Quantum: Advancing Photonics for 100 Years

Year 2025 is recognized by the United Nations as the International Year of Quantum Science and Technology. This celebration is more than a symbolic milestone; it is a recognition of the profound impact quantum science is having across disciplines and applications. But quantum science has its roots firmly in optics. It all began with Max Planck's work on black body radiation. Planck's discovery of quantized energy levels laid the foundation for quantum theory. Albert Einstein further advanced the field with explanation of the photoelectric effect, demonstrating that light could be understood as discrete packets of energy, which we now call photons. Niels Bohr then developed a model of the atom that explained the emission spectrum of hydrogen.

These foundational discoveries paved the way to physics as we know it today. Quantum and photonic technologies are truly symbiotic. Quantum science defined photonics, with a laser being intrinsically a quantum device. Photonics in turn has a fundamental role is delivering quantum technologies. From quantum communications and computing to quantum-enhanced imaging and sensing, photonics opens unprecedented possibilities in security and privacy, modelling of molecules, medical diagnostics with quantum-enhanced microscopes, and detecting gravitational waves with extreme precision. These advances underscore that photonics is not merely supporting quantum technologies but is, in many ways, the approach through which quantum potential can be realized.

As we celebrate the International Year of Quantum, it is important for the photonics community to actively engage in shaping the quantum future. The need for scalable quantum light sources, loss-resistant quantum channels, high-efficiency detectors, and new quantum algorithm implementations continues to drive photonics research. *Advanced Photonics* regularly covers these advancements in original and review articles (special collection here), and we hope they help our readers to plot their next breakthrough in quantum technologies and educate the next generation of scientists and engineers who will propel these advancements forward. We always welcome submissions that explore the frontiers of quantum-photonic research, and encourage discussions on novel materials, devices and systems, as well as theoretical insights that will define the future of quantum for the next 100 years.

Anatoly Zayats
Co-Editor-in-Chief

Xiao-Cong (Larry) Yuan
Co-Editor-in-Chief