

Special issue: Quantum photonics

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With the availability of sophisticated nanofabrication and novel quantum emitters, it is possible to study novel quantum optical phenomena in nanophotonic systems. Strong confinement of light at the nanoscale results in extremely strong light-matter interaction, where the effect of a single photon is substantial and easily measurable. In this special issue on “quantum photonics”, we have a number of papers on nanophotonic quantum systems from leading groups in the world. The research spans from large mode-volume waveguides, low mode-volume silicon cavities to ultra-low volume plasmonic devices. The material systems range from atoms to semiconductor quantum emitters. A critical issue is to transition traditional quantum optics, relying on experiments on an optical table covered with a maze of lenses, filters, mirrors, splitters, laser sources and detectors to compact photonic on-chip circuits integrable with other chip scale devices. Several of the reviews highlight how this is being done in silicon to generate single photons, entangle photons, create quantum-based devices. Metal-based nanophotonic structures relying on plasmonics provide a different set of challenges. Plasmonics has long been considered a part of classical photonics. However, recently it has become increasingly clear that quantum effects can be important in plasmonics as well. Several of the reviews show how this transition from classical to quantum plasmonics is taking place. While these articles in this special issue may be thought of as collection of review articles, they should really be considered as a sign post toward the many exciting possibilities for quantum photonics that are just beginning to appear, pointing to the applications to quantum technologies for information processing, measurement and sensing that will be made possible when strong light-matter interaction in nanophotonics allows quantum manipulation of photons one at a time to realize fully quantum photonic circuits.

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