Special Section on Quantum Information Processing

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Quantum information processing is an active cross-disciplinary field drawing upon theoretical and experimental physics, computer science, engineering, mathematics, and material science. Its scope ranges from fundamental issues in quantum physics to prospective commercial exploitation by the computing and communications industries. Popularly known as quantum computing, quantum communications, quantum metrology, etc., quantum information processing has burgeoned in the world over the last two decades, producing high-level scientific results, and eventually reaching critical mass in many of its subfields. The great potential of quantum information processing had been deeply recognized by most of the countries, so that in the very recent years, the science and technology for quantum information processing are developing faster and faster. Many significant progresses have been made so that the application prospects of quantum information processing become much clearer than ever. In the next years, many more developments and breakthroughs will definitely come to the world, so we open the topic of quantum information processing in Journal of Electronic Science and Technology (JEST) to welcome the boosting research.

This Special Section on Quantum Information Processing in JEST is dedicated to presenting the state-of-the-art researches and applications on quantum computing, quantum communications, quantum metrology, etc. We received a number of high quality submissions, from which we have accepted 4 papers after a careful review process.

This section starts with the paper “Elimination of Spatial Side-Channel Information for Compact Quantum Key Distribution Senders”. In this article, the authors develop a method to analyze the spatial side-channel information in a compact quantum key distribution (QKD) sender for polarization encoding of the BB84 protocol. This compact QKD sender design has the potential to be realized in a small package with a height of several millimetres, which is preferred to the applications of portable equipment.

In the second paper titled “Direct Measurement of Non-Classical Photon Statistics with a Multi-Pixel Photon Counter”, the authors focus on a new kind of spatial multiplexing photon-number-resolving detector suitable for ultralow photon number distinguishing. The non-classical state photon number distribution is directly observed with a multi-pixel photon counter instead of a classic Hanbury-Brown and Twiss system. The photon number resolving detector is proved a fundamental quantum device for the application of quantum information processing.

The third paper is entitled ‘Quantum Cryptography for Internet of Things Security’. For the security of Internet of things, this article reviews the problems of traditional security technologies and advantages of quantum cryptography, and analyzes the feasibility of introducing quantum cryptography into the Internet of things security. It is quite interesting and attractive to try using the quantum information technique in the Internet of things.
In the field of fiber-based quantum communications, 1.55-μm quantum emitter is a challenge. The last paper “Micropillar Cavity Design for 1.55-μm Quantum-Dot Single-Photon Sources” proposes systematically a designing method for efficient 1.55-μm quantum-dot photon emitters well coupling to fibers. The advanced adiabatic design is proved an effective way to obtain prospective candidates for quantum light sources.

The above contributions show impressively the profoundness and prospects of the present research on quantum information processing. As the guest editor of this special section, I would like to express my sincere appreciation to all the reviewers and contributors of this special section.

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Hai-Zhi Song was born in Shanxi in 1968. He received the B.S. degree in semiconductor physics from Nanjing University, Nanjing in 1990 and the Ph.D. degree in condensed-matter physics from Peking University, Beijing in 1995. From 1995 to 1998, he did postdoctoral work at Nanjing University and Katholieke Universiteit Leuven, Leuven. From 1998 to 2001, he was a research associate with University of Tsukuba, Ibaraki. In 2001, he joined Fujitsu Laboratories Ltd., Kawasaki to be a researcher. From 2012 to 2014, he was a senior researcher with The University of Tokyo, Tokyo. Since 2014, he has been a professor with Southwest Institute of Technical Physics (SITP), Chengdu. In 2015, he joined University of Electronic Science and Technology of China, Chengdu as a professor. He is the author/coauthor of more than 100 articles and more than 25 inventions. His research interests include semiconductor optoelectronics, quantum information, and nano-photonics.