

# Physics & beyond

## MPI Colloquium

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## Addressing Fundamental Physics Questions with Large-Scale Entanglement

Hundreds and thousands of fireflies synchronize their dazzling light on summer nights – one of nature's most beautiful demonstrations of the importance of synchronization and scalability in a network. Inspired by this, we can ask such a question: is it possible to synchronize millions or even billions of devices in a future quantum internet?

In this talk, I will first give an overview of our previous works on generating single photons and entangled photon pairs from semiconductor quantum dots. The first successful demonstration of entanglement swapping with this type of source, which is essential to solving the "scalability" problem, will be highlighted. Based on that, I will discuss how to solve the "synchronization" problem by using the latest technique in metrology sciences.

Our experiment employs a testbed that sits on a deployed dark fibre network. It connects the major science cities across Germany and even Europe. Our ultimate goal is to demonstrate a large-scale multipartite time- and frequency-synchronized entanglement network. With recent advances in theoretical and experimental quantum information sciences, we strongly believe that the large-scale entanglement network with photons will help to address several of the most fundamental questions in modern physics, such as:

- Entangle remote quantum computers and build a scalable "quantum internet"
- Redefine "time" with quantum-synchronized atomic clocks
- Detect gravitational waves in a "quantum way"

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