

Eighth International Conference on Cryocrystals and Quantum Crystals

Chernogolovka, Russia, July 26–31, 2010

This issue of *Fizika Nizkikh Temperatur* contains the Proceedings of the 8th International Conference on Cryocrystals and Quantum Crystals (CC-2010), held in Chernogolovka, Russia, from July 26th until July 31st, 2010.

The general approach of the CC Conferences involves the organization of a forum for the exchange of ideas on diverse aspects of the physical, chemical and technological properties of solidified rare and molecular gases, including condensed helium and hydrogen isotopes (quantum fluids and solids at low pressure), by gathering together the best experts in the field.

It should be mentioned that the idea of organizing an all-Union meeting on cryocrystals and quantum crystals was first proposed by the well known Ukrainian scientists V.G. Manzhelii and A.F. Prihot'ko in the mid-70s of the last century. Moreover it was A.F. Prihot'ko who suggested making use of the abbreviated term “cryocrystals” instead of its longer equivalent — “solids formed by rare and molecular gases condensed at low temperatures”. The first CC seminar took place in 1979 in the small resort city of Villyandy in Estonia. The next series of seminars on cryocrystals and quantum crystals were organized by the Ukrainian scientists, every second year in a different place: at a tourist camp near Kharkov in 1981, in the “Krasnyi li-man” camp near Donetsk city, in Odessa.

As was pointed out by A. Jezowski (*Fiz. Nizk. Temp.* **35**, 331 (2009)), beginning with the meeting in Alma-Ata (Almaty, Kazakhstan) in 1995, the CC Conference had acquired international status (the 1st International Conference on Cryocrystals and Quantum Crystals) and it has been the most important international forum for presenting new results on the physics and chemistry of atomic and molecular solids such as rare gas solids, hydrogen, nitrogen, oxygen, methane, helium isotopes, water ice, etc. The next two International Conferences took place in Poland — in 1997 in Polanica Zdroj and in 2000 in Szklarska Poreba. In 2002 the 4th CC conference was held in Friesing (Germany), in 2004 — in Wroclaw (Poland), in 2006 — in Kharkov (Ukraine), and the 7th International Conference was organized in 2008 in Wroclaw (Poland).

The present 8th International Conference on Cryocrystals and Quantum Crystals (CC-2010) was organized in Chernogolovka (Russia) in continuation of this series of biennial meetings. The Conference was organized by the Institute of Solid State Physics RAS, the RAS Council on Low Temperature Physics and the RAS Council on Condensed Matter Physics under the sponsorship of the Russian Academy of Sciences, the Russian Foundation for Basic Research, the

Ministry of Education and Science of the Russian Federation and the Dynasty Foundation (Russia).

The scope of the 8th Conference was wide, including, but not limited to, physical properties of cryocrystals and quantum crystals, charged species and microscopic defects in crystals, spectroscopy studies of thin films, high-pressure studies and experiments at ultra-low temperatures, matrix isolation in cryocrystals, order-disorder phenomena, nanoscale systems, nonlinear waves and turbulence in bulk and at the surface of quantum fluids and solids, technological applications and instrumentation.

In development of the existing traditions, the first day of the meeting (July 26) was devoted to the School of Young Scientists. Lectures presented by top-level experts in condensed matter physics at low temperatures included:

D. Lee (*Department of Physics and Astronomy, Texas A&M University, Department of Physics, Cornell University, USA*) “50 Years of Matrix Isolation of Atomic Free Radicals”;

R. Hemley (*Geophysical Laboratory, Carnegie Institution of Washington, Washington, USA*) “New Findings in Simple Molecular Systems under Pressure”;

G.E. Volovik (*Low Temperature Laboratory, Aalto University, Finland and Landau Institute for Theoretical Physics RAS, Moscow, Russia*) “Topological media: Quantum Liquids, Topological Insulators and Quantum Vacuum”;

M.A. Strzhemechny (*B. Verkin Institute for Low Temperature Physics and Engineering NASU, Kharkov, Ukraine*) “Molecular Semiconductor Fullerite C₆₀”;

V.V. Nesvizhevsky (*Institute Laue-Langevin, Grenoble, France*) “Experiments with Ultracold Neutrons”.

The full texts of the lectures can be seen at the Conference website: <http://issp3.issp.ac.ru/cc2010/program.html>

More than 100 scientists from 10 countries had submitted 35 oral and 66 poster reports. The content of the reports were distributed among the following topics:

- dusty fluids and solids;
- solids formed by atomic and molecular gases at high and ultra high pressures;
- preparation and physical properties of massive cryocrystals and thin films;
- heat transport phenomena in cryocrystals;
- allotropic forms of pure and doped carbon — graphite, fullerenes, carbon nanotubes, etc.;
- phase transitions in solid helium and properties of helium crystals;
- crystal growth and phenomena at the surface of helium crystals;
- properties of impurity–helium condensates in liquid helium;

- charged and neutral impurity nanoparticles in bulk and at the surface of condensed helium and other quantum liquids and solids;
- nonlinear waves and turbulent phenomena on the surface and in bulk of quantum fluids and solids.

In addition to 9 oral sessions and 3 evening poster sessions, 2 round-table events were devoted to discussions of results of the most recent investigations of cryocrystals and phenomena in condensed helium. Abstracts of the reports were collected in the “Book of Abstracts” delivered to the participants on registration and available at the Conference site.

A full list of all the reports presented in the oral and poster sessions is given below. For different reasons, only a selection of the reports (about 1/5 of the total number of presentations) was submitted by their authors to the Program Committee for publications in this issue of magazine. These papers have been refereed and, if necessary, revised before being accepting for inclusion in the Proceedings. We are very grateful to the referees for their quick and very thoughtful responses. We would like to offer our thanks to all the contributors and participants who brought and shared their knowledge, expertise, ideas, and views to make the meeting fruitful and efficient.

We would like to thank all the members of the Program and Advisory Committees for their efforts in the preparation and administration of the Conference; with special thanks to the members of the Local Organizing Committee who did their best to make a success of CC-2010. The ISSP management played a crucial role in supporting the Conference: it was this support that made the Conference possible.

Our grateful acknowledgments are also due to the sponsors of the Conference: the Russian Academy of Sciences, the Russian Foundation for Basic Research, the Ministry of Education and Science of the Russian Federation, and the Dynasty Foundation (Russia). The organizers are appreciative of the IUPAP and its C-5 Committee, including fruitful discussions and permission to use the IUPAP logotype in token of their support for the idea of holding the International CC-2010 conference in Chernogolovka.

The next Conference on Cryocrystals is tentatively planned for Odessa, Ukraine, in 2012.

List of contributions

Oral reports

1. E. Lozovik “Quantum Crystals and Formation of Supersolid from Excitations in Solid Matter”.
2. O.F. Petrov “Dust Liquids and Crystals at Cryogenic Dusty Plasma”.
3. R. Hemley “Melting Behavior of Hydrogen at Megabar Pressures”.
4. I.L. Iosilevski “New Data on Shock Compression of Liquid Nitrogen in 1–3 Megabar Range”.
5. Yu.A. Freiman “Lattice Distortion and Raman Scattering in hcp Cryocrystals under Pressure”.
6. E. Yakub “Fluid–Fluid Phase Transition in Strongly Compressed Polymerizing Nitrogen”.
7. V.E. Bondybey “Matrix Isolation — Almost 100 Years Old, but Still Hale and Hearty”.
8. P. Leiderer “Colloids as Model Systems for Condensed Matter”.
9. M.A. Strzhemechny “Novel Mechanism of the Negative Expansion of Fullerite C₆₀ Doped with Chemically Neutral Species”.
10. V.A. Konstantinov “Heat Transfer in Solid N-alkanes”.
11. V. Lebedev “Probing the Phonon Spectra of Condensed ⁴He with Atomic Impurities”.
12. V.A. Benderskii “Regular–Chaotic Transitions in Quantum Dynamics of Nanosystems”.
13. R. Jochemsen “Crystal Shape and Crystal Growth of ³He: The Influence of Magnetic Order”.
14. I.A. Todoschenko “Nuclear Spin Ordering on the Surface of a ³He Crystal: Magnetic Steps”.
15. N.P. Mikhin “The Effect of ³He Impurities on New Phase Nucleation under bcc–hcp Phase Transition in Helium Solid”.
16. S.N. Burmistrov “Oscillation Spectra of a Crystal ⁴He Facet and Its Destruction with Generating Crystallization Waves”.
17. J.P. Toennis “A Quantum Theorem of Corresponding States Study of Small Quantum Fluid Clusters”.
18. H. Ikegami “Wigner Crystals Confined in Micrometer-Wide Channels”.
19. J. Eloranta “Solvation of Impurities in Bulk Superfluid Helium”.
20. V.M. Atrazhev “Atomic and Molecular Spectra Emitted by Normal Liquid ⁴He Excited by Corona Discharge”.
21. V.A. Slipko “Propagation of Strongly Nonlinear Second Sound Waves in Anisotropic Phonon Systems”.
22. E.V. Savchenko “Radiation Effects in Atomic and Molecular Cryocrystals Probed by Optical and Current Spectroscopy”.
23. A. Drobyshv “Structural Phase Transitions in Thin Films Glassy Condensates”.
24. E.Ya. Misochko “High Resolution EPR Spectroscopy of High-Spin Pyridylnitrene Molecules in Solid Argon”.
25. V.V. Khmelenko “Electron Spin Resonance Studies of Hydrogen and Deuterium Atoms in Krypton–Helium Condensates”.
26. S. Vasiliev “Magnetic Resonance Studies of Atomic Hydrogen Stabilized in Solid H₂ at Temperatures below 1 K”.
27. E.B. Gordon “The Structure and Properties of Metallic Nanowires Formed in Quantized Vortices of Superfluid Helium”.
28. B.M. Smirnov “Kinetic Model for Metal Atoms Coalescence in Superfluid Helium”.
29. L.V. Abdurakhimov “Classical Capillary Turbulence on the Surface of Quantum Liquid He-II”.
30. V.B. Efimov “Quantum Turbulence in Superfluid Helium at $T \geq 0$ ”.
31. A.I. Golov “The Amount of Non-Classical Rotational Inertia in Solid ⁴He as a Function of the Crystal Quality”.
32. S.K. Nemirovsky “Vortex Fluid Relaxation Model for Torsional Oscillation Responses of Solid ⁴He”.
33. E.V. Lebedeva “Charged Impurity Clusters in Liquid Helium”.
34. A.G. Khrapak “Negative Ions in Liquid Helium”.

35. V.B. Shikin “Dynamical Phenomena with Participation of Charged Clusters in Cryogenic Matter”.

Poster reports

A) High-pressure studies

1. Ie.Ie. Gorbenko, I.V. Zhikharev, E.P. Troitskaya, Val.V. Chabanenko, and N.V. Kuzovoy “Ab Initio Calculation of Three-Body Interaction in Cryocrystals under Pressure”.
2. V.S. Vorob'ev and V.G. Novikov “Cell Model of Hydrogen Liquid at Megabar Pressures”.
3. L.N. Yakub “Phase Transition Line of Solid Molecular Nitrogen into CG-Polymeric Phase”.
4. P.V. Kashtanov, B.M. Smirnov, and E.B. Gordon “Equation of State for Compressed Inert Gases”.
5. O. Degtyareva, C.L. Guillaume, J.E. Proctor, and E. Gregoryanz “Open Questions in Metallisation and Superconductivity of Silane”.
6. V.F. Degtyareva “Low Melting Point in Compressed Alkali Metals: Electronic Origin”.
7. E. Gregoryanz “On Quantum Effects in Dense Lithium”.

B) Dusty plasma

8. S.N. Antipov, M.M. Vasiliev, O.F. Petrov, and V.E. Fortov “Dense Dusty Plasma Structures in Cryogenic DC Glow Discharges”.

C) Allotropic forms of graphite

9. M.I. Bagatskii, V.V. Sumarokov, A.V. Dolbin, V.G. Manzhelii, and B. Sundqvist “Low Temperature Heat Capacity of Fullerite C₆₀ Doped with CD₄”.
10. I.V. Legchenkova and M.A. Strzhemechny “Dynamics of Dopant Particles in Octahedral Voids of Fullerite C₆₀”.
11. A.V. Dolbin, V.B. Esel'son, V.G. Gavrilko, V.G. Manzhelii, S.N. Popov, N.A. Vinnikov, and B. Sundqvist “Quantum Effects in Radial Thermal Expansion of Single-Walled Carbon Nanotube Bundles Doped with Helium”.
12. E.I. Salamatov “Simulation of Long-Wave Phonon Scattering at Geometric Imperfections in Nanowires by the FDTD Method”.
13. K.V. Kravchenko, S.B. Feodosyev, I.A. Gospodarev, V.I. Grishaev, E.V. Manzhelii, and E.S. Syrkin “The Phonon Spectrum of Graphite and Stability Conditions in Quasi-Two-Dimensional Structures”.
14. M.I. Bagatskii, V.V. Sumarokov, and A.V. Dolbin “A Simple Low Temperature Adiabatic Calorimeter-Inset for Small Samples”.
15. V.V. Sumarokov, M.I. Bagatskii, A.V. Dolbin, V.G. Manzhelii, V.G. Gavrilko, V.B. Esel'son, N.A. Vinnikov, and B. Sundqvist “Low-Temperature Specific Heat Capacity of Fullerit C₆₀”.
16. S.B. Feodosyev, I.A. Gospodarev, V.I. Grishaev, K.V. Kravchenko, E.V. Manzhelii, and E.S. Syrkin “Quasi-Particles Spectra in Graphite Compounds with Metallic Intercalated Layers”.

D) Cryocrystals and films

17. V.V. Danchuk, A.A. Solodovnik, and M.A. Strzhemechny “Orientational Order Parameter in CO₂-Kr Solution”.

18. A.I. Erenburg, A.V. Leont'eva, G.A. Marinin, and A.Yu. Prokhorov “The Low-Frequency Internal Friction and Phase Transition of Solid Oxygen”.
19. A.Yu. Prokhorov, V.N. Vasyukov, B.Ya. Sukharevsky, and A.V. Leont'eva “Cellular Nanostructure of Methane Hydrate”.
20. A.N. Ogurtsov, O.N. Bliznjuk, and N.Yu. Masalitina “Thermal Inactivation of Excitonically-Induced Defect Formation in Solid Xe and Kr”.
21. A.I. Krivchikov, O.A. Korolyuk, F.J. Bermejo, C. Cabrillo, and A.C. Hannon “Metastable Defect Structure in Orientational Ordered Crystal of Ethanol”.
22. P. Stachowiak, E. Pisarska, A. Jezowski, and A.I. Krivchikov “Investigation of Conversion of Methane Molecular Spins in CD₄-Kr Solid Solution”.
23. A.N. Nechay, E.V. Gnatchenko, V.N. Samovarov, and A.A. Tkachenko “Polarization Bremsstrahlung from Xenon Atoms and Clusters”.
24. A. Aldiarov “Oscillation Spectroscopy of Nanosized Structures of Indium in Cryomatrices of Condensed Gases. Methods, Installation, Results”.
25. A. Aldiarov “Influence of Water and Ethanol Cryocondensate Film's Thickness on Structural-Phase Transitions in the Range of Temperatures 12–160 K”.
26. M. Aryutkina, A. Aldiarov, A. Drobyshev, and V. Kurnosov “Dynamical Transitions in Cryocondensates of Ethanol Close to Glass-Transition Temperature”.
27. M. Aryutkina, A. Aldiarov, A. Drobyshev, and V. Kurnosov “Infrared Spectrometry of Structural-Phase Transitions in Two-Layer (Crystal-Amorphous) Films of Ethanol Cryocondensates”.
28. I. Khyzhniy, S. Uyutnov, A. Ponomaryov, G. Gumenchuk, E. Savchenko, and V. Bondybey “Low-Temperature Post-Desorption from Solid Nitrogen”.
29. S.A. Uyutnov, I.V. Khyzhniy, E.V. Savchenko, G.B. Gumenchuk, A.N. Ponomaryov, and V.E. Bondybey “Charged Centers and Their Relaxation in Pre-Irradiated by an Electron Beam Solid Kr”.
30. V.L. Vakula, Yu.S. Doronin, M.Yu. Libin, and V.N. Samovarov “Charged Molecular Centers in Pure Kr and Mixed Kr-Ar Clusters”.
31. V.B. Kokshenev “Ergodic Instability in Amorphous Solids”.
32. I.I. Poltavsky, T.N. Antsygina, M.I. Poltavskaya, and K.A. Chishko “Condensed Phases of Hard Core Bosons on a Square Lattice”.
33. T.N. Antsygina, M.I. Poltavskaya, I.I. Poltavsky, and K.A. Chishko “Two-Dimensional Hard Core Bosons at Zero Temperature: Superfluid Density and Spin Wave Dispersion”.
34. K.A. Chishko, T.N. Antsygina, M.I. Poltavskaya, and I.I. Poltavsky “Two-Dimensional Hard Core Bosons in the Random Phase Approximation”.
35. A.A. Solodovnik, V.V. Danchuk, and M.A. Strzhemechny “Behavior of Structural Characteristics of CO₂ Solids with Atomic Impurities”.
36. E.S. Syrkin, S.B. Feodosyev, I.A. Gospodarev, V.I. Grishaev, A.V. Kotlyar, K.V. Kravchenko, and E.V. Manzhelii “Similarity of the Boson Peak in Disordered Systems to the Acoustic van Hove Singularities in Regular Crystals”.

37. A.G. Belov, M.A. Bludov, and E.I. Tarasova “D₂ Dissociation in Xe Matrix under Electron Beam Irradiation”.
38. Yu.A. Dmitriev “Hindered Rotation of Impurity Molecules in Ordered and Disordered Matrices”.
39. N.V. Krainyukova “On the Role of Distortion in the hcp vs fcc Competition in Rare Gas Solids”.
- E) Thermal conductivity and thermal expansion of the cryocrystals*
40. O.A. Korolyuk “Thermal Conductivity of Molecular Crystals of Monoatomic Alcohols: from Methanol to Butanol”.
41. O.I. Pursky and V.A. Konstantinov “Thermal Expansion Effect on Phonon Localization in Simple Molecular Crystals”.
42. V.A. Konstantinov, V.P. Revyakin, and V.V. Sagan “Isochoric Thermal Conductivity of Isobutane”.
43. V.A. Konstantinov, V.P. Revyakin, and V.V. Sagan “Thermal Conductivity of Solid Cyclohexane”.
- F) Solid helium*
44. I.V. Kalinin, E. Kats, M. Koza, H. Lauter, V.V. Lauter, and A.V. Puchkov “Observation of the Nonequilibrium Superfluid Phase into Solid Helium within Aerogel”.
45. V.A. Lykah and E.S. Syrkin “The Free Energy, Pressure Change, and Twin Boundaries in Solid Helium at the bcc-hcp Phase Transition”.
46. Ye.O. Vekhov and N.P. Mikhin “Vacancy Destabilization of hcp Solid Helium”.
47. V.Y. Rubanskii, V.N. Grigor’ev, A.A. Lisunov, V.A. Maidanov, S.P. Rubets, E.Y. Rudavskii, A.S. Rybalko, and V.A. Tikhii “Investigation of Thermodynamic Properties of Deformed ⁴He in the Supersolid Region”.
48. S.P. Rubets, T.N. Antsygina, K.A. Chishko, A.A. Lisunov, V.A. Maidanov, and V.Y. Rubanskii “Concentration Dependence of Fluctuation Effects in Solid ³He–⁴He Mixtures”.
49. V.P. Kisel “Classical Deformation Explains the Properties of Solid/Fluid He”.
- G) Charges on helium surface and in bulk of condensed helium*
50. K.A. Nasyedkin and V.E. Syvokon “Conductivity and Critical Field of the 2D-Electron Crystal at the Dynamic Phase Transition”.
51. A. Dyugaev, P. Grigor’ev, and E. Lebedeva “Diffusion Transport of Negative Ions through Interface between Cryogenic Liquids”.
52. V.E. Syvokon and K.A. Nasyedkin “A Possible Crystal–Glass Transition in a 2D Surface Electron System”.
53. V. Shikin and S. Nazin “Critical Types of Electron Mobility in Cryogenic Matter”.
- H) Impurity condensates in liquid helium*
54. R.E. Boltnev, V.V. Khmelenko, V.P. Kiryukhin, D.M. Lee, and V.V. Nesvizhevsky “Oxygen–Helium Condensates as Optimal Medium for Very Cold Neutron Reflectors”.
55. R.E. Boltnev, I.B. Bykhalo, and I.N. Krushinskaya “Ions in Impurity–Helium Condensates”.
56. A.V. Karabulin, E.B. Gordon, V.I. Matyushenko, V.D. Sizov, and I.I. Khodos “High Efficient Field-Induced Electron Emission from the Bundles of Nanowires Grown in Superfluid Helium”.
57. A.N. Izotov and V.B. Efimov “Infrared Light Interaction with Impurity Gels in Superfluid Helium”.
58. V. Kiryukhin, V.V. Khmelenko, R.E. Boltnev, and D.M. Lee “X-ray Studies of Impurity–Helium Condensates”.
59. L.P. Mezhov-Deglin, G.V. Kolmakov, V.B. Efimov, and V.V. Nesvizhevsky “Nanocluster Condensates in He-II as a Tool for Production of Ultra-Cold Neutrons: Experiment and Numerical Simulation”.
60. E.A. Popov, E. Vehmanen, and J. Eloranta “Laser Ablation of Boron in Bulk Superfluid Helium”.
61. L.A. Surin, A.V. Potapov, B.S. Dumesh, and S. Schlemmer “Rotational Spectroscopy of Doped Small Helium Clusters”.
- I) Turbulent phenomena in condensed helium and hydrogen*
62. L.V. Abdurakhimov, M.Yu. Brazhnikov, S.V. Filatov, and A.A. Levchenko “Viscous Decay of Capillary Turbulence on the Surface of Liquid Hydrogen”.
63. V.B. Efimov, A.N. Ganshin, G.V. Kolmakov, and P.V.E. McClintock “Decay of Second Sound Turbulence in He-II”.
64. L.V. Abdurakhimov, M.Yu. Brazhnikov, S.V. Filatov, and A.A. Levchenko “Discrete Turbulent Cascade in the Dissipative Region on the Surface of Liquid Helium and Hydrogen”.
65. L.V. Abdurakhimov, M.Yu. Brazhnikov, I.A. Remizov, and A.A. Levchenko “Structure Functions of Capillary Wave Turbulence on the Surface of He-II”.
66. L.P. Kondaurova and S.K. Nemirovskii “Numerical Simulation of Vortex Tangle without Mutual Friction in Superfluid Helium”.

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