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Recent Advances in Optical Quantum Information Processing

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Message from the Guest Editor

Quantum information processing once held the allure of dramatically transforming information processing capabilities, posing significant challenges to contemporary cryptographic methods. As researchers delved deeper into the field, our collective understanding of the potential and constraints of quantum information processing grew. Remarkably, recent advancements in laser technologies, combined with developments in both linear and nonlinear optical systems, have greatly enhanced optical quantum information processing on the NISQ platform.

Historically, quantum information processing was perceived to bring groundbreaking changes in three major sectors: quantum computation, quantum sensing, and quantum communication. However, with recent developments, quantum simulation and quantum machine learning have also emerged as fields where NISQ can have substantial influence. Undoubtedly, a deeper understanding of light–matter interactions and optical quantum processing has made significant contributions to these fields. It is imperative, now more than ever, to discern the disparity between the lofty promises of quantum information processing and the tangible boundaries within which we can construct quantum systems that outperform their classical equivalents, particularly in the emerging field of optical quantum information processing.

We welcome submissions from theoretical, numerical, and experimental perspectives with the following subjects when light–matter interactions and optical systems are used for quantum information processing:

- Gate-based quantum computations and algorithms;
- Qubit encodings and their implementations;
- Scaling of quantum computers;
- Quantum networks;
- Entanglement management (generation, distribution, and distillation);
- Quantum repeaters;
- Quantum communications on DV or CV encodings;
- Quantum channel capacities;
- Quantum imaging;
- Quantum gravimeters;
- Materials for quantum information processing;
- Quantum simulations;
- Quantum machine learning;
- Non-conventional quantum computations.

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