Curriculum vitae.

Correspondent Member of Russian Academy of Sciences.
Prof. Dr. Maxim Yu. Kagan was born in Moscow in 1961, married, has a child.

Education

- In 1984 he graduated with excellence from Moscow Engineering-Physical Institute. His specialty was Theoretical Nuclear Physics.
- From 1984 till 1989 he is a researcher and then a postgraduate student in P.L. Kapitza Institute for Physical Problems. His scientific supervisor was Prof. A.F. Andreev.
- In 1989 M.Yu. Kagan obtained PhD degree in Kapitza Institute. The title of his thesis was "Superfluid properties in systems with anisotropic and inhomogenious ordering".

Principal Employment

- From 1988 till nowadays in the permanent staff of Kapitza Institute.
- From 1989 till 1991 Junior Scientist in Kapitza Institute
- From 1991 till 1994 Scientist in Kapitza Institute.
- In 1994 M.Yu. Kagan obtained a degree of Doctor of Science in Kapitza Institute. His Habilitation thesis was titled "Superconductivity and superfluidity in Fermi-systems with repulsion ".
- From 1994 till 1999 Senior Scientist in Kapitza Institute.
- From 1999 till 2006 Leading Scientist in Kapitza Institute, group leader.
- In September 2006 he was appointed as a Principal Scientist at Kapitza Institute
- In 1996 he started to read lectures as Associate Professor in Moscow Engineering-Physical Institute on Galitskii Chair of Theoretical Nuclear Physics.
- In 1999 he was elected on the Full Professor position in Moscow Engineering-Physical Institute.
- In the year 2001 he got a Professor Title.
- From the beginning of 1999 till present time he is also an Executive Director of Russian Science Support Foundation, established by the Presidium of Russian Academy of Sciences.
- In May 2006 Prof. Kagan was elected as a Corresponding member of Russian Academy of Sciences
- At present time he is Corresponding member of Russian Academy of Sciences, Principal Scientist in P. L. Kapitza Institute for Physical Problems and Professor of Theoretical Physics in Moscow Engineering-Physical Institute. He is also an Executive Director of Russian Science Support Foundation.

Research Interests:

Theory of condensed matter physics. More specifically:

Low-temperature physics:

- 3D and 2D superfluidity, bulk systems, thin films and submonolayers of ^{3}He and ^{3}He-^{4}He mixtures, s-wave and p-wave pairing, phase-diagram and effects of spin-polarization
- surface phenomena in quantum crystals: roughening transitions, melting-crystallization waves, Rayleigh and Stonely waves
- possible supersolidity in quantum crystals, glassy behavior and quenching phenomena
- quantum hydrodynamics and quantum vortices, Kelvin and Tkachenko waves, bound states in the vortex cores and Hall- Vinen friction coefficients
- hydrodynamic instabilities and anomalous currents, chiral anomaly and Dirac spectrum,

fermionic goldstone mode and supersymmetric hydrodynamics
- collective excitations in fermionic and bosonic superfluids: first sound and second sound waves, orbital and spin waves
- Bose-Einstein condensation in magnetic traps, mean-field and Kosterlitz-Thouless transitions, low-dimensional sustems
- 3D and 2D Fermi-Bose gasses and mixtures, composite fermions and bosons, many-particle bound states, optical lattices
- s-wave and p-wave Feshbach resonances, BCS-BEC crossover, Leggett equations, sound velocity and thermodynamics

Solid-state physics:

- Novel superconductive materials: HTSC, bismuthates and ruthenates, organic superconductors and layered materials
- non-phonon mechanisms of superconductivity, low-density T-matrix approximation, Kohn-Latinger effect and p- wave pairing
- superconductivity in spin-polarized systems, reentrant behavior, nodal and chiral superconductors
- t-J model, repulsive and attractive Hubbard models, d- wave pairing and local pairing, pseudogap regime and Saha temperature
- underdoped HTSC-materials, spin-charge separation and spin-charge confinement, composite particles, spinons and holons, spin-bags and strings
- heavy-fermion materials and kondo-insulators, kondo-lattice model and two-band Hubbard model, kondo-singlets and Zhang-Rice singlets, Electron Polaron Effect
- non Fermi-liquid behavior, forward scattering and Landau f-function, the antibound state
- spin chains and ladders, Luttinger and Luther-Emery liquids, Spin-Peirls transitions
- nanoscale phase-separation and charge ordering, double exchange model and Verwey model, colossal and giant magnetoresistance
- 3D and 2D, anisotropic and frustrated AFM-lattices, free and bound FM-polarons, orbital ordering and zig-zag structures
- transport and thermodynamic properties in manganites, resistivity and magnetoresistance, spin-susceptibility, global phase-diagram
- mesoscopic effects: Coulomb blockade and spin-assistant tunneling, 1/f-noise spectrum
- kinetics of the interacting point defects in irradiated metals, first-order phase transitions and kink solutions, GL-functionals and hidden variables, the vacancy voids

Accomplishments

Prof. Kagan is a prominent expert in condensed matter theory. He made an important contribution both to solid-state physics and low-temperature physics, especially to the physics of strongly correlated electron systems, superconductivity and magnetism, as well as to the physics of superfluidity, quantum fluids and solids, and Bose-Einstein condensation in ultracold quantum gasses. He has a publication list of more than 110 papers including several review articles and an original lecture course.

Prof. Kagan got the pioneering results in the field of unconventional superconductivity in novel materials. He predicted a possibility of p-wave pairing in slightly nonideal Fermi-gas with repulsive interaction between particles. He also predicted a possibility of triplet fermionic superfluidity in the gas of neutral particles in magnetic traps at ultra-low temperatures. Moreover Prof. Kagan showed that a critical temperature of a triplet superconductive transition can be strongly enhanced in large magnetic fields and in a two-band situation. The theoretical predictions of Prof. Kagan were experimentally confirmed by Prof. Frossatti in Leiden (The Netherlands). They played a very

important role for the understanding of the nature of superconductivity in the heavy-fermion systems and in ^{3}He-^{4}He mixtures.

In the theory of high-T_c superconductivity Prof. Kagan was one of the first who rigorously proved the existence of superconductive d-wave pairing in basic models for HTSC systems, including Hubbard and t-J models. He constructed also the theory of a pseudogap state in superconductors with strong attractive interaction between electrons and predicted a possibility of the formation of normal Bose-liquid in this system. Prof. Kagan also made an important contribution in the theoretical understanding of the ladder materials and the nature of composite particles in them. Recently he constructed a theory of space-separated Fermi-Bose mixture for the explanation of normal and superconductive properties of the bismuthates and introduced a novel scenario of superconductivity in high-Tc materials based on the BCS-BEC crossover for pairing of two composite holes, each one containing a spinon and a holon, in the d-wave channel.

Prof. Kagan obtained fundamental results in the theory of hydrodynamic phenomena in quantum fluids and solids. Together with Prof. Andreev he constructed a complete system of hydrodynamic equations for superfluid systems with a large number of vortices and proved a stability of their bending oscillations. These results were confirmed by the experiments of Prof. Packard in Berkley (USA). Prof.Kagan constructed also a supersymmetric hydrodynamics of anisotropic A-phase of superfluid He-3, which includes a fermionic goldstone mode. He proposed a scenario for the suppression of chiral anomaly in a low-frequency hydrodynamic regime for A1- phase of ^{3}He at $T\rightarrow 0$. He also predicted an instability of the tangential flow of the superfluid liquid on the phase interface between quantum liquid and quantum crystal. These predictions were confirmed recently by the experiments in Kurchatov Institute in Moscow.

Prof. Kagan made an important contribution to the physics of magnetism. Here he got the pioneering results on the nanoscale phase separation, charge ordering and electron transport in the systems with colossal magnetoresistance. He also constructed the theory for free and bound FM-polarons on anisotropic and frustrated AFM-lattices in manganites and related materials. These results helped to explain the main features of the phase diagram of manganites together with nontrivial transport properties in these systems in the broad range of temperatures and concentrations. They have stimulated numerous experimental investigations both in Russia and abroad. Recently his theoretical predictions on the formation of small FM-polarons in different AFM or CO matrices were confirmed in the measurements of transport properties in four different families of the materials with the colossal magnetoresistance.

Quite recently Prof. Kagan together with his pupil have got the pioneering results in the field of ultracold quantum Fermi-Bose gasses in the magnetic traps. He evaluated the binding energies and predicted the possibility of the creation of composite fermions, trios and quartets in the Fermi-Bose mixture with resonance attraction between fermions and bosons. He also evaluated diagrammatically the scattering amplitude for four resonantly interacting fermions. These results allowed Prof. Kagan together with French theorists to construct the phase diagram of the resonance Fermi-gas in the BCS-BEC crossover regime and to determine the spectrum of collective excitations in the superfluid state of the resonance Fermi-gas. During last year Prof. Kagan constructed the phase-diagram of the p-wave resonance superfluids in the regime of BCS-BEC crossover and revealed interesting topological effects connected with the nodes in the superfluid gap of these systems.

In the year 2010 Prof. Kagan started investigations of the kinetics of the interacting point defects in metals irradiated by neutron emission. Together with the theorists from Moscow Engineering Physical Institute he proposed a new mechanism of the formation of the vacancy voids based on the development of the two types of instabilities in the system of interacting vacancies and impurities. The first stage of the formation of the vacancy void is connected with the creation of a cloud with a

higher local density of point defects, while a second stage – with an instability of a lattice inside a cloud. This mechanism could be rather general for the first-order phase transmitions. From microscopic point of view it describes a very slow kinetics connected with phonon-assistant tunneling of the system in the double-well structure of the Ginzburg-Landau functional.

In general theoretical investigations of Prof. Kagan made a very important contribution to the modern condensed matter physics.

International reputation

Prof. Kagan is a well-known theoretical physicist with a high international reputation. He worked practically in all leading European centers and established a fruitful collaboration with many prominent experts in his field worldwide. He was many times a visiting or invited Professor in leading European institutes. In 1994 Prof. Kagan read a lecture course as an invited Professor in Amsterdam University. In 1996 he got a senior NWO position in the University of Groningen. In 1998 he was a visiting Professor in ETH Zürich and in the year 2000 – an invited Professor in Newton Institute in Cambridge. In the year 2001 he served as a visiting Professor in Max-Planck Institute in Dresden, and in the year 2004 as an invited professor in the University of Piere and Marie Curie in Paris. In the year 2006 he was appointed as an invited Professor in Ecole Normale Superieure and in the year 2007 an invited Professor in Henri Poincare Institute. Prof. Kagan presented more than 50 invited talks on large international conferences and many times served as a session chairman. He also gave more than 120 seminars in leading European and American institutes. In the year 2008 Prof. Kagan was a member of the Program Committee of the International Low Temperature Conference LT-25 in Amsterdam (the scope of the conference 1500 participants) In the year 2010 he was nominated on the Leverhulme professorship in Loughborough University (UK)

Research visits.

The Netherlands

- Leiden - 6 times (Prof. Frossati)
- Amsterdam - 5 times (Prof. Capel)

Germany

- Achen - (Prof. Vollhardt)
- Karlsruhe - (Prof. Woelfle)
- Bayreuth - (Prof. Pobel)
- Drezden- (Prof. Fulde)

France

- Grenoble -2 times (Prof. Nozieres)
- Paris (Prof. Balibar, Prof. Brezin)

Switzerland

- ETH - Zurich (Prof. Rice)
- IBM - Rushlikon (Prof. Bednorz)
- Neuchatel (Prof. Beck)

Sweden

- Goeteborg -(Prof. Wendin)

USA

- Harvard - (Prof. Halperin)

Visiting and invited professor positions.

- 1994 Amsterdam – invited professor
- 1996 Groningen – senior NWO position
- 1997 Neuchatel
- 1998 ETH Zurich
- 1999 Geneva
- 2000 Cambridge – invited professor
- 2001 Dresden
- 2002 National Physical Laboratory, Teddington UK– invited professor
- 2004 University of Piere and Marie Curie – invited professor
- 2006 Ecole Normale Superieure – invited professor
- 2007 Henri Poincare Institute – invited professor
- 2010 Loughborough University – Leverhulme professorship

Invited talks on international conferences.

- Soviet Low Temperature Conferences in Tallinn and Tbilisi (1984 and 1987)
- Soviet-German Conference on Solid State Physics (Chernogolovka, 1990)
- Soviet-American-Scandinavian Conferences Nordita (Zvenigorod 1988, Stokholm 1991)
- Swedish Conference on HTSC (Stokholm-Turku 1991)
- Dutch Conferences on Statistical Physics (Amsterdam 1989) and on Solid State Physics (Lunteren 1995)
- International Conferences on Mechanisms of Superconductivity and on Strongly Correlated Electron Systems (Trieste, Italy 1988 and 1993)
- Russian Low Temperature Conferences in Kazan, Ekaterinburg and Chernogolovka (1993, 2001, 2003 and 2009)
- First European Conference on Quantum Liquids and Crystals (Corgese, France 1993)
- Low-Temperature Conference LT-XXI (Prague, Czech Republic 1996),
- International Conference on Novel Superconductive Spectroscopy (Boston, USA 1997)
- International Conferences on High-Tc Superconductivity and on the Materials with Colossal Magnetoresistance (Dubna 1997 and 1999)
- First European Conference on Anomalous Complex Superconductors (Crete, Greece 1998)
- International Workshop on Electronic and Magnetic Properties of Novel Transition Metal Compounds (Drezden, Germany 1998)
- International Conference on the new developments in HTSC and related compounds New3HTSC. (Honolulu, Hawaii, USA 2001)
- Low-Temperature Conference LT-XXIII (Hiroshima, Japan 2002)
- International Workshop on. Strongly Correlated Electrons in New Materials **SCENMO2** (Loughborough, UK, December 2002)
- Russian conferences on strongly correlated electron systems and quantum critical phenomena

(Moscow, April 2003, June 2004, May 2005, June 2007)
- Workshops of Russian academy of sciences and National academies of sciences of USA on strengthening linkages between Russian industry and manufacturing enterprises in Russia (Moscow, April 2003, May 2005)
- Second Meeting of RAS-US DOE Joint Coordinating Committee on Science and Technology Cooperation (Saint-Petersburg, September 2003)
- International workshop on Ultracold Fermi Gases in Levico (Trento - Italy, March 2004)
- 2nd Euro-Asian Symposium "Trends in magnetism" (EASTMAG-2004, Krasnoyarsk, August 2004)
- 1-st International Conference on Fundamental Problems of High Temperature Superconductivity (FPS'04, Moscow, October 2004)
- International Conference on Theoretical Physics devoted to the 70th anniversary of the Tamm Theory Department (TD70, Lebedev Institute, Moscow, April, 2005)
- The ESF Exploratory Workshop "New phenomena in superfluidity and superconductivity" (Camerino, Italy, 4-5 July, 2005)
- 2-nd International Conference on Fundamental Problems of High Temperature Superconductivity (FPS'06, Moscow, October 2006)
- International Workshop on Ultracold Quantum Gasses, Paris, June-July 2007
- Low Temperature Conference LT-XXV (Amsterdam, The Netherlands, August 2008)
- 3-rd International Conference on Fundamental Problems of High Temperature Superconductivity FPS-08(Moscow, October 2008)
- 4-th Sakharov International Conference on Physics (Moscow, May 2009)

Membership in Organizing and Program committees of the International Conferences

- International Conferences on High-Tc Superconductivity and on the Materials with Colossal Magnetoresistance (Dubna 1997 and 1999).
- Program Committee Vice-Chairman of the Conference on novel materials and their applications (Moscow, March 2002).
- Program Committee Vice-Chairman of the Conference on the interaction between Science, Industry and Government (Moscow, June 2002).
- Program Committee member for 2-nd and 3-rd International Conferences on Fundamental Problems of High Temperature Superconductivity (FPS'06, Moscow, October 2006, FPS'08, Moscow, October 2008).
- Program Committee member for Eastmag 2007 (Kazan, August 2007)
- Program committee member for LT 25 Conference, Amsterdam 2008
- Program committee member for XXXII International workshop on Condensed Matter Theory (CMT 32) (UK, Loughborough, August 2008)

Session chairman on the International Conferences

- Low-Temperature Conference LT- XXII (Helsinki, Finland 1999)
- International Conference on the Materials with Colossal Magnetoresistance (Dubna 1999)
- Conference on novel materials and their applications (Moscow, March 2002).
- Low-Temperature Conference LT-XXIII (Hiroshima, Japan 2002)
- Russian Low Temperature Conferences (LT-XXXIII, Ekaterinburg 2003)
- Workshop of Russian academy of sciences and National academies of sciences of USA on strengthening linkages between Russian industry and manufacturing enterprises in Russia (Moscow, April 2003)
- 2nd Euro-Asian Symposium "Trends in magnetism" (EASTMAG-2004, Krasnoyarsk, August

2004)

Grants and Awards.

Prof. Kagan was a fellow of Soros grant, several European grants of INTAS (1994, 1997, 2001), grants of American Physical Society (1992) and British Royal Society (2000), CRDF grants (2001, 2004), grants of Russian Foundation for Basic Research (RFBR 1995, 1997, 1999, 2002, 2004, 2006) and Russian Ministry of Science and Technology (2001, 2002, 2004, 2005).
In the years 1996-2003 Prof. Kagan recieved an Award for young Professors from the President of Russian Federation.

Participation in evaluating committees:

- Since 1997 he is in evaluating committee of Russian Council on HTSC-materials.
- Since 1999 he is in evaluating committee on solid state physics in Russian Foundation for Basic Research (RFBR). Since 2009 he is a chairman of Solid State Theory council of RFBR.
- Since 2000 he is an expert on superconductivity and magnetism in the European granting program INTAS.

Participation in Scientific Councils:

- Since 1996 Prof. Kagan is a member of Dissertational Council in P.L.Kapitza Institute
- Since 1999 he is a member of Dissertational Council in Moscow Engineering- Physical Institute
- Since 2001 he is a Vice Chairman of a Scientific Council on novel materials and their applications in Russian Academy of Sciences.
- Since December of 2008 he is a Vice-Chairman of a Scientific council on Condensed Matter theory in Russian Academy of Science.

Editorial Board

- Since 2005 he is a member of editorial board of Russian Journal of Crystallography
- Since 2001 Prof. Kagan is a member of editorial board of Journal of Economical Strategies in Science published by Russian Academy of Sciences

Teaching experience

Prof. Kagan has a teaching experience of 20 years on postgraduate level and 15 years on undergraduate level. In the year 1994 Prof. Kagan delivered a one-semester course on Green-functions and their applications in Amsterdam University as an invited professor. Since 1996 he is reading a two-semester advanced course on superconductivity and strong correlations as a Professor on Galitskii chair in Moscow Engineering-Physical Institute. In the year 2006 he delivered a general theoretical course on Statistical Physics in Moscow Engineering-Physical Institute. In the year 2009 Prof. Kagan delivered a one-semester course on exactly solvable models and topological applications in condensed-matter physics. In the year 2010 he started to read an advanced course on foundations of mesoscopics and localization theory.

Prof. Kagan is a scientific supervisor of several Russian students. Four of them have already got PhD degrees in Kapitza Institute. During a considerable period of time he was also a scientific supervisor of several Swiss and Dutch students together with Prof. H. Capel (University of Amsterdam, the Netherlands) and Prof. H. Beck (University of Neuchatel, Switzerland). Two of his students have already got Ph.D. degrees in their home countries.

Experience in Scientific Management on Top Level.

Prof. M.Yu. Kagan was very active in establishing international collaboration between Kapitza Institute and leading Institutions in the West. In 1992-1994 together with Prof. Andreev he organized a network between Kapitza Institute and Kamerlingh-Ohnnes Laboratory in Netherlands as well as with Chalmers University of Technology in Sweden. Both collaborations are still very active and got a high estimate from Swedish and Dutch side.

Later on he was actively involved in creation of Russian Science Support Foundation, which was established in January 1999 by the Presidium of Russian Academy of Sciences (RAS) and a group of leading Russian companies. Since 1999 Prof. Kagan is an Executive Director of Russian Science Support Foundation. The target of the foundation is to promote fundamental science in the country and to help young Russian scientists to continue their research at home. In the years 1999-2008 in the framework of five main programs "The outstanding scientists. The best young scientists of RAS", "The best post-graduate students of RAS", "The best managers of RAS", "The best economists of RAS" and "The best professors and graduate students in the field of power engineering" the foundation has delivered more than 2850 grants and awards for distinguished professors, talented young researchers and graduate students in exact and humanitarian sciences, including physics and astronomy, power engineering, mathematical sciences, chemistry, biology, earth sciences, history, economy and law. In the year 2002 Prof. Kagan also organized a large interdisciplinary conference in Moscow named "Science, Business, Government 2002". The goal of the conference was to restore the connections between fundamental science and Russian industry. The efforts of the foundation to save fundamental science in the country got very positive reaction both in Russia and abroad. There were more than 180 publications in leading Russian and international newspapers and journals, as well as on radio and television, devoted to the activity of the foundation (see e.g. Science, v.291, p.1878, 2001). The activity of the foundation was strongly approved by Russian scientific community and Russian authorities including Ministry of Science and Education, Ministry of Industry and Power Engineering, Russian State Parliament, Government of Moscow and Russian Chamber of Industry and Commerce.
In the year 2008 Prof. M.Yu. Kagan has created the joint R&D centre between RAS and the leading Russian industrial companies. The target of the R&D centre is to utilize the best achievements of the universities and the institutes of RAS in Russian industry. In the year 2010 he also started the project of the Institute of Advanced Studies and Technologies in Moscow.

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