

## Highlights: Center for Hybrid Quantum Networks (Hy-Q)

### Research highlights

In 2021, Hy-Q researchers have continued to push the experimental platforms forward in a close collaboration with the theorists of the center. A major advancement has been the development of deterministic sources of entangled photons. Two different approaches have been demonstrated, i.e. using either an electron spin as entangler of photons or multi-electron processes in the quantum emitter. In both cases new theoretical protocols have been proposed and realized in proof-of-concept experimental demonstrations. This work constitutes a significant extension of previous research within Hy-Q that focused primarily on the generation of high-quality single photons. Indeed, these new entanglement sources have a wide range of applications within quantum science enabling ultimately secure quantum communication or advanced and resource-efficient photonic quantum computing architectures. Hy-Q has published a perspective article formulating our visions and roadmap towards such advanced applications based on our quantum hardware. The figure below shows Hy-Q's cover illustration at the occasion of publishing this work.

Additional major 2021 highlights include the demonstration of electromechanical ground state cooling with a phononic membrane coupled to a superconducting resonator and the theoretical proposal of a high-fidelity quantum gate for photons based on the hardware developed within Hy-Q.



### Outreach

Quantum science has been gaining significant attention in recent years and substantial investments have been launched worldwide to further develop and scale-up this potentially disruptive technology area. Likewise, the public interest in quantum science and technology is growing. Since Hy-Q is recognized internationally as a leading quantum-science center, we have in 2021 been hosting numerous visits to our labs, e.g., politicians, investors, and other stakeholders in the quantum area. Moreover, Hy-Q has participated in several press outreach activities. The photograph above shows the visit of EU Executive Vice-President Margrethe Vestager to our labs.