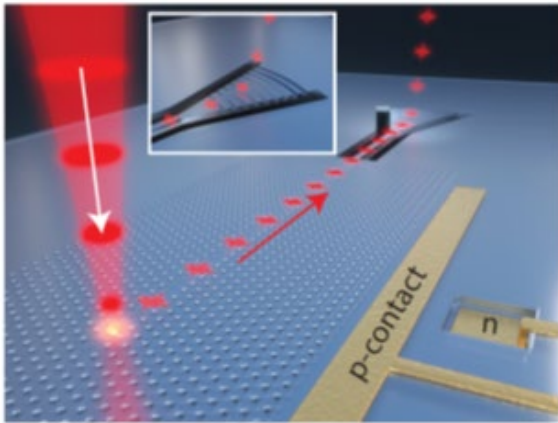


Highlights: Center for Hybrid Quantum Networks (Hy-Q)

Research highlights



After a build-up phase of our experimental activities, significant breakthroughs have been achieved in 2020. Hy-Q develops quantum hardware for long-term applications in quantum technology. Our photon sources have reached new levels: we have developed an on-demand coherent single-photon source (cf. figure inset) that enables realizing Quantum Advantage. This steep benchmark signifies that the photon source quality and scalability suffice for implementing a quantum algorithm that is intractable on even the World's most powerful classical computer. This is a major milestone proving the scalability of the Hy-Q quantum hardware. In a close collaboration between experiment and theory, we are furthermore developing more advanced photonic quantum

resources, notably multi-photon entangled sources. In a first step, we have very recently demonstrated spin-photon entanglement, and are currently extending to realizing on-demand photon-photon entanglement. Furthermore, continuous developments on the quantum optomechanics platforms have been taking place in 2020 by fundamental studies of phonon decoherence processes. This insight has been utilized for generating optical entanglement by exploiting photon-phonon coupling. This new hardware development continues to inspire the advancement of new theoretical protocols in Hy-Q, one recent example being a fully device-independent quantum cryptography protocol.

Social and scientific highlight: The Hy-Q retreat

Despite the pandemic, we were fortunate to be able to carry through the yearly Hy-Q retreat. In September, we spent three delightful days at The Forest College (Skovskolen) in Nødebo in the proximity of Gribskov and Esrum Lake. While last years retreat focused on establishing new collaborations, our aim this year was to get a snapshot of on-going research projects and to stimulate in-depth discussions. Consequently, all Hy-Q junior members were presenting their work either through a scientific talk or during the very lively poster- and poster pitch sessions. A special workshop, organized independently by Ph.D. students and Post Docs, focused on racism in academia and quantum physics. Finally, the Hy-Q team enjoyed a variety of "Covid-19 friendly" social events including a team-building exercise in the forest.

