

# FYSICA 2025 – Leiden 11 April 2025

## Focus session 2 of the NNV section for history and the foundations of physics

### History and foundation of physics (session 2): Quantum-safe cryptography and the societal relevance of foundational thinking

It is sometimes said that the sciences determine what we *can* do, while the humanities decide what we *should* do. But this simplistic division entirely overlooks the role of the scientist in difficult ethical and philosophical questions development of new theories in technology. What has the role of physicists been historically, and what should it be? Two sessions, organized by the history and foundations of physics section of the NNV, aim to explore the ethical and societal challenges that arise as physicists push the boundaries of emerging technologies.

The two talks in this second session are about current developments: Quantum-safe cryptography and the societal relevance of foundational thinking

#### **Sebastian De Haro and Ailsa Robertson (UvA): The Societal Impact of Quantum-Safe Cryptography: Opportunities, Risks and the Path Forward**

Quantum technology promises significant advancements, but it also poses substantial risks, particularly in the realm of cryptography. As the potential risks and consequences of cybersecurity breaches by future quantum computers are devastating, governments and organisations are already preparing for a transition to quantum-safe cryptography. However, as the development of other technologies illustrates, after an initial period of excitement, overhyped expectations can trigger disappointment and even withdrawal of resources, invoking technology winters that freeze further advancements.

This presentation will explore the transition to quantum-safe cryptography, addressing common misconceptions and potential threats posed by quantum computers. The presentation will outline the complexities of transitioning to quantum-safe cryptography and the reasons for concern. We will also discuss the current quantum-safe cryptography ecosystem in the Netherlands: who are the main players, what role do they fulfil within the ecosystem, and what are the main challenges they face.

#### **Luca Consoli (Nijmegen): The Societal Relevance of Foundational Thinking in Physics**

Foundational thinking is not always associated with societal relevance, and certainly not in the case of physics. This attitude is unjustified. We will show three lines of argument – and the possible pitfalls - to support the claim that foundational thinking is more necessary than ever in the current historical and political climate.

Firstly: by addressing fundamental questions about space, time, and matter, physicists advance understanding and drive transformative innovations. Breakthroughs like quantum mechanics and general relativity, born from challenging classical ideas, have revolutionized technology, enabling semiconductors, GPS, and medical imaging.

Secondly: foundational thinking clarifies and reshapes concepts that are fundamental to understand how to address current societal challenges in a responsible way, allowing to critically reflect on seemingly uncontroversial points. Moreover, it ensures the ethical

development of emerging technologies like quantum computing, aligning innovation with societal values.

Thirdly: In showing how fundamental concepts are (re)shaped in an often implicit way, foundational thinking can contribute to awareness and empowerment of citizens, resulting in more open and tolerant arrangements in an ever-evolving global society.