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Editorial

Quantum Innovations and the SPQEO journal

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Abstract. This article outlines some selected events from the numerous activities held during the 2025 International Year of Quantum Science and Technology, elucidating the core concepts, themes and developmental trends explored within these initiatives. QuantumFest 2025 (USA), QuanTour (Germany), Quantum Curio (USA), Communicating Quantum Science and Technology to Public (South Korea**),** Quantum Crossroads (New Zeland) have shown synergy in various branches of quantum science and technology. SPQEO journal follows the world trends in quantum innovation and publishes appropriate articles, in particular, on the effects of charge carrier interaction, peculiarities of waves propagation in optical fibres for communication etc.

Keywords: quantum innovations, global quantum tendencies, SPQEO journal

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1. Some events during 2025 the International Year of Quantum Science and Technology

Innovation as an accelerator for implementation of research results is a decisive factor in the development of the economy and society. Quantum science and quantum technology are no exception. Precisely for this reason, numerous science and education activities focused on innovation are being held throughout the 2025 International Year of Quantum Science and Technology [1, 2]. For example, American Physical Society held "QuantumFest 2025" at the Global Physics Summit in Anaheim, USA [3]. The quantum anniversary was accompanied by exciting performances, scientific demonstrations and lightning talks showcasing wonders of quantum physics. The programme consisted of three parts: Quantum Harmonies, Quantum Journeys and Quantum Celebrations. Another event was "QuanTour" [4], the official outreach project of the German Physical Society for the 2025 International Year of Quantum Science and Technology. The QuanTour is an exciting journey featuring a quantum light source travelling through Europe over a course of 12 months. This one-of-a-kind initiative will take the source to 12 laboratories across 12 different countries, showcasing the quantum nature of light at each stop.

Yet one more example was "Quantum Curio": Back to School Edition, which was held on Thuesday, August 28, Seattle [5]. The main message of this event was: Quantum is evolving from theory to foundation of future technology. Together with Barclo Studio, Future Force is excited to host an event that brings innovation, curiosity, and community to the forefront.

South Korea held an event titled "Communicating Quantum Science and Technology to Public" in Yonsei University, Seoul, June 27-29, 2025 [6]. It brought national and international outreach and science communication experts and practitioners of quantum science and technology to discuss the issues, difficulties, and opportunities related to public communication of quantum science and technology. Topics such as outreach in quantum science and technology, including games and arts; journalism, mass media, social media, SNS, AI, etc. for science communications in quantum science and technology; science communications to experts in different fields and in industry; and science communications and policy making in quantum science and technology were discussed. It is also necessary to mention the event in New Zealand: Quantum Crossroads, at the intersection of arts, culture and quantum science and technology [7]. Market analysis for the future of quantum computing was made by the Research and markets: the world's largest market research store [8].

2. Vision of innovations in quantum technologies by Quantum Innovation Hub

A highly significant event took place from late August to early September: the 2025 International Symposium on Quantum Science, Technology and Innovation (Quantum Innovation 2025), jointly organised by research institutes under the Quantum Technology Innovation Centre and

universities [9]. This event received support from the Japanese government, the Japan Science and Technology Agency (JST), and corporate sponsors. The symposium programme showcases rich and diverse innovations in quantum technology across computing, communications, sensing technologies, and interdisciplinary applications [10]. The proceedings closely follow the mainstream trajectory of the world quantum technology development, presenting not only the current state of cutting-edge technologies but also revealing the technological directions that will drive transformative change over the coming decades.

The inaugural sessions of the Symposium on Quantum Algorithms, Fundamental Theory and Practical Quantum Computing established an intellectual basis for this symposium. These sessions emphasised a dual mission: developing novel quantum algorithms that surpass classical methods, and translating them into practical platforms applicable to solving real-world problems in optimisation, chemistry and machine learning. The Semiconductor Quantum Computing session, closely aligned with the SPQEO journal, focuses on spin qubits in silicon and related materials, where advances in SiGe and FDSOI technologies promise CMOS compatibility and scalable integration. Together, these topics illustrate the cycle of innovation from theory to device: from abstract algorithms to engineering for specific platforms and to the grand challenge of creating a fault-tolerant quantum computer.

The trajectory of communication within the quantum technology domain underscores the growing significance of quantum-secure information technology. Consequently, quantum communication establishes a foundational framework, while advancements and prospects in quantum cryptography, alongside standardisation and certification of quantum key distribution (QKD) and post-quantum cryptography, encompass both scientific progress and regulatory environment. Explorations in free-space QKD extend secure links beyond fibre-optic networks, paving the way for a global satellite quantum internet. The societal implementation of quantum communication emphasises the need to translate laboratory technologies into physical infrastructure, striking a balance between technological maturity and societal acceptance. Quantum Security and Networks further elucidate the integration of communication technologies with quantum networks, pointing towards future development of hybrid quantum-classical infrastructure. The core innovation here lies in scalability, interoperability, and trustworthiness, merging deep physical principles, engineering standards, and cybersecurity policies.

3. Quantum innovations and the SPQEO journal

It was previously shown [11] that the SPQEO journal focuses on current developments in the fields such as physics of nanoparticles and nanostructures. In particular, the journal has published articles on semiconductor nanocrystals, quantum dots, thin lattices, and related topics, including their growth, characterization, physical property studies, and theoretical descriptions.

Here is a review of some articles related to quantum science and technology. The development of high-temperature superconducting (HTSC) qubits could lead to a breakthrough in quantum computing, making it more accessible and practical. This research line has great potential, as does the study of HTSC mechanisms, including the bipolaron mechanism in low-dimensional systems [12].

Kochelap [13] analyzed interaction of a pair of electrons with complex single-electron energy dispersion. It was shown that relative motion of the electron pair is of a very peculiar character. For example, the real space trajectories corresponding to electron-electron scattering can have three reversal points, reversal points at non-zero radial momentum and other unusual features. The investigation of rotating bi-electrons at the Mexican-hat single-electron energy dispersion may bring new interesting effects in low-dimensional and low-temperature physics.

Dimitriev [14] has shown that the exciton size can be as small as few angstroms, but even smaller sizes can be, probably, justified. At the same time, coupling of exciton to a polariton mode can enlarge the exciton-polariton coherence length to values as high as 20 μm, thus extending the scale of possible exciton sizes up to five orders of magnitude.

Few articles report quantum features of low-energy photoluminescence of aluminum nitride films [15], electron levels of defects in In(Ga)As/(In)GaAs nanostructures [16], influence of quantum dots bandgap and their dispersion on the loss of luminescent quanta [17], impact of semiconductor quantum dots bandgap on reabsorption in luminescent concentrator [18], and a method for fast calculating the electronic states in 2D quantum structures based on group-III element nitrides.

A series of studies devoted to solitons [20-28] shows that it is necessary to be absolutely sure that chromatic dispersion accidentally or otherwise does not get to be rendered nonlinear during the soliton propagation through underground or underwater cables across intercontinental distances. This is true for any kind of optoelectronic device that is applicable in the telecommunication industry such as optical fibers, optical couplers, magneto-optic waveguides, crystals, optical metamaterials or dispersion-flattened fibers and several others. The results would be otherwise catastrophic with stalled solitons as illustrated and exemplified. Thus, telecommunication engineers must exercise extra care and caution to make sure to avoid this fall out.

Humayun, et al. [29] studied the effect of optical fibre core diameter on Brillouin scattering loss. Through a comparative analysis, it has been ascertained that the Brillouin scattering loss is affected not only by the operating wavelength, but also by the core diameter of different cable types. It is revealed by comparative analysis that the Brillouin scattering loss declines with application of multi-mode graded index silica fiber. However, in the plastic fibre category, a plastic step index fibre offers better performance.

Conclusion

The events during 2025 International Year of Quantum Science and Technologies outline a comprehensive roadmap for quantum innovation: (i) fundamental research in algorithms and physics; (ii) competitive hardware platforms and error correction strategies; (iii) next-generation secure networks; (iv) precision sensing technologies for life, health and the environment; (v) cross-disciplinary Platforms and Talent Development Programmes. These themes collectively demonstrate that quantum technology is not merely an isolated breakthrough, but an integral component of a synergistically evolving ecosystem. The symposium thus reflected the global trajectory towards a quantum-enabled future that reshapes computing, communications, and sensing, while simultaneously addressing ethical, societal, and educational challenges.

SPQEO journal follows the main trends in the development of quantum science and technology. It is necessary to mention such topics during last years: effects of charge carriers interaction, peculiarities of waves propagation in optical fibres for communication etc.

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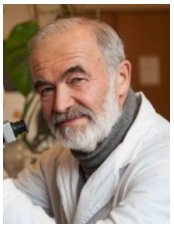

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Квантові інновації та журнал SPQEO

П.С. Смертенко, З.В. Максименко, О.Є. Бєляєв

Анотація. У цій статті висвітлюються деякі видібрані події з численних заходів, що відбулися протягом Міжнародного року квантової науки і технологій 2025, з роз'ясненням основних концепцій, тем і тенденцій розвитку, що обговорювалися в рамках цих ініціатив. QuantumFest 2025 (США), QuanTour (Німеччина), Quantum Curio (США), Communicating Quantum Science and Technology to Public (Південна Корея), Quantum Crossroads (Нова Зеландія) продемонстрували синергію в різних галузях квантової науки і технологій. Журнал SPQEO слідкує за світовими тенденціями в галузі квантових інновацій і публікує відповідні статті, зокрема, про ефекти взаємодії носіїв заряду, особливості поширення хвиль в оптичних волокнах для зв'язку тощо.

Ключові слова: квантові інновації, глобальні квантові тенденції, журнал SPQEO.