

In memory of Andrei Anatol'evich Grib

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On June 8, 2024, a remarkable person and talented scientist, Andrei Anatol'evich Grib, passed away at the age of 85 after a long illness.

Andrei Anatol'evich Grib was born on March 28, 1939 in the city of Tomsk, where his father worked after completing his graduate studies at Leningrad State University (LSU). In 1940, his family returned to Leningrad, but during the Great Patriotic War they lived in Saratov. After the end of the war, Andrei Anatol'evich's family returned to Leningrad.

In Leningrad, Andrei Anatol'evich was accepted at school no. 213 with an advanced study in the English language and finished with Gold Medal in 1956. That same year, Andrei Anatol'evich became a student in the Physics Department of LSU, where he decided to study theoretical physics. After graduating from the Physics Department in 1961, Andrei Anatol'evich was accepted to the postgraduate course of the Department of Theoretical Physics headed by the outstanding scientist, one of the founders of quantum field theory, Academician Vladimir Aleksandrovich Fock. At that time, the Department of Theoretical Physics of LSU was a remarkable place, where graduate and postgraduate students attended lectures by outstanding invited scientists such as Paul Dirac, Julian Schwinger, Roy Glauber, Leon Rosenfeld, Gleb Vatagin, John Wheeler, and others and were able to get acquainted with new achievements of science.

At the postgraduate school, A A Grib analyzed the idea of spontaneous symmetry breaking, vacuum state noninvariance, the Coleman and Goldstone theorems, and the possible existence of the Higgs boson. As a matter of fact, Andrei Anatol'evich worked on his candidate thesis independently and defended it successfully in 1969. The further development of physics, in particular, the formulation of the Weinberg–Salam theory, quantum chromodynamics, the discovery of W- and Z-bosons, as well as the Higgs boson, confirmed that Andrei Anatol'evich was right to have chosen this area of science. The results of his work on spontaneous symmetry breaking and related problems were summarized in his review published in the journal *Physics–Uspekhi (Uspekhi Fizicheskikh Nauk)* [1] and in book [2].

Another field of physics to which A A Grib made an outstanding contribution is the theory of particle production from a vacuum in the gravitational field of the expanding Universe. In two pioneering studies [3, 4] published jointly with S G Mamayev, he used the Hamiltonian diagonalization method to obtain for the first time a finite value of the density of the number of particle–antiparticle pairs created in the early Friedmann Universe. These results, obtained for the case of a scalar field, were later extended to the cases of spinor and vector particles. The proposed method proved to be very



Andrei Anatol'evich Grib
(28.03.1939–08.06.2024)

effective. It was used by A A Grib and his colleagues to investigate vacuum quantum effects not only in a gravitational but also in a nonstationary electromagnetic field. The results obtained were generalized in three monographs [5–7].

In 1980, A A Grib successfully defended his doctoral thesis, entitled “Particle production in the early Universe,” at M V Lomonosov Moscow State University (MSU).

From 1975 to 1982, A A Grib worked in the Department of Theoretical Physics at the Leningrad Institute of Precise Mechanics and Optics, and from 1982 to 2002, he was head of the Department of Higher Mathematics at the N A Voznesenskii Leningrad Institute of Economics and Finance (since 1991, Saint Petersburg University of Economics and Finance). Another area of his scientific interests in that period was axiomatics and the interpretation of quantum mechanics, including nondistributive quantum logics, Bell inequalities, and construction of macroscopic examples of quantum games. The obtained results were presented in reviews [8, 9] and monographs [10, 11].

In the late 1990s, A A Grib worked in Brazil for several years. Monograph [11] was written jointly with W A Rodri-

guez. He wrote book [12] in co-authorship with his French colleague Professor J-P Luminet.

Beginning in 2004 and to the last days of his life, A A Grib was a professor in the Department of Theoretical Physics at A I Herzen Russian State Pedagogical University (Herzen University). In that period, he delivered lectures for students in different areas of theoretical physics and worked on the fundamentals of modern cosmology and, more extensively, on the conceptions of the modern natural sciences. The results of this work are presented in two books [13, 14]. A A Grib was a deep thinker interested in the problems of interaction of science, philosophy, and religion and published several studies devoted to this area. To the last days of his life, he continued studying classical and quantum effects in a gravitational field, in particular, in the black hole metric [15]. His last work concerning this topic was published in March of 2024 [16].

Throughout his scientific life, A A Grib supervised students and postgraduates and held a regular theoretical seminar. He was a wonderful teacher. His intuition helped him understand what the most pronounced ability of each student was, and he contributed to its development. Under his supervision, many young scientists defended their Ph.D. theses. Later, some of them became doctors of physical and mathematical sciences. Professor A A Grib was a co-chair of the organizing committee of the second, third, and fourth international Friedmann seminars on gravitation and cosmology. He was also a member of the organizing committee of all subsequent Friedmann seminars from the fifth to the tenth, a member of the organizing committee of the Russian Gravitational Conferences, international conferences on gravitation, astrophysics, and cosmology, a member of the editorial board of the international journal *Gravitation & Cosmology*, and a member of the Presidium of the Russian Gravitational Society.

The scientific achievements of Professor A A Grib received high praise from specialists. In recognition of his outstanding results in studies of particle production in a curved space–time, A A Grib was awarded the Telesio–Galilei Gold Medal (France). He was elected academician of the Russian Academy of Natural Sciences. In addition to the above-mentioned books and reviews, A A Grib had over 300 scientific works. Many of his studies, published even 40 and 50 years ago, are now actively cited.

The blessed memory of this remarkable man, a brilliant theoretical physicist and outstanding teacher, will forever remain in the hearts of his disciples, colleagues, and all those who had the chance to meet him.

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Selected publications of A A Grib

1. Grib A A, Damaskinskii E V, Maksimov V M “The problem of symmetry breaking and in variance of the vacuum in quantum field theory” *Sov. Phys. Usp.* **13** 798 (1971); “Problema narusheniya simmetrii i invariantnosti vakuuma v kvantovoi teorii polya” *Usp. Fiz. Nauk* **102** 587 (1970)
2. Grib A A *Problema Invariantnosti Vakuuma v Kvantovoi Teorii Polya* (The Problem of Vacuum Invariance in Quantum Field Theory) (Moscow: Atomizdat, 1978)
3. Grib A A, Mamayev S G “On field theory in Friedmann space” *Sov. J. Nucl. Phys.* **10** 722 (1970); “K teorii polya v prostranstve Fridmana” *Yad. Fiz.* **10** 1276 (1969)
4. Grib A A, Mamayev S G “Creation of matter in Friedmann model of the Universe” *Sov. J. Nucl. Phys.* **14** 450 (1972); “Rozhdenie veshchestva vo fridmanovskoi modeli Vselennoi” *Yad. Fiz.* **14** 800 (1971)
5. Grib A A, Mamayev S G, Mostepanenko V M *Kvantovyye Effekty v Intensivnykh Vneshnikh Polyakh: Metody i Rezul'taty, ne Svyazannyye s Teoriiey Vozmushchenii* (Quantum Effects in Intense External Fields: Methods and Results not Related to the Perturbation Theory) (Moscow: Atomizdat, 1980)
6. Grib A A, Mamayev S G, Mostepanenko V M *Vacuum Quantum Effects in Strong Fields* (St. Petersburg: Friedmann Lab. Publ., 1994); Translated from Russian: *Vakuumnyye Kvantovyye Effekty v Sil'nykh Polyakh* (Moscow: Energoatomizdat, 1988)
7. Grib A A *Early Expanding Universe and Elementary Particles* (St. Petersburg: Friedmann Lab. Publ., 1995)
8. Grib A A “Bell’s inequalities and experimental verification of quantum correlations at macroscopic distances” *Sov. Phys. Usp.* **27** 284 (1984); “Neravenstva Bella i eksperimental'naya proverka kvantovykh korrelyatsii na makroskopicheskikh rasstoyaniyakh” *Usp. Fiz. Nauk* **142** 619 (1984)
9. Grib A A “On the problem of the interpretation of quantum physics” *Phys. Usp.* **56** 1230 (2013); “K voprosu ob interpretatsii kvantovoi fiziki” *Usp. Fiz. Nauk* **183** 1337 (2013)
10. Grib A A *Narushenie Neravenstva Bella i Problema Izmereniya v Kvantovoi Teorii* (Violation of Bell Inequalities and the Problem of Measurement in Quantum Theory) (Lectures for Young Scientists, P2-92-211) (Dubna: JINR, 1992)
11. Grib A A, Rodrigues W A (Jr.) *Nonlocality in Quantum Physics* (New York: Kluwer Academic. Plenum Publ., 1999)
12. Grib A A, Luminet J-P *Essais de Cosmologie. Alexandre Friedmann, Georges Lemaître* (Paris: Seuil, 1997)
13. Grib A A *Osnovnye Predstavleniya Sovremennoi Kosmologii* (The Main Concepts of Modern Cosmology) (Moscow: Fizmatlit, 2008)
14. Grib A A *Kontseptsii Sovremennogo Estestvoznaniya* (Concepts of Modern Natural Science) (Moscow: BINOM. Laboratoriya Znaniy, 2003)
15. Grib A A, Pavlov Yu V “Is it possible to see the infinite future of the Universe when falling into a black hole?” *Phys. Usp.* **52** 257 (2009); “Vozmozhno li uvidet' beskonechnoe budushchee Vselennoi pri padenii v chernuyu dyru” *Usp. Fiz. Nauk* **179** 279 (2009)
16. Grib A A, Pavlov Yu V “On phase transitions during collisions near the horizon of black holes” *Universe* **10** (3) 131 (2024)