

This Special Issue of Low Temperature Physics (Fizyka Nyzkykh Temperatur) presents original research papers from the VI International Conference "Condensed Matter and Low Temperature Physics 2026" (CM&LTP 2026), held online June 1–5, 2026. The B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine (ILTPE of NASU) traditionally organized the conference, with the National Academy of Sciences of Ukraine, the Trade Union of ILTPE of NASU employees, and the international scientific society Optica as co-organizers and partners.

The conference has a rich history. It grew out of the Kharkiv Region Conference for Young Scientists "Low Temperature Physics", which ILTPE has held annually since 2004. From the start, it aimed to engage young researchers in modern low-temperature and condensed-matter physics. The regional conference subsequently evolved into the Ukrainian Conference for Young Scientists "Low Temperature Physics" (2008 and 2009), bringing together early-career researchers from scientific institutions across Ukraine. Since 2010, the conference has been known in the international scientific community as the International Conference for Young Scientists "Low Temperature Physics" (ICYS-LTP), and since 2017, when its audience was substantially broadened by experienced researchers, as the International Conference for Professionals and Young Scientists "Low Temperature Physics" (ICPYS-LTP). The IX conference (2018) was dedicated to the 100th anniversary of the National Academy of Sciences of Ukraine, and the jubilee X conference (2019) to the 100th anniversary of the birth of the Institute's founder, Academician B. I. Verkin.

In 2020, the conference changed its name and format and became the International Advanced Study Conference "Condensed Matter and Low Temperature Physics" (CM&LTP). Its scientific scope encompasses a broad range of contemporary experimental and theoretical research, including low-temperature physics, superconductivity, magnetism, optics, nanophysics, biophysics, and materials science. The second conference of the new series took place in 2021. In 2022, in the first months of the full-scale war launched by the russian federation, the conference was not held because of intense hostilities in Kharkiv; however, it was resumed as early as 2023 (III conference, CM&LTP 2023) and has since been held annually in June: IV in 2024, V in 2025, and VI in 2026. Thus, CM&LTP 2026 continues a tradition spanning more than a decade and a half and sixteen conferences, which, over this time, have become an open platform for sharing knowledge and ideas and for finding partners for joint projects. The conference proceedings are regularly published in special issues of the journal Fizyka Nyzkykh Temperatur, whose English version is published by AIP Publishing as Low Temperature Physics.

Due to the continuous shelling of Kharkiv, CM&LTP 2026 was held online via the Zoom platform. The work of the conference was guided by the International Program Committee, which included scientists from Ukraine and Poland,

and by the Organizing Committee chaired by D. Hurova (vice-chairs O. Konotop and V. Geidarov, scientific secretary Yu. Savina).

The scientific program of the conference covered nine topics: electronic properties of conducting and superconducting systems; magnetism and magnetic materials; optics, photonics, and optical spectroscopy; quantum liquids, quantum crystals, and cryocrystals; nanophysics and nanotechnology; biophysics and the physics of macromolecules; materials science; theoretical condensed matter physics; and technologies and instrumentation for physical experiments. The conference *Book of Abstracts* (ISBN 978-617-95630-0-3) includes 245 peer-reviewed contributions, including 18 plenary lectures, 81 oral presentations in thematic sessions, 145 poster presentations, and one workshop contribution. The contributions came from researchers affiliated with universities and scientific institutions in Ukraine and more than twenty other countries across Europe, Asia, and the Americas, reflecting the broad international participation in CM&LTP 2026.

Plenary lectures were delivered by leading scientists from Ukraine, Germany, Israel, Italy, Japan, the Netherlands, Poland, Romania, Sweden, the United Arab Emirates, the United Kingdom, and the USA. They covered a wide range of topics: thermal transport properties and phonon-glass features in dimer-Mott quantum spin liquids (Y. Nakazawa, The University of Osaka, Japan), angle-resolved photoemission spectroscopy (S. Borisenko, IFW Dresden, Germany), the unresolved problem of the chiral-induced spin selectivity effect (J. M. van Ruitenbeek, Leiden University, the Netherlands), superconducting quantum and classical thermoelectricity (A. Braggio, CNR-NANO, Pisa, Italy), ^{4}He and ^{3}He–^{4}He mixture films studied by neutron reflectometry (O. Kirichek, STFC, United Kingdom), soft point-contact spectroscopy at ultralow temperatures (S. Lee, National High Magnetic Field Laboratory, USA), formation of bio-oligomers in space via low-temperature radiation chemistry (D. V. Mifsud, NASA Ames Research Center, USA), fractional charges and conductances in strongly interacting wires (V. Kagalovsky, Shamoon College of Engineering, Israel), a high-temperature limit of quantum fluctuations (E. Aurell, KTH Royal Institute of Technology, Stockholm, Sweden), as well as the Sagnac and Mashhoon effects in graphene (S. Sharapov, Bogolyubov Institute for Theoretical Physics of NASU, Ukraine), biophysical processes in the Universe viewed through mass spectrometry (M. Kosevich, ILTPE of NASU, Ukraine), spectroscopy and imaging of biomolecules and cells (G. Dovbeshko, Institute of Physics of NASU, Ukraine), laser microstructuring of materials for sensing applications (V. Dzhagan, V. Lashkaryov Institute of Semiconductor Physics of NASU, Ukraine), optical coherence tomography (V.-F. Duma, Polytechnic University of Timişoara, Romania), silicon photonics (M. F. Pereira, Khalifa University, UAE), persistent luminescence of spinels (V. Boiko, Institute of Low Temperature and Structure Research of PAS, Wrocław, Poland), and THz-driven magnetization dynamics in orthoferrites (N. Vovk, University of Glasgow, United Kingdom).

A special plenary lecture by Yu. G. Naidyuk (ILTPE of NASU) was dedicated to the 125th anniversary of the birth of the outstanding physicist L. V. Shubnikov, whose work, carried out in Kharkiv in the 1930s, laid the foundations of low-temperature physics in Ukraine, in particular the study of type-II superconductors. This year also marks another memorable date, the 40th anniversary of the discovery of high-temperature superconductivity, and a number of conference talks and papers in this issue are devoted to this topic. The conference program was complemented by the workshop "Opportunities and Technologies for Researchers", at which P. Jaeger (Pexon Consulting GmbH, Munich, Germany) presented modern approaches to scientific computing and data visualization in Python.

This Special Issue contains 19 original papers prepared by conference participants based on their presentations. Their authors are scientists from Ukraine, Cyprus, the Czech Republic, Finland, Georgia, Hungary, India, Japan, and Türkiye. The papers are grouped according to the journal sections.

The scientific contributions presented in this Special Issue reflect the diversity of current research in condensed matter and low-temperature physics. They bring together theoretical and experimental studies of quantum phenomena, superconductivity, electronic and dielectric properties, nanostructured and functional materials, as well as advances in experimental techniques. Together, these works illustrate the broad scientific scope of CM&LTP 2026 and the connections between fundamental physical research and its potential applications.

The section *Quantum Crystals and Liquids* is represented by the theoretical paper by A. N. Tarasov, "Peculiarities of phase diagram for dense superfluid neutron matter with spin-triplet anisotropic p-wave pairing in superstrong magnetic fields" (A. I. Akhiezer Institute for Theoretical Physics, NSC "Kharkiv Institute of Physics and Technology" of NASU, Ukraine). Analytical expressions are obtained for the splitting of the phase transition temperatures to superfluid states, analogs of the ^{3}He-A1 and ^{3}He-A2 phases, taking into account the quadratic and cubic field corrections, which are important for describing matter in the cores of magnetars.

The section *Superconductivity, in Particular High-T_c*, contains three papers. Two of them were prepared by a group of Georgian and Cypriot researchers (Ilia Vekua Sukhumi Institute of Physics and Technology, Ivane Javakhishvili Tbilisi State University, Georgian Technical University, Cyprus University of Technology): A. D. Tchankvetadze *et al*. "Formation and characterization of Tl-2212 superconducting films on LaAlO3 substrates via a metal-organic deposition route", in which films with a critical temperature

of 97.5 K were obtained by a fluorine-free metal-organic route, and I. R. Metskhvarishvili *et al*. "Influence of iodine pentoxide volatilization pressure on the synthesis and properties of HTS Tl-1223", which shows that the addition of I_2O_5 as an internal oxygen source suppresses thallium volatilization and yields nearly single-phase Tl-1223 with enhanced critical temperature and critical current density. In the paper by A. G. Sivakov, A. S. Pokhila, and A. E. Kolinko, "Phase-slip processes in $Bi_2Sr_2CaCu_2O_8$ single crystals" (ILTPE of NASU, Ukraine), prepared on the occasion of the 40th anniversary of the discovery of HTS, the concept of a phase slip surface is introduced as a three-dimensional analog of phase slip centers and lines.

The section *Electronic Properties of Conducting Systems* contains two papers. S. Udachan *et al*. (KLE Technological University, Hubballi, India) studied the size effect on the electrical resistivity of chromium nanofilms and the influence of post-deposition annealing and aging in air on resistivity.

H. Bán, D. Gál, A. Horvat, and A. Molnar (Uzhhorod National University, Ukraine; HUN-REN Wigner Research Centre for Physics, Budapest; University of Pécs, Hungary), in the paper "The effect of iron doping on the electrophysical properties of $Cd_2P_2S_6$", revealed a dipole-glass-type state and hopping conductivity with a Coulomb gap in $CdFeP_2S_6$.

In the section *Low-Dimensional and Disordered Systems*, A. A. Horvat, A. A. Molnar, and V. V. Minkovych (Uzhhorod National University, Ukraine) analyzed the dielectric properties of glassy selenium aged for decades and of $Se_{95}M_5$ glasses doped with Ge, As, Ga, In, and Sb, while I. Yu. Ropakova (Institute for Scintillation Materials of NASU, Ukraine) and A. A. Zvyagin (ILTPE of NASU, Ukraine) theoretically studied the influence of inhomogeneous energies of one-dimensional Frenkel excitons on the dynamical dielectric permittivity, refractive index, and extinction coefficient of molecular aggregates.

The section *Nanostructures at Low Temperatures* is represented by the paper by J. M. Gudenko *et al*. (Institute of Physics of NASU, Ukraine; Frantsevich Institute for Problems of Materials Science of NASU, Ukraine), which studies the influence of ferroelectric $BaTiO_3$ nanoparticles on the anisotropy of the dielectric properties of the nematic liquid crystal 5CB and reveals a nonmonotonic dependence of the nematic–isotropic transition temperature on the nanoparticle concentration.

The section *Quantum Effects in Condensed Matter* includes two theoretical papers. Yu. O. Seti (Lviv Polytechnic National University, Ukraine) and I. V. Boyko (Ternopil Ivan Puluj National Technical University, Ukraine) studied the renormalization of electron states due to interaction with confined optical phonons in a wurtzite-type AlGaN/GaN nanostructure. J. Kumar (Aalto University, Finland) developed an exactly solvable model of the tilt-controlled infrared thermodynamics of a soft Fock–Darwin quantum dot.

The section *Lattice Dynamics* contains two papers: C. Aksu, N. Arikan, A. İyigör, and E. Tel (Osmaniye Korkut Ata University, Kırşehir Ahi Evran University, Türkiye) investigated from first principles the structural, electronic, elastic, thermodynamic, and hydrogen storage properties of Mg_3XH_4 (X = Sc, Ti) hydrides, while I. I. Nebola *et al*. (Uzhhorod National University, Ukraine) considered the realization and features of nodal points in the phonon spectra of A15 family crystals.

In the section *Low-Temperature Optical Spectroscopy*, O. Chugai, Yu. Voloshyn, D. Zavadskyi, D. Omelianchuk, and S. Kulish (National Aerospace University "Kharkiv Aviation Institute", Ukraine) proposed a modified scanning photodielectric spectroscopy technique, which for the first time made it possible to detect donor-type localized states in $Cd_{1-x}Zn_xTe$ crystals, and studied the effect of electromagnetic radiation from a spark discharge on these states.

The section *Low-Temperature Physics of Plasticity and Strength* includes three papers: V. Riaboshtan *et al*. (National Technical University "Kharkiv Polytechnic Institute", Ukraine; University of West Bohemia, Pilsen, Czech Republic) studied the dynamics of processes in the highly dispersed structure of Cu–Mo vacuum condensates during annealing; O. M. Liubymenko and O. A. Shtepa (Donetsk National Technical University, Drohobych, Ukraine) investigated the deformation response of a palladium cantilever during interaction with hydrogen within the α-phase of the Pd–H system; O. V. Khomenko *et al.* (Sumy State University, Ukraine; Educational and Scientific Institute of Vocational Education of the National Academy of the National Guard of Ukraine, Kharkiv, Ukraine) proposed a model of the structural-phase state evolution and strengthening of metals under severe plastic deformation.

In the section *Physical Properties of Nanobiosystems*, N. V. Khmil, A. V. Shestopalova (O. Ya. Usikov Institute for Radiophysics and Electronics of NASU, Ukraine), and M. O. Kryvobok (Kharkiv National University of Radio Electronics, Ukraine) used molecular docking and molecular dynamics simulations to demonstrate the potential of phenolic compounds, in particular epigallocatechin gallate, as inhibitors of extended-spectrum β-lactamases, a problem that is especially acute for treating the wounded in wartime. The issue concludes with the paper by T. Masuta, L. Zhang, Y. Mu, S. Yamashita, H. Akutsu, and Y. Nakazawa (The University of Osaka, Japan) "Extended relaxation calorimetry available for measuring heat capacity of molecular compounds," in the section *Instruments and Experimental Techniques*, which describes a new calorimeter for measuring the absolute heat capacity of microcrystals weighing 10–100 μg in the range from ^{3}He temperatures to 300 K.

Taken together, the contributions to this Special Issue demonstrate the diversity of current research in condensed matter and low-temperature physics and highlight the value

of continued scientific exchange across institutions, disciplines, and national borders. We hope that these papers will stimulate further discussion, inspire new research directions, and encourage future collaborations within the international scientific community.

The Organizing and Program Committees of CM&LTP 2026 sincerely thank all participants for their contribution to the conference, which is especially valuable in these difficult times, the authors of the papers in this Special Issue, the reviewers for their careful work on the manuscripts, and the Editorial Board of Low Temperature Physics for preparing this issue. We are deeply grateful to the Defenders of Ukraine, thanks to whom we are able to work and hold scientific conferences.

We warmly invite the international scientific community to join us for the VII International Conference "Condensed Matter and Low Temperature Physics 2027" (CM&LTP 2027), scheduled for June 2027 at the B. Verkin Institute for Low Temperature Physics and Engineering of NASU in Kharkiv, Ukraine. We look forward to continuing our scientific discussions, sharing new research findings, and strengthening international collaborations.

A. V. Dolbin

Yu. A. Savina

R. M. Basnukaeva