

## International Year of Quantum Science and Technology and the SPQEO journal

Petro Smertenko<sup>1</sup>, Zoia Maksimenko<sup>1</sup>, Sergii Golovynskyi<sup>2,\*</sup>, Alexander Belyaev<sup>1</sup>

<sup>1</sup> *Institute of Semiconductor Physics, National Academy of Sciences of Ukraine, 03028, Kyiv, Ukraine*

<sup>2</sup> *College of Physics and Optoelectronic Engineering, Shenzhen University, 518060, Shenzhen, P.R. China*

\* Corresponding author. E-mail addresses: *serge@szu.edu.cn*

**Abstract.** SPQEO Journal and the world physics community jointly mark the 100th anniversary of W. Heisenberg, M. Born, and P. Jordan's development of matrix mechanics, as well as E. Schrödinger's proposal of wave mechanics. This issue of the journal supports the United Nations General Assembly's designation of 2025 as the International Year of Quantum Science and Technology. Through the century-long efforts of outstanding physicists such as A. Einstein, P. Dirac, M. Planck, N. Bohr, M. Born, H. Kramers and many others, the base for the development of quantum technology has been created. Semiconductor-based zero-dimensional (0D), one-dimensional (1D) and two-dimensional (2D) nanostructures, driven by quantum confinement effects, have spurred the rapid development of quantum technology and the creation of materials with fundamentally new properties. The future development of quantum technology, like other technologies, lies in addressing societal challenges such as healthcare, ecology, security, and information dissemination. Quantum technology must possess characteristics such as understandability, specificity, openness, accessibility, responsibility, cultural rootedness, and importance. The SPQEO journal also focuses on current developments in fields such as nanoparticle and nanostructure physics. In recent years, 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.

**Keywords:** quantum science, quantum technology, SPQEO journal

<https://doi.org/10.15407/spqeo28.02.128>

PACS 68, 73, 77, 78, 81, 85.30.-z, 85.35.B2

Manuscript received 22.05.25; revised version received 06.06.25; accepted for publication 11.06.25; published online 26.06.25.

### 1. Why is 2025 the International Year of Quantum Science and Technology?

On June 7 2024, United Nations General Assembly proclaimed 2025 as the International Year of Quantum Science and Technology (IYQ) **to mark 100 years after Heisenberg, Born, and Jordan developed matrix mechanics and Schrödinger formulated wave mechanics** [1]. According to the proclamation, this year-long, worldwide initiative will “be observed through activities at all levels aimed at increasing public awareness of the **Technology** (IYQ) is to use the occasion of 100 years of quantum mechanics in 2025 to help raise public awareness of the importance and impact of quantum science and applications on all aspects of life. Anyone, anywhere can participate in IYQ by helping others to learn more about quantum on this centennial occasion or simply taking the time to learn more about it themselves. The Resolution emphasizes that quantum science and technology is vital for economic advancement

and that its potential applications could address basic needs such as food, health, sustainable cities and communities, communications, clean water and energy, and support climate action [2]. Furthermore, the Resolution notes that at the heart of the International Decade of Sciences for Sustainable Development, 2024–2033, lies the advancement of basic sciences and recognition that quantum science offers unparalleled insights into the behaviour of matter and energy at the atomic and subatomic levels.

The R&I future priorities 2025-2027, considered in [3, 4] marked among other the quantum technologies in such research areas as (i) **TECHNOLOGY** with the chip, photonics (in sensing, telecom, and other application fields), electric battery technologies, and microelectronics; (ii) **CIVIL SECURITY FOR SOCIETY** with resilience of communication systems and infrastructure, high-performance computing, and space research and exploration; (iii) **DIGITAL, INDUSTRY, AND SPACE** with the digital infrastructures and networks, innovative



**Fig. 1.** A common image depicting the "fathers of quantum theory" in the first Solvay Council in Brussels. Front row: Irving Langmuir, Max Planck, Marie Curie, Hendrik Lorentz, Albert Einstein, Paul Langevin, Charles-Eugène Guye, C.T.R Wilson, Owen Richardson. Middle row: Peter Debye, Martin Knudsen, William Lawrence Bragg, Hendrik Anthony Kramers, Paul Dirac, Arthur Compton, Louis de Broglie, Max Born, Niels Bohr. Back row: Auguste Piccard, Émile Henriot, Paul Ehrenfest, Édouard Herzen, Théophile de Donder, Erwin Schrödinger, JE Verschaffelt, Wolfgang Pauli, Werner Heisenberg, Ralph Fowler, Léon Brillouin. (<https://rarehistoricalphotos.com/solvay-conference-probably-intelligent-picture-ever-taken-1927>)

materials, such as semiconductors, digital technologies (e.g., digital twins, 6G), space technologies, and sustainable use of space [5].

In addition, IQY will celebrate the 100<sup>th</sup> anniversary of the creation of matrix mechanics by Heisenberg, Born, and Jordan and the formulation of wave mechanics by Schrödinger. Fig. 1 shows a historic photo of the first Solvay Council in Brussels with these prominent scientists.

## 2. Quantum technologies for the future

The main direction of the future development of quantum technologies, as well as other technologies, is to solve social problems, such as healthcare, ecology, security, and information dissemination. Ch. Coenen et al. [6] have considered in great detail what features quantum technologies should meet:

- **Comprehensible:** present quantum technologies in ways that are legible, honest, and publicly accountable, avoiding the rhetoric of competition and battle, and focusing on non-classical protocols and available applications that may have particular advantages and disadvantages for different groups of stakeholders.

- **Specific:** instead of relying on generic metahistorical narratives, sociological clichés, or the historic discussion of the enigmas of quantum mechanics, attend to quantum technologies with their specific innovation pathways, sociotechnical processes and designs, denoting new resources, application fields, relevant actors, development strategies, legal and ethical considerations, and scientific challenges.

- **Open:** make research on quantum technologies available to communities beyond early adopter states, start-ups, and Big Tech companies and provide access to cutting-edge research facilities for the Global South.

- **Accessible:** enhance the diversity of the field's workforce, design implementations that anticipate and

support the greatest variety of users and contexts, and avoid tunnel visions that fixate on the first commercial use cases for industry or on geopolitical advantages to the USA, China, or EU.

- **Responsible:** involve sustainability research, technology assessment, and practices of responsible research and innovation to investigate possible long-term effects of quantum technologies, including unintended consequences, with an eye to the interests of future generations as much as our own.

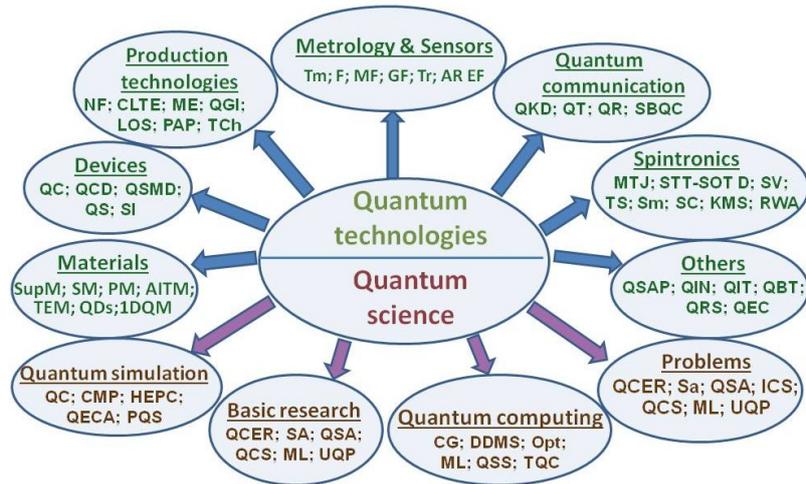
- **Culturally embedded:** develop outreach efforts and participatory opportunities for citizens that speak to implications of quantum technologies in the popular imagination, in different cultural contexts.

- **Meaningful:** engage with a greater variety of societal needs, hopes, and concerns, steering the development of quantum technologies toward applications that are meaningful not only for industry but also for society.

## 3. Main areas of quantum science and quantum technologies

Fig. 2 illustrates the main areas of quantum science and quantum technology. All of these areas are deeply and intimately connected and influence each other. Briefly, they can be described as follows.

The primary goal of quantum simulation is to replicate the behavior of complex quantum systems using a controllable quantum system. This is important because many natural systems, such as molecules, materials, and atomic interactions, are too complex to be simulated accurately using classical computers due to exponential scaling of computational resources. The quantum simulation allows understanding and predicting the behavior of complex quantum systems, which classical computers cannot handle efficiently. It is a tool that could



**Fig. 2.** Conventional division of quantum science and quantum technologies areas. Here, the following abbreviations are used. *Quantum Simulation*: QC: quantum chemistry; CMP: condensed matter physics; HEPC: high-energy physics & cosmology; QECA: quantum error correction and algorithms; PQS: platforms for quantum simulation (trapped ions and ultracold atoms in optical lattices, superconducting circuits, photonic, analog quantum simulators, digital quantum simulators). *Basic research*: QCER: qubit coherence and error rates; SA: scalability; QSA: quantum software and algorithm - integration with classical systems; QCS: quantum communication security; ML: material limitations; UQP: understanding quantum phenomena. *Quantum Computing*: CG: cryptography; DDMS: drug discovery and materials science; Opt: optimization; ML: machine learning; QSS: quantum system simulation; TQC: types of quantum computers (universal gate-based quantum computers – IBM, Google, IonQ; quantum annealers – D-wave; photonic, topological). *Problems in quantum science*: QCER: qubit coherence and error rates; Sa: scalability; QSA: quantum software and algorithms; ICS: integration with classical systems; QCS: quantum communication security; ML: material limitation; UQP: understanding quantum phenomena. *Materials*: SupM: superconducting materials (Nb, Al), YBaCuO; SM: semiconductors (Si, GaAs, Ge); PM: photonic materials (Si<sub>3</sub>N<sub>4</sub>, LiNbO<sub>3</sub>, diamond, InP); AITM: atomic and ion trap materials (Be, Ca, Yb, Sr; Rb, Cs); TEM: topological and exotic materials (topological insulators, Majorana fermion candidates, graphene, and 2D); QDs: quantum dots (typically 2–10 nm in size; CdSe, InAs, GaAs, Si, etc.); 1DQM: one-dimensional quantum materials (carbon nanotubes, CNTs; nanowires, e.g., InSb, InAs; atomic chains on surfaces, like Au or Pt atoms, polyacetylene, and other conducting polymers). *Devices*: QC: quantum computers (they use superconducting qubits, e.g., IBM, Google, Rigetti; trapped ions, e.g., IonQ, Honeywell; photonic qubits, e.g., Xanadu, PsiQuantum; spin qubits in semiconductors, e.g., Intel); QCD: quantum communication devices (QKD - quantum key distribution systems, single-photon sources, quantum repeaters, entangled photon generators); QSMD: quantum sensors and metrology devices (atomic clocks, quantum magnetometers, quantum gravimeters, quantum gyroscopes, and accelerometers); QS: quantum simulators; SI: supporting infrastructure (dilution refrigerators, vacuum chambers, laser systems, and high-precision electronics). *Production Technologies for Quantum Applications*: NF: nanofabrication (electron beam lithography (EBL), photolithography, etching, deposition techniques (ALD, PVD, CVD); CLTE: cryogenics and low-temperature engineering (dilution refrigerators, vacuum chambers, thermal filtering, and shielding); ME: materials engineering (isotopically purified Si (28Si, for spin qubits), high-purity niobium/aluminum, diamond with NV centers); QGI: quantum-grade integration (quantum control electronics, hybrid integration, waveguide and fiber coupling); LOS: laser and optical systems (stabilized laser sources, optical trapping and cooling systems, beam steering and shaping technologies); PAP: precision assembly & packaging (cleanroom assembly stations, micromanipulators, quantum packaging); TCh: testing & characterization (scanning tunnelling microscopy (STM) and AFM, quantum tomography, noise spectroscopy, and coherence time measurements). *Metrology & Sensors*: Tm: time (GPS, internet, standards); F: frequency (telecommunications, spectroscopy); MF: magnetic fields (brain imaging (MEG), material science); GF: gravitational fields (Earth science, archaeology, navigation); Tr: temperature; AR: acceleration & rotation; EF: electric fields. *Quantum Communication*: QKD: quantum key distribution; QT: quantum teleportation; QR: quantum repeaters; SBQC: satellite-based quantum communication. *Spintronics*: MTJ: magnetic tunnel junctions; STT-SOTD: spin-transfer torque and spin-orbit torque devices; SV: spin valves; TS: topological spintronics; Sm: skyrmionics (uses magnetic skyrmions: nano-scale vortex-like spin textures as information carriers); SC: spin caloritronics; KMS: key materials in spintronics (ferromagnets: Co, Fe, Ni, CoFeB; semiconductors: GaAs, InSb; 2D Materials: graphene, MoS<sub>2</sub>, WTe<sub>2</sub>; topological insulators: Bi<sub>2</sub>Se<sub>3</sub>, BiSb; heavy metals: Pt, Ta); RWA: real-world applications (data storage, quantum computing, sensors, communication). *Other*: QSAP: quantum software, algorithms, and programming; QIN: quantum internet and networking; QIT: quantum information theory; QBT: quantum biology and thermodynamics; QRS: quantum-resistant security; QEC: quantum education and commercialization.

revolutionize materials science, chemistry, physics, and quantum engineering.

It is possible to mark two main tasks of quantum computing: (i) to leverage quantum mechanics to solve certain problems far beyond the reach of classical computers, enabling breakthroughs in science, security, and technology; (ii) to solve certain types of problems more efficiently than classical computers by using the

principles of quantum mechanics: specifically, superposition, entanglement, and quantum interference.

As to material science, it plays a central role in enabling quantum technologies. Different types of quantum devices rely on highly specialized materials that exhibit quantum properties like superconductivity, entanglement, coherence, low decoherence, and single-photon absorption and emission. Quantum devices are

**extremely sensitive** and require **ultra-precise fabrication techniques**, often at the **nanometer scale**. That is why the quantum technologies rely on an entire ecosystem of unique materials, from ultrapure silicon to superconducting metals, atomic vapors, and even diamond crystals. The choice of material directly influences qubit performance, coherence times, scalability, and error rates. **Production technologies for quantum applications** involve an advanced mix of **nanofabrication, materials science, cryogenics, optics, and precision engineering**: all designed to make quantum systems reliable, reproducible, and scalable.

Spintronics combines quantum mechanics, materials science, and nanotechnology to use not only the charge of electrons, but also their *spin* as a carrier of information and holds the promise of faster, more efficient, and quantum-aware electronics, bridging classical computing and quantum technologies. Quantum communication is the use of quantum mechanical properties (like superposition, entanglement, and quantum no-cloning) to transmit information securely and enable new forms of communication that classical systems cannot provide. Its key promise is unbreakable encryption and the foundation for the future quantum internet. It aims to revolutionize how we transmit information, offering ultimate security and the foundations for quantum networking and computing on a global scale. Quantum metrology and sensors are destined to use quantum states and quantum systems to measure physical quantities with extremely high precision. They focus on using quantum phenomena to improve the precision of measurements beyond the limits of classical methods.

#### 4. Quantum science and SPQEO journal

Quantum dots (QDs) are mostly zero-dimensional nanocrystals (NCs) of rather ideal spherical shape with sizes below 20 nm, which have a size-tunable bandgap absorption and emission over a very wide range, used for laser diodes, displays, photodetectors, cameras, and solar cells [7,8]. Few articles report the synthesis and optical properties of CdS-based [9,10] and oxide [11-14] semiconductor QDs and NCs. A green synthesis of metal oxide NCs, using plant extracts, may be highlighted. For CdS, CdSe, CdTe, InP, InAs, and PbSe QDs, Kulish et al. [15] proposed a theoretical method for estimating the loss of luminescent quanta caused by reabsorption, based on the analysis of absorption and luminescence spectra of QDs with different radii and dispersion of radius. Solid-state QDs, such as nanoislands of InAs, InGaAs, GaAs, InP, GaN, AlGaIn, AlN, are highly investigated during last decades [16,17]. The reports on In(Ga)As/GaAs QDs published in SPQEO [18,19] were focused on the quantum-confinement emission and the influence of defects created in such nanostructures due to the mismatch between the QD material and embedding layers.

SPQEO also focuses on quantum effects and electron/exciton behavior in two-dimensional (2D) quantum structures. Slipokurov et al. [20] presented a method for calculating the electronic states in 2D quantum well InGaN/GaN structures, based on the representation of electronic states in the form of a linear

combination of bulk wave functions of the materials. Milenin and Redko [21] analyzed below-bandgap photoluminescence of AlN films, which contained a series of equidistant maxima. They proposed that this phenomenon might be caused by strong electron-phonon interaction, leading to appearance of quasi-particles in the bandgap of AlN, which are a bound state of an electron with an ion in a crystal lattice site, called elions. Kasumov et al. [22] studied the properties of ZnO:Ho thin films, focusing on morphology, structure, electrical and optical properties, and charge carrier lifetime. Sizov et al. [23] reported the detection of strong polarization-dependent photoresponses in direct narrow-gap HgCdTe thin layer biased and unbiased hot-electron bolometers with receiving antennas under elliptically polarized THz radiation. The observed effects were assumed to be due to the Rashba spin splitting in HgCdTe, caused by large spin-orbit interactions. Balabai et al. [24] theoretically obtained the spatial distributions of the valence electrons density, the electron energy spectra, and the atom charge states of 1D-coordination polymers based on arendiyl-bisphosphinic acids and metal ions under participation of strong intermolecular bonds.

Regarding the graphene-like 2D materials, Kochelap et al. [25] theoretically analyzed the interaction of a pair of electrons with mexican-hat single-electron energy dispersion, focusing on its motion and trajectory for the example of bi-graphene. Despite the repulsive Coulomb interaction, two electrons can be coupled forming a rotating bi-electron. For slowly moving bi-electrons, the kinetic energy and effective mass as functions of quantum states of the bi-electron were estimated. Moreover, Esposito et al. [26] comprehensively reviewed 2D MoS<sub>2</sub> for photonic applications.

#### Conclusions

The SPQEO journal, together with the global physics community, has declared this year the year of quantum physics and technology. It highlights some trends in quantum physics and technology, including: (i) the synthesis and optical properties of CdS-based and oxide semiconductor QDs and NCs; (ii) the quantum-confinement emission and the influence of defects created in In(Ga)As/GaAs QDs due to the mismatch between the QD material and embedding layers; (iii) quantum effects and electron/exciton behavior in 2D quantum structures; (iv) the detection of strong polarization-dependent photoresponses in a direct narrow-gap HgCdTe thin layer due to the Rashba spin splitting in HgCdTe, caused by significant spin-orbit interactions; (v) the interaction of a pair of electrons with mexican-hat single-electron energy dispersion in the graphene-like 2D materials, focusing on bi-electron motion and trajectory; (vi) the spatial distributions of the valence electrons density, the electron energy spectra, and the atom charge states of 1D-coordination polymers based on arendiyl-bisphosphinic acids and metal ions under participation of strong intermolecular bonds.

#### References

1. Resolution #78/287 from June 7, 2024. <https://digitallibrary.un.org/record/4052700?v=pdf>.

2. Official site of IYQ: <https://quantum2025.org/>
3. Synopsis Report - Looking into the R&I future priorities 2025-2027. European Commission. Directorate-General for Research and Innovation. First edition. Luxembourg: Publications Office of the European Union, 2023. <https://doi.org/10.2777/93927>.
4. Belyaev A. & Smertenko P. Science in 2025-2027 and the SPQEO journal. *SPQEO*. 2024. **27**. P. 004–009. <https://doi.org/10.15407/spqeo27.01.004>.
5. Krag H. A sustainable use of space. *Science*. 2021. **373**. P. 259. <https://doi.org/10.1126/science.abk3135>.
6. Coenen Ch., Grinbaum A., Grunwald A., *et al.* Quantum technologies and society: Towards a different spin. *Nanoethics*. 2022. **16**. P. 1–6. <https://doi.org/10.1007/s11569-021-00409-4>.
7. Liu M., Yazdani N., Yarema M., *et al.* Colloidal quantum dot electronics. *Nat. Electron*. 2021. **4**. P. 548–558. <https://doi.org/10.1038/s41928-021-00632-7>.
8. Belyaev A., Maksimenko Z., Golovynskiy S., *et al.* Semiconductor nanomaterials for optoelectronics and the SPQEO journal. *SPQEO*. 2025. **28**. P. 004–009 <https://doi.org/10.15407/spqeo28.01.004>.
9. Pylypova O.V., Korbutyak D.V., Tokarev V.S. *et al.* Composite polymer films with semiconductor nanocrystals for organic electronics and optoelectronics. *SPQEO*. 2024. **27**. P. 208–215. <https://doi.org/10.15407/spqeo27.02.208>.
10. Rose M.M., Christy R.S., Benitta T.A., *et al.* Phase transition and comparative study of  $\text{Cu}_x\text{Cd}_{1-x}\text{S}$  ( $x = 0.8, 0.6, 0.4,$  and  $0.2$ ) nanoparticle system. *SPQEO*. 2024. **27**. P. 176–183. <https://doi.org/10.15407/spqeo27.02.176>.
11. Vella Durai S.C., Kumar E., Indira R. Green route to prepare zinc oxide nanoparticles using Moringa oleifera leaf extracts and their structural, optical and impedance spectral properties. *SPQEO*. 2024. **27**. P. 064–069. <https://doi.org/10.15407/spqeo27.01.064>.
12. Amrin M.I., Roshan M.M., SaiGowri R., *et al.* Green synthesis of silver oxide nanoparticles using Trigonella foenum-graecum leaf extract and their characterization. *SPQEO*. 2024. **27**. P. 162–168. <https://doi.org/10.15407/spqeo27.02.162>.
13. Dharmarajan P., Sathishkumar P., Gracelin Juliana S. *et al.* Phytosynthesis of titanium dioxide nanoparticles using Cynodon dactylon leaf extract and their antibacterial activity. *SPQEO*. 2024. **27**. P. 287–293. <https://doi.org/10.15407/spqeo27.03.287>.
14. Gudenko J.M., Pylypchuk O.S., Vainberg V.V. *et al.* Ferroelectric nanoparticles in liquid crystals: Role of ionic transport at small nanoparticle concentrations. *SPQEO*. 2025. **28**. P. 010–018. <https://doi.org/10.15407/spqeo28.01.010>.
15. Kulish M.R., Kostilyov V.P., Sachenko A.V., *et al.* Influence of the quantum dots bandgap and their dispersion on the loss of luminescent quanta. *SPQEO*. 2020. **23**. P. 155–159. <https://doi.org/10.15407/spqeo23.02.155>.
16. Seravalli L. Metamorphic InAs/InGaAs quantum dots for optoelectronic devices: A review. *Microelectron. Eng.* 2023. **276**. No 111996. <https://doi.org/10.1016/j.mee.2023.111996>.
17. Golovynskiy S., Datsenko O., Seravalli L. *et al.* Near-infrared lateral photoresponse in InGaAs/GaAs quantum dots. *Semicond. Sci. Technol.* 2020. **35**. No 055029. <https://doi.org/10.1088/1361-6641/ab7774>.
18. Iliash S.A., Kondratenko S.V., Yakovliev, A. *et al.* Thermally stimulated conductivity in InGaAs/GaAs quantum wire heterostructures. *SPQEO*. 2016. **19**. P. 75–78. <https://doi.org/10.15407/spqeo19.01.075>.
19. Datsenko O.I., Kravchenko V.M., Golovynskiy S. Electron levels of defects in In(Ga)As/(In)GaAs nanostructures: A review. *SPQEO*. 2024. **27**. P. 194–207. <https://doi.org/10.15407/spqeo27.02.194>.
20. Slipokurov V.A., Korniychuk P.P., Zinovchuk A.V. A method for fast calculating the electronic states in 2D quantum structures based on AIIIBV nitrides. *SPQEO*. 2023. **26**. P. 165–172. <https://doi.org/10.15407/spqeo26.02.165>.
21. Milenin G.V., Redko R.A. Quantum features of low-energy photoluminescence of aluminum nitride films. *SPQEO*. 2024. **27**. P. 157–161. <https://doi.org/10.15407/spqeo27.02.157>.
22. Kasumov A.M., Strelchuk V.V., Kolomys O.F., *et al.* Properties of nanosized ZnO:Ho films deposited using explosive evaporation. *SPQEO*. 2021. **24**. P. 139–147. <https://doi.org/10.15407/spqeo24.02.139>.
23. Sizov F.F., Gumenjuk-Sichevska J.V., Danilov S.N. *et al.* Spin dependent polarization response in HgCdTe hot-electron bolometers. *SPQEO*. 2022. **25**. P. 254–261. <https://doi.org/10.15407/spqeo25.03.254>.
24. Balabai R.M., Bondarenko O.O., Yatsiuta M.V. Complex formation of 1D-coordination polymers based on arendiyl-bisphosphinic acid. *SPQEO*. 2023. **26**. P. 036–040. <https://doi.org/10.15407/spqeo26.01.036>.
25. Kochelap V.A. Rotating bi-electron in two-dimensional systems with mexican-hat single-electron energy dispersion. *SPQEO*, 2022. **25**. 240–253. <https://doi.org/10.15407/spqeo25.03.240>.
26. Esposito F., Bosi M., Attolini G. *et al.* Two-dimensional  $\text{MoS}_2$  for photonic applications. *SPQEO*. 2025. **28**. P. 037–046. <https://doi.org/10.15407/spqeo28.01.037>.

#### Authors and CV



**Petro Smertenko**, Senior Researcher at the Department of Kinetic Phenomena and Polaritonics of the V. Lashkaryov Institute of Semiconductor Physics, NAS of Ukraine, PhD in Physics and Mathematics. Authored over 150 publications, 30 patents, and 8 textbooks. The area of his scientific interests includes physics

and technology of semiconductor materials, hetero- and hybrid structures and devices (solar cells, photoresistors, light-emitting structures, *etc.*) as well as analysis, diagnostics, modeling and prediction of electrophysical processes in various objects.

E-mail: [petrosmertenko@gmail.com](mailto:petrosmertenko@gmail.com),  
<http://orcid.org/0000-0001-8793-302X>



**Zoia Maksimenko**, PhD in Physics and Mathematics, Researcher at the Department of Ion-beam Engineering and Structural Analysis, V. Lashkaryov Institute of Semiconductor Physics, NAS of Ukraine. The main direction of her scientific activity is

studying semiconductor nanostructures by high-resolution X-ray diffractometry in the field of anomalous X-ray dispersion.

E-mail: [ZMaksimenko@gmail.com](mailto:ZMaksimenko@gmail.com),  
<https://orcid.org/0000-0002-3434-3728>



**Sergii Golovynskyi** defended his PhD thesis in Physics and Mathematics (Optics, Laser Physics) in 2012 at the Taras Shevchenko National University of Kyiv. In 2012, he started his research carrier at the V. Lashkaryov Institute of Semiconductor Physics, NAS of Ukraine. Since 2016, he is an Associate

Researcher at the Shenzhen University, China. Author of more than 70 scientific articles, obtaining an H-index of 20. His main research activity is in the fields of semiconductor physics and optics, spectroscopy, nanomaterials and optoelectronics.

<https://orcid.org/0000-0002-1864-976X>.  
E-mail: [serge@szu.edu.cn](mailto:serge@szu.edu.cn)



**Alexander Belyaev**, Professor, Academician of the NAS of Ukraine. He obtained his PhD degree in Semiconductor Physics and Dielectrics in 1980 and the Dr. Sci. degree in 1991. A. Belyaev is Professor from 1999. He is the author of more than 220 publications. The area of his scientific activity is transport in quantum multilayer

heterostructures and low-dimensional systems and their optical properties as well as application of such structures in UHF devices.

E-mail: [belyaev@isp.kiev.ua](mailto:belyaev@isp.kiev.ua),  
<https://orcid.org/0000-0001-9639-6625>

#### Authors' contributions

**Smertenko P.:** methodology, verification, formal analysis, writing - review & editing.

**Maksimenko Z.:** resources, data curation, writing - review & editing.

**Golovynskyi S.:** conceptualization, writing – original draft, visualization, writing - review & editing.

**Belyaev A.:** supervision, writing - review & editing.

#### Міжнародний рік квантової науки і технологій та журнал SPQEO

П.С. Смертенко, З.В. Максименко, С. Головинський, О.Є. Беляєв

**Анотація.** Журнал SPQEO та світова фізична спільнота спільно відзначають 100-річчя розробки матричної механіки В. Гейзенбергом, М. Борном і П. Йорданом, а також пропозиції Е. Шредингера щодо хвильової механіки. Цей випуск журналу підтримує рішення Генеральної Асамблеї ООН про проголошення 2025 року Міжнародним роком квантової науки і технологій. Столітні зусилля видатних фізиків, таких як А. Ейнштейн, П. Дірак, М. Планк, Н. Бор, М. Борн, Г. Крамерс та багатьох інших, заклали основу для розвитку квантових технологій. Напівпровідникові нульвимірні (0D), одновимірні (1D) та двовимірні (2D) наноструктури, що базуються на ефектах квантового обмеження, стимулювали швидкий розвиток квантових технологій та створення матеріалів з принципово новими властивостями. Майбутній розвиток квантових технологій, як і інших технологій, полягає у вирішенні таких суспільних викликів, як охорона здоров'я, екологія, безпека та поширення інформації. Квантова технологія повинна мати такі характеристики, як зрозумілість, специфічність, відкритість, доступність, відповідальність, культурне коріння та важливість. Журнал SPQEO також фокусується на сучасних розробках у таких галузях, як фізика наночастинок та наноструктур. Останніми роками журнал публікував статті про напівпровідникові нанокристали, квантові точки, тонкі решітки та пов'язані теми, включаючи їх вирощення, характеристику, дослідження фізичних властивостей та теоретичні описи.

**Ключові слова:** квантова наука, квантова технологія, журнал SPQEO