
MICROSCOPIC THEORY OF SUPERCONDUCTION AND SUPERFLUIDITY



Director of the school – Anatolii Svidzynskiy, Ph. D., Doctor of Physical and Mathematical Sciences, Full Professor, Head of the LUEENU Department of Theoretical and Mathematical Physics Department, Honoured Figure in Science and Engineering of Ukraine (2010).

Email: svidzynskiy.anatolij@eenu.edu.ua
svan29@gmail.com

Areas of scientific research:

- the microscopic theory of superconduction and superfluidity;
- the Josephson effect in superconducting land;
- the influence of the Bose–Einstein condensate on kinetics of atom condensation in atomic gases of bosons.

Scientific output of A. Svidzynskiy. Approximately 100 hundred research articles have been published, as well as monographs and textbooks.

Research supervision of the Ph. D. theses. Under the supervision of A. Svidzynskiy, nine scientists have defended their Ph. D. (*Kandydat*) theses: Y. Ivanchenko, V. Sliusariev, T. Antsyhina, O. Ma-keiev, S. Savchenko, L. Akhramovych, H. Shevtsov, V. Sakhniuk, and P. Shyhorin.

Summary. The research work of this School is conducted in the areas of low-temperature superconduction and of superfluidity. Among other things, the tunnel dynamics of the Josephson effect in Bose and Fermi systems with broken symmetry, and the influence of Bose–Einstein condensate on the kinetics of atom condensation in the atomic gases of bosons have been elucidated. The theoretical

substantiation of new experimental results has been carried out, such as with the spreading of first and second waves of sound in condensed Bose gas, and the tunneling of condensation through a potential barrier, etc. The current state has been elucidated, both with respect to homogeneous superconductors and to spatially-inhomogeneous superconductors, especially superconducting contacts through other layers of materials: non-conductors, metals, combinations of them which provide low superconductivity, an examination of composite material and microstructure such as restriction, nanoscale structure etc.

Scientific activity of the school. A series of mathematical methods were developed in the scientific school, in order to formulate basic equations of the theory of superconductivity and superfluidity. Among them was the method of quasiclassical equations, which makes it possible to build a straightforward gradient invariant Maissner effect, and take into account the possible presence of impurities, in particular when their concentration is high, in order to get a Uzadel equation. The fluctuation effects of the order parameter have been described. The Josephson contacts on the basis microscopic

approach in both stationary and unstationary cases were studied. A generalization of the theory to the case of complex contacts was made, in particular with the combination of normal layers and insulator layers.

Members of the School

Vasyl Sakhniuk, Ph. D. in Physical and Mathematical Sciences, Associate Professor in the LUEENU Department of Theoretical and Mathematical Physics.
Email: sve2008@ukr.net

Area of scientific research: phase coherence effects in nano- and microsystems with broken symmetry.

Pavlo Shyhorin, Ph. D. in Physical and Mathematical Sciences, Associate Professor in the LUEENU Department of Theoretical and Mathematical Physics.
Email: pashyh@gmail.com

Areas of Scientific research: phase coherence effects in nano- and microsystems with broken symmetry

