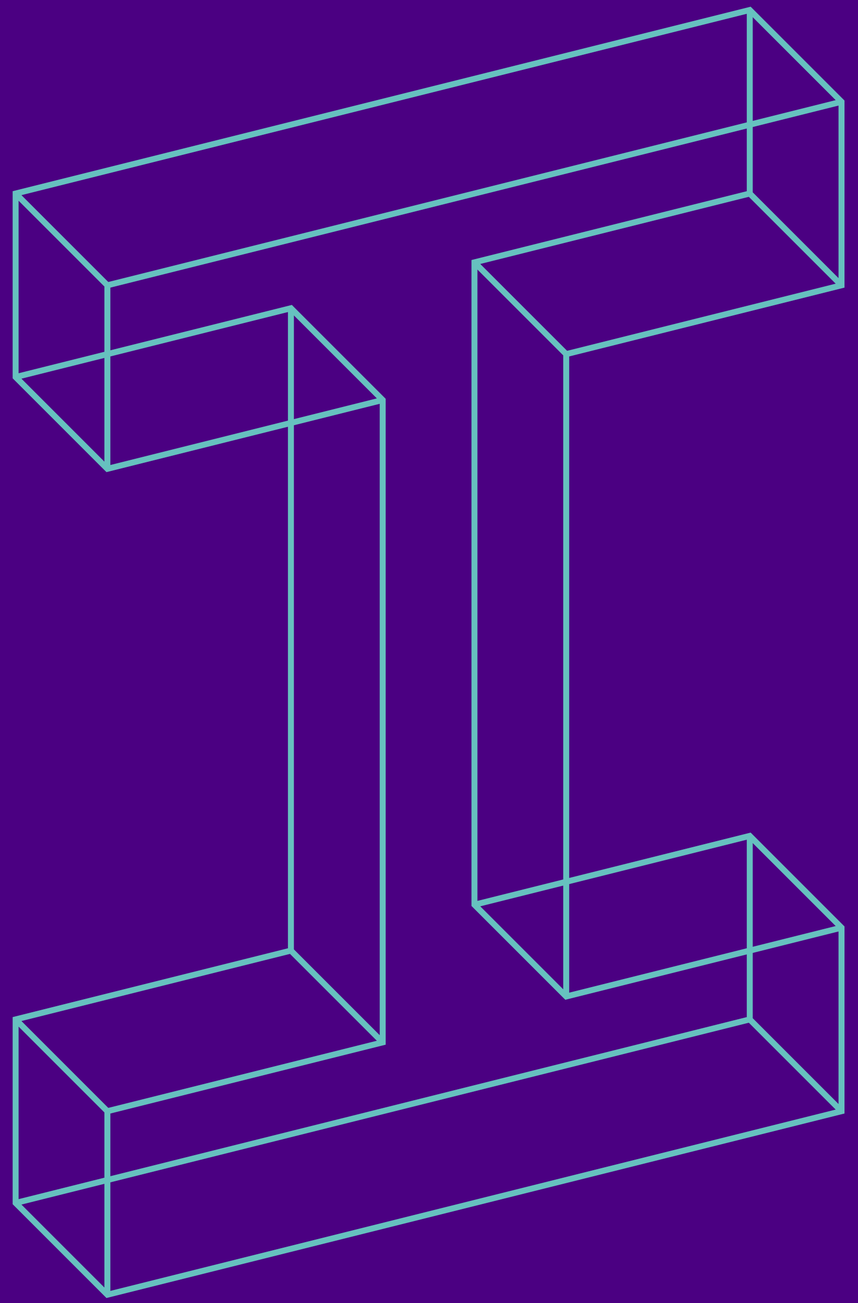
IMPERIAL POLICY FORUM

Quantum Fundamentals 2025



Imperial College London

About the programme

The Quantum Fundamentals is designed for policymakers to understand the basic principles of quantum science, the main types of quantum technologies and the challenges associated with the development and deployment quantum hardware. We will focus on key areas related to the National Quantum Strategy, Quantum Missions and consider important policy implications, including:

- identifying potential applications and challenges for quantum technologies in public services
- identifying the ethical, legal and social implications of quantum technologies
- assessing the national and sectoral strategic importance of quantum technologies for the UK economy, national security and wider society
- discussing the development informed policy recommendations for quantum technologies

Benefits

1. Understanding of Quantum Technologies and the science that underpins them: Gain a solid foundation in the basic principles of quantum science, key quantum technologies (e.g., computing, sensing, communication), and their potential societal and economic impact.

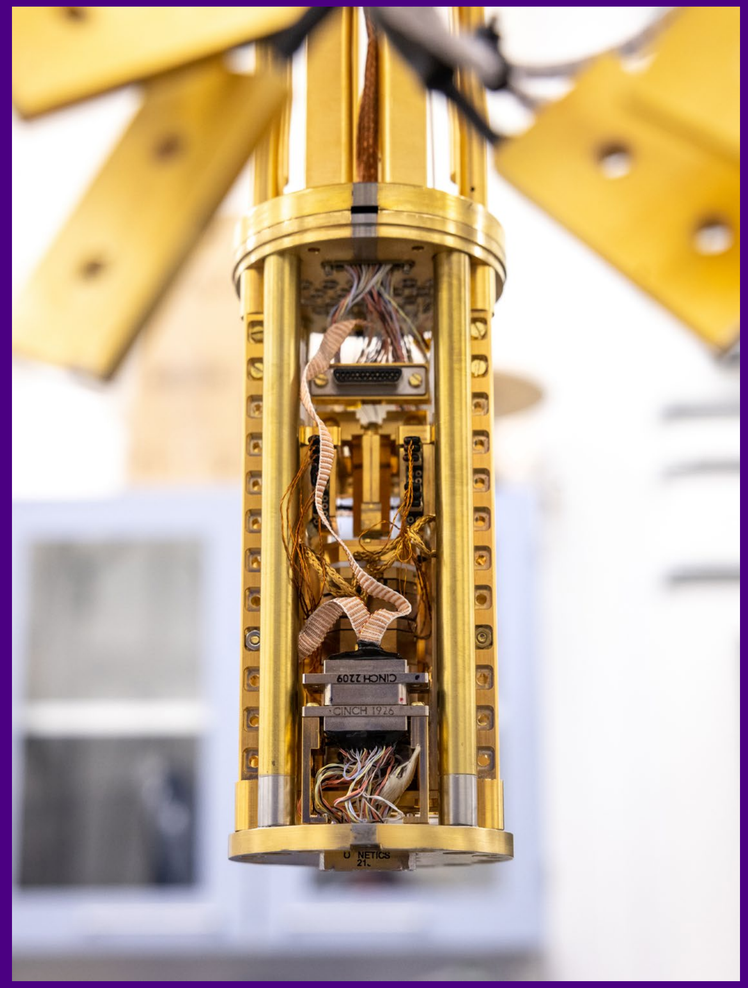
2. Policy Insights for Public Services: Identify the practical applications and challenges of quantum technologies in public services and develop informed policy recommendations for their deployment.

3. World-Class Expertise: Learn from Imperial College London's globally renowned faculty, leaders in quantum research and application across engineering, medicine, and science.

4. Strategic Impact on National Security and Economy: Assess the national and sectoral strategic importance of quantum technologies, especially regarding the UK's economy, national security, and wider society.

5. Interactive Learning with Experts: Participate in dynamic sessions that combine lectures from Imperial academics with hands-on workshops, Q&A, and lab/facility tours to deepen understanding.

6. Informed Decision-Making for Policymakers: Equip yourself with the knowledge and tools to contribute to the development of national strategies and informed decisions on the regulation, investment, and innovation of quantum technologies.



Course outline

The programme will consist of eight half-day training sessions over eight weeks. This will consist of one-hour lecture style workshop delivered by one of Imperial's academics followed by an interactive two-hour session, taking the form of a workshop, Q&A or lab/facility tour that will help policymakers get a clearer idea of the topics and applications discussed.

Week 1:
From the classical to the quantum

- Fundamentals of quantum mechanics and key quantum phenomena (e.g. superposition, entanglement etc.) and how quantum tech differs from classical technologies
- Intro to main types of quantum tech (computing, sensing, communication and imaging, metrology, simulation)
- Potential societal and economic impact of quantum tech

Week 2:
Quantum Computing: Capabilities and Applications

- Operating principles, current state-of-the-art and benefits/drawbacks for different materials platforms
- Achieving quantum advantage
- Software and quantum algorithms; applications of quantum computing (e.g. drug discovery, route optimisation)

Week 3:
Quantum Comms and Cryptography

- Quantum networks, future telecoms and 'Quantum Internet'
- Distributed quantum computing
- Post Quantum Cryptography and policy implications

Week 4:
Quantum Sensing, Timing and Imaging

- Operating principles, current state-of-the-art
- Applications of quantum sensors (e.g. medical imaging and diagnostics, navigation, defence, environmental monitoring, detection of underground resources etc)
- Transformative potential, current technology and market readiness

Week 5:
Quantum Positioning, Navigation and Timing (PNT)

- Operating principles, current state-of-the-art
- Applications of quantum navigation systems (e.g. improved positioning, transport, defence and communications)
- Current and future capabilities in timing accuracy and importance of agreed benchmarks

Week 6:
Quantum Materials and Engineering

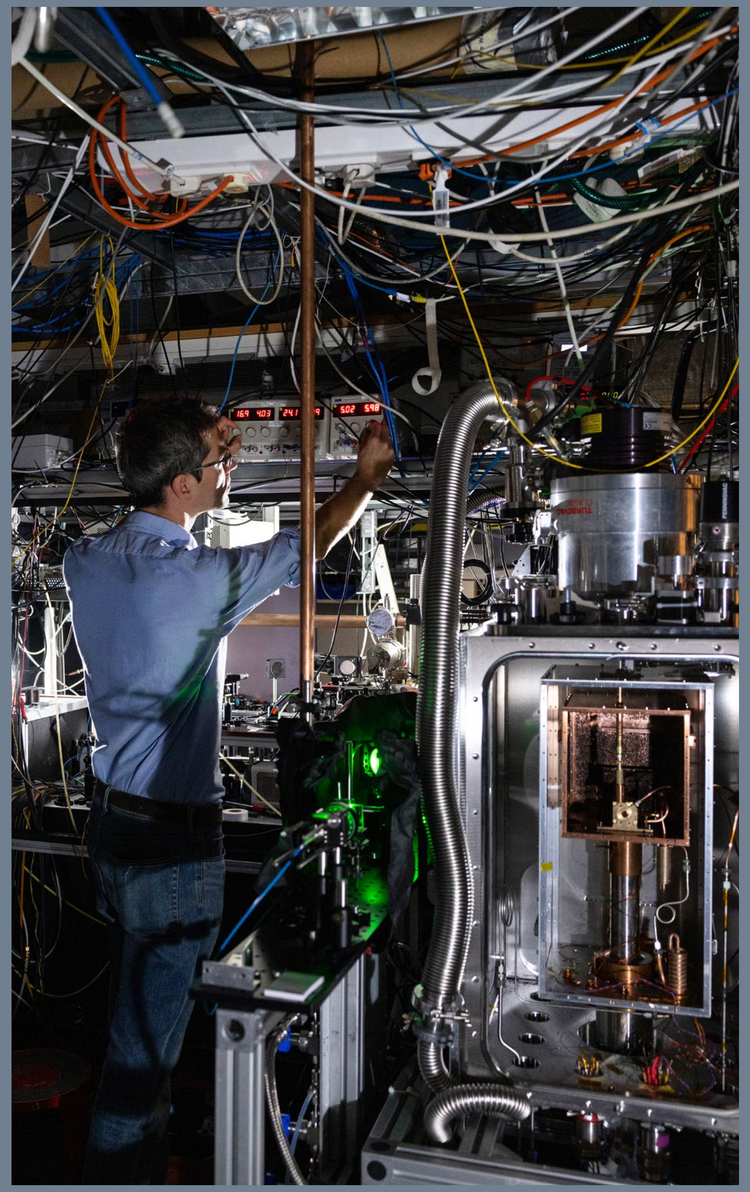
- Materials (including critical minerals) that underpin quantum technologies
- Quantum skills pipeline; education and (re)training
- National and international quantum infrastructure, the recent Royal Academy of Engineering Quantum Infrastructure Review
- National security, cyber and resilience

Week 7:
Global quantum landscape: technology readiness levels, investments, and international standards

- Overview of the global quantum ecosystem
- Comparative national approaches to regulation and innovation
- International quantum co-operation and international investments landscape
- Geopolitical competition and global supply chain issues

Week 8:
Industry and policy panel discussion, with cohort Q&A

- Responsible innovation and ethics, potential misuse, dual-use technologies
- Alternative unconventional approaches to computing and sensing
- Strengths and weaknesses of space-based vs quantum PNT



Who should apply?

This course is for civil servants of any grade with responsibilities or interests in the development and regulation of quantum technologies; the implications of quantum for government ambitions and strategies; or the impact of quantum either on specific sectors of the economy or for UK economic growth. No prior quantum, physics/maths or engineering training required.

Application process

Applications will open on 17th March. Please complete the application form, which will be available to download on the Quantum Fundamentals page on the Policy Forum website and return to the.forum@imperial.ac.uk by 4th April.

Successful applicants will be contacted by the Policy Forum team on the week commencing 7th April, with the course due to start on 25th April.

Download form

Programme leads

Dr Jessica Wade, Programme Lead

Jess is a Royal Society University Research Fellow and Lecturer in Functional Materials at Imperial College London. Broadly speaking, her research considers new materials for optoelectronic, spintronic and quantum devices, with a focus on chiral molecular materials.

She was previously an Imperial College Research Fellow in SPIN-Lab at Imperial, which is led by Professor Sandrine Heutz. She worked as a postdoctoral researcher in the Fuchter and Campbell groups at Imperial College London, where she optimised these chiral systems such that can absorb/emit circularly polarised (CP) light for CP OLEDs and OPDs. For her PhD Jess concentrated on organic photovoltaics and the development of advanced characterisation techniques to better understand molecular packing under the supervision of Dr Ji-Seon Kim.

Outside of the lab, Jess is involved with several science communication and outreach initiatives. She is committed to improving diversity in science, both online and offline, and since the start of 2018 has written the Wikipedia biographies of women and people of colour scientists every single day.

About Imperial Policy Forum

Imperial Policy Forum uses the latest evidence from Imperial's academics to inform the policy conversations that really matter. Our work draws on the skills, expertise and resources of different parts of the College and its wider networks. We harness the College's excellence in fundamental and applied research from across the Faculties of Natural Science, Engineering, Medicine and the Business School, and draw on the substantial expertise in some of its world-class Institutes and Centres.

We recognise that it is only by bringing together academia, government and industry we can find solutions to the biggest challenges facing the world today across climate, future technologies and health.

We support researchers to better engage with policymakers and crossing the divide between academia and policy. We support policymakers through bespoke briefings, workshops and events to understand the latest evidence in key areas, supporting evidence-based decision-making.