

Isaak Markovich Khalatnikov (on his 90th birthday)

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Academician Isaak Markovich Khalatnikov, outstanding Soviet and Russian physics theorist, celebrated his 90th birthday on October 17, 2009. I M Khalatnikov's life in physics research is multifaceted and covers most fields in modern theoretical physics — from the theory of superfluidity to quantum field theory and to general relativity. It was on his initiative that the L D Landau Institute of Theoretical Physics of the Academy of Sciences was founded; he headed it from 1965 to 1992.

Isaak Markovich Khalatnikov was born on October 17, 1919 in the town of Ekaterinoslav (now Dnepropetrovsk, Ukraine). He received his higher education at Dnepropetrovsk State University from which he graduated in 1941. While still a student at the university, Isaak Markovich began to take exams for Lev Davidovich Landau's 'theoretical minimum', and was invited by Landau to become his postgraduate student. However, this plan would not work out, as WWII reached the USSR and Isaak Markovich spent his war years in the armed forces in the air defense corps.

After demobilization, Isaak Markovich enrolled in postgraduate courses at the Institute for Physical Problems of the USSR Academy of Sciences, where he began working under L D Landau's supervision on the theory of superfluidity, to which he made contributions of prime importance, and for many years he remained the leading theorist in this field. He obtained equations describing the dynamics of elementary excitations in superfluid helium, developed the theory of relaxation processes, analyzed diverse hydrodynamical processes in superfluid helium, including shock waves, studied the hydrodynamics and kinetics of superfluid solutions of helium isotopes, and constructed the theory of temperature jump at the boundary between liquid helium and a solid (the Kapitza jump). All this work was conducted in the closest cooperation with experimentalists and undoubtedly stimulated superfluidity research on an international scale. In 1953, Isaak Markovich submitted and defended his DSc thesis, which became a brilliantly concluding chapter of his research on the theory of superfluid helium. The list of his opponents at the viva voce of the thesis defense is spectacular: N N Bogoliubov, V L Ginzburg, and I M Lifshits.

In 1946, I M Khalatnikov and colleagues in L D Landau's group were involved in the work on the Soviet Atomic Project. He organized numerical calculations first for the atomic bomb and then for the hydrogen bomb. During this work, he developed original numerical methods, such as implicit difference schemes, and solved the problem of stability of numerical methods. These accomplishments made it possible to successfully complete computational work for the project. In 1953, I M Khalatnikov was awarded the USSR State Prize for this important achievement.



Isaak Markovich Khalatnikov

In subsequent years, I M Khalatnikov continued to work at the Theoretical Department of the Institute for Physical Problems. In the second half of the 1950s, he completed a series of papers covering the theory of Fermi liquids: he studied kinetic phenomena in these liquids and constructed the theory of light scattering in it. I M Khalatnikov formulated canonical methods (Lagrangian and Hamiltonian) in the hydrodynamics of quantum liquids, which are useful for studying nonlinear phenomena. I M Khalatnikov's paper (co-authored with L D Landau) constructing a theory of sound absorption in the vicinity of points of a second-order phase transition became extremely valuable for the dynamic theory of phase transitions. Isaak Markovich summarized his work on the physics of quantum liquids in the monograph *The Theory of Superfluidity*, which was published in 1971 and remains a desktop fixture for every physicist working in this field.

I M Khalatnikov conducted fundamental studies in quantum electrodynamics, performed together with L D Landau and A A Abrikosov in the second half of the 1950s. These papers for the first time formulated the problem of the asymptotic behavior of the main quantities in quantum field

theory (Green's functions of the proton and the electron) at large values of momenta and solved it. Furthermore, a new original method of summation of the main sequence of Feynman diagrams was developed, which later found extensive applications both in statistical physics and in quantum field theory. I M Khalatnikov was the first to formulate methods of functional integration for Fermi fields; they became an everyday tool for theoreticians.

I M Khalatnikov's work in cosmology and relativistic astrophysics deserves special mention. Many years of work jointly with E M Lifshitz led to the discovery in relativistic cosmological models of a new oscillatory type of behavior in the vicinity of an original singularity. It was found that this kind of singularity is the most general and served as a basis for constructing a general cosmological solution of Einstein's equations with singularity in time, known as the Belinskii–Khalatnikov–Lifshitz singularity. These results are now widely used in astrophysics when analyzing the initial stages of the evolution of the Universe. Finally, I M Khalatnikov, in a joint paper with a number of co-authors, found the solution to the problem of the stochastic properties of the evolution of homogeneous Universe. This series of papers is closely related to the progress in developing original qualitative methods of investigating the evolution of the Universe with dissipative processes taken into account.

Short of listing here all I M Khalatnikov's publications, we shall nevertheless mention a series of papers on relativistic hydrodynamics (the results were later applied to the theory of multiple creation of particles), I M Khalatnikov's (jointly with A A Abrikosov) paper on superconductivity, and also a joint paper with V L Pokrovskii on above-barrier reflection in quantum mechanics.

The L D Landau Prize awarded to Isaak Markovich in 1974 was a sign of recognition of his achievements in science. He received four orders (the last of them in 2000 — the Order of Service to the Fatherland of the Third Class) and several medals, and also has a number of prestigious foreign decorations. In 1972, I M Khalatnikov was elected a Corresponding Member of the USSR Academy of Sciences, and in 1984 became a Full Member of the Academy. In 1994, Isaak Markovich was elected a foreign member of the Royal Society.

I M Khalatnikov initiated the creation of the Institute of Theoretical Physics at the USSR Academy of Sciences; it was named after L D Landau. The actual work of building the new institute was carried out by I M Khalatnikov together with a group of L D Landau's disciples (A A Abrikosov, L P Gor'kov, and I E Dzyaloshinskii); I M Khalatnikov became its first Director and stayed at this post from 1965 till 1992. Over these years, the institute became an internationally appreciated center of theoretical physics and acquired an extremely high reputation. Several generations of Soviet and Russian physics theoreticians emerged from it.

In 1954, I M Khalatnikov became a Professor at the Moscow Institute of Physics and Technology (FizTekh) and started his courses of lectures and supervision of undergraduates and postgraduates at the Chair of Problems of Theoretical Physics at the L D Landau Institute of Theoretical Physics. A large group of his students grew to scientific maturity around him; among them we find not only CandSc and DSc scientists, but also members of the Academy of Sciences.

Isaak Markovich is still full of energy and creative projects. In recent years his work in cooperation with his

disciples has centered on problems in cosmology. In fact, I M Khalatnikov's scientific horizon is much wider than this field; he follows the latest achievements in theoretical physics and actively supports research at the forefront of physics. At the same time, he takes an active part in the life of the Institute he created and is proud to be its Honorary Director.

Isaak Markovich generously shares his enlightening vital experience with the rising generation. His book of reminiscences, *Dau, Centaur and Others*, was published quite recently. It comprises very interesting and instructive stories telling about the years of advancement of physics in the Soviet Union, and found a broad response in the scientific community.

On this jubilee, we wish Isaak Markovich good health, happiness, and further success.

*A A Abrikosov, A F Andreev, V L Ginzburg,
L P Gor'kov, I E Dzyaloshinskii, V E Zakharov,
V P Mineev, S P Novikov, L P Pitaevskii,
V L Pokrovskii, A A Starobinskii, G M Eliashberg*