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Anatoliĭ Alekseevich Logunov (on his seventieth birthday)

December 30, 1996 marked the seventieth birthday of Academician Anatoliĭ Alekseevich Logunov, an outstanding physicist of world fame and an organizer of science and higher education.

Logunov's multifaceted scientific activity has been inseparably linked to the emergence of elementary-particle and high-energy physics, a new field of fundamental research that has been evolving in big strides since the early 1950s, and more recently, to the development of new views on space-time and gravitation.

In his early works, he dealt with the diffusion and acceleration of cosmic rays in the intergalactical magnetized medium.

It was his close professional contact and joint work with Academician N N Bogolyubov that deeply affected his further scientific activity and style of work — his acumen for the most fundamental and pivotal problems and his creation of appropriate mathematical methods of study.

In 1956, Logunov generalized the renormalization-group equations of quantum electrodynamics to the case of an arbitrary gauge of electromagnetic-field potentials. Together with the basic works of N N Bogolyubov and D V Shirkov, his research provided a solution to the problem of a consecutive formulation and the use of the renormalization invariance method in quantum field theory.

By carrying on the work started by N N Bogolyubov on the method of dispersion relations, he was successful in developing and applying it to various interactions of elementary particles, in particular, the derivation of dispersion relations for the photoproduction of π-mesons on nucleons. On the basis of the dispersion relations and the unitarity condition, he derived systems of equations that served as the foundation for the theory that explains the photoproduction of hadrons at low and medium energies.

A A Logunov was the first to effectively use the method of dispersion relations to get insight into inelastic processes, 'blocks' with virtual ends, and the processes of multiparticle production.

A A Logunov found new ways to investigate the analytical properties of scattering amplitude in perturbation theory through resort to the majoration technique he had previously developed. This helped to prove dispersion relations for the partial amplitudes of nucleon-nucleon scattering.

With his study of the analytical properties of scattering amplitude as a foothold, Logunov was able to rigorously substantiate many relationships between the observable characteristics of processes at high energies. He generalized the known Pomeranchuk theorem to the case where the total cross-sections and effective radius of an interaction increase with a rise in energy.

Anatoliĭ Alekseevich Logunov

A systematic inquiry, within the framework of an axiomatic method, into scattering amplitude as the boundary value of an analytic function of two complex variables, energy and momentum transfer, led Logunov to an important conclusion that the effective interaction radius of any inelastic process should be not greater than that of the corresponding elastic process.

The higher the energy of colliding particles, the greater the number of new particles that can be produced in such collisions. Given sufficiently high energies, the final states of the reaction become so complex as to make the traditional methods of study of little use.

In 1967, Logunov came up with a fundamentally novel approach to studies into the inelastic interaction of particles at high energies. Its basis was the concept of what is known as an inclusive measurement or an inclusive reaction. With it, one concerns oneself with the characteristics of only one or a small number of selected particles of a specified kind, but considering them together in all possible reaction channels. The inclusive approach offered a way to give a model-independent description of the most important relationships involved in many-particle processes at high energies, using the general principles of quantum field theory as the basis.

The package of theoretical studies Logunov and his disciples made on the inclusive processes of strong interaction

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and the experimental investigation of the processes at the Serpukhov accelerator, which led to the discovery of the properties of scale invariance, have been entered in the USSR State Register of Discoveries.

Carrying on the method of dispersion relations, Logunov together with L D Solov'ev and A N Tavkhelidze derived finite energy sum rules, which later served as the basis for the concept of duality. The ideas of the sum rules also proved fruitful in quantum chromodynamics.

An important contribution to the present-day quantum field theory was made when Logunov together with his disciples and coworkers developed the so-called quasi-potential method in the relativistic two-body problem. The Logunov – Tavkhelidze equation, basic to this method, is a relativistic counterpart of the Schrödinger equation. The potential picture of interaction, backed up by the notion of the effective radius of interaction introduced by Logunov, allowed a revealing quasi-classical description to be given for elastic scattering at high energies.

More recently, Logunov advanced new views on space-time and formulated, on their basis, a relativistic theory of gravitation (RTG).

In formulating the RTG, Logunov, following Poincare's suit, worked on the premise that the gravitational field is a physical field that has energy – momentum density, and spins 2 and 0, and advanced a generalized principle of relativity which assures for the RTG to rigorously obey the laws of conservation of energy-momentum and momentum for matter and the gravitational field taken together.

Importantly, the source of the gravitational field in the RTG is the energy-momentum density tensor of all material fields, including the gravitational field.

Logunov's relativistic theory of gravitation explains all known gravitational effects in the Solar system referred to an inertial coordinate system. Under the RTG, the homogeneous and isotropic Universe evolves cyclically from some maximum density toward a minimum one, and back. The RTG predicts the existence of a large hidden mass of matter in the Universe.

Logunov is known all over the world not only as a major researcher in physics, but also as an outstanding organizer of science. Working at Dubna, he and N N Bogolyubov did much to set up what is known as the Laboratory of Theoretical Physics, now in the forefront of world science.

Logunov has contributed immensely to the creation of an experimental base and to the promotion of studies in particle physics in this country to a qualitatively new level. It is under his guidance that a scientific center of world renown, the Institute of High Energy Physics (IHEP), has been set up at Protvino. The start-up at the IHEP in 1967 of an accelerator, the world's largest at the time, and the success in implementing a scientific program that drew heavily on international cooperation enriched world science with a considerable number of fundamental discoveries.

The development and commissioning of the 70-GeV IHEP proton synchrotron won Logunov a Lenin Prize in 1970.

With Logunov as the scientific head of the IHEP, the world's largest accelerator-accumulator complex was designed and construction work was started in the early 1980s. In 1987 – 1991, a state program on high-energy physics, covering all of Russia's key projects in the field, was drawn up and successfully implemented under his guidance. Logunov put a great deal of effort into establishing the country's broad international cooperation in high-energy physics.

At the same time, Logunov carried the huge burden of a science organizer as Vice President of the USSR Academy of Sciences (1974 – 1991). As Rector of the Moscow State University (1977 – 1992), he did much to improve the training of young scientists, to help science at universities and colleges, to disseminate knowledge of physics and to build up its image. For more than 25 years, Logunov has held the Chair of Quantum Theory and High Energy Physics he created at the Physical Faculty of the Moscow State University, whose graduates are now working at IHEP and many other scientific centers in Russia.

The books and monographs written by Logunov have been translated into many foreign languages and are highly praised by specialists. Logunov is the Editor-in-Chief of the journal *Teoreticheskaya i Matematicheskaya Fizika* (Theoretical and Mathematical Physics).

He has brought up a large group of disciples at the Joint Institute of Nuclear Research, the Institute of High Energy Physics, and the Moscow State University. They are widely known for their research work in high-energy physics, field theory, and gravitation theory.

Logunov's achievements as a scientist, a science organizer, and an educator have been widely acclaimed both inside and outside Russia. He is a full-fledged member of the Russian Academy of Sciences, a member of several foreign academies, and a honorary doctor of many universities the world over. He has won Lenin and State Prizes more than once. He has been awarded many Russian and international orders and medals.

As the scientific supervisor and Director of the Institute of High Energy Physics, which has the official status of a Scientific Center of the Russian Federation, Logunov is active in giving guidance and counsel in matters relating to the advancement of high-energy physics and in intensive research work.

We wish Anatoliĭ Alekseevich to continue on working with his inexhaustible energy for many more years, for the good of Russian science and our home country. We wish him many years' health and new remarkable achievements in his multifaceted activity.

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