

bigQ - Annual highlights 2020

Distributed Sensing

When discussions turn to quantum mechanics, you often hear phrases like ‘*In quantum mechanics, things can be in two places at the same time*’. Most people probably feel more confused than enlightened when hearing this. But however odd it may sound, there is some truth to it. And experiments confirm it time and again. In 2020, bigQ demonstrated in a collaboration with the Villum Centre for the Mathematics of Quantum Theory (QMATH) at the University of Copenhagen that by using quantum-correlated light, it is possible to achieve clear improvements when measuring many separate objects at the same time – a technique known as *distributed sensing*. More specifically, an optical phase shift – the delay in the propagation of light – in four different glass sheets placed in four different locations was measured simultaneously. Crucially, this quantum physical approach to the task yielded more accurate results in determining the average phase shift than if the measurements had been done one at a time. The experiment is the first of its kind to illustrate the potential of quantum networks, where spatially distributed nodes are entangled into a single unit with perfect internal synchronization. This may find application in synchronization of atomic clocks and measurement of molecular motion in cells.

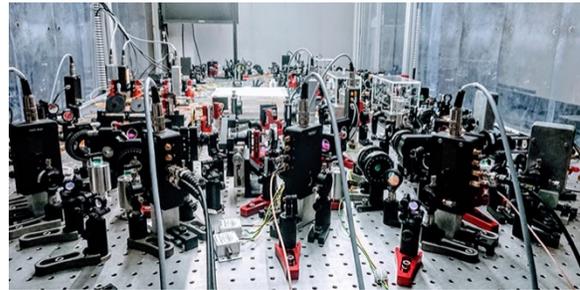


Figure 1: A view of the experimental setup in bigQ's labs used for demonstration of distributed sensing.

X. Guo et al. *Distributed quantum sensing in a continuous-variable entangled network*, Nat. Phys. **16**, 281 (2020), <https://doi.org/10.1038/s41567-019-0743-x>

Danish Quantum Community

Throughout 2020, QuantumDTU – headed by bigQ – has been a driving force behind the process of unifying and strengthening Danish quantum research through the formation of the *Danish Quantum Community*. Community activities and actions have included organisation of two community conferences (Jan. and Oct. 2020 with +100 participants), drafting of a Danish quantum agenda, and establishing relations to relevant ministries. Medio 2020, the Danish Quantum Community engaged in a new working group including major tech companies, SMEs, quantum start-ups, and trade organisations with the purpose of fostering a vibrant Danish quantum technology ecosystem and in the long-term a new value-creating industry. The ambition is to raise political support and funding for an ambitious national Danish quantum initiative. This is needed if Denmark is to strike gold in the quantum rush and capitalise on the internationally recognised excellence in basic quantum research that has been established during the last decades.



Figure 2: At the 2nd community conference, held online Oct. 7-8, 2020, keynote speaker Prof. Seth Lloyd (MIT) gave a memorable talk from his cottage outside Boston.