

## Igor Ivanovich Tkachev (on his 60th birthday)

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The 12th of January 2017 was the 60th birthday of the well-known theoretical physicist, author of pioneering studies on elementary particle astrophysics and cosmology, and full member of the Russian Academy of Sciences (RAS) Igor Ivanovich Tkachev.

On graduating from the Faculty of Physics of Lomonosov Moscow State University (MSU), Tkachev began working at the Institute for Nuclear Research of the USSR Academy of Sciences (INR RAS) as a postgraduate student. His supervisor was the outstanding theoretician V A Kuzmin. Tkachev published his first scientific work on the physics of the early Universe in 1981. Having successfully defended his PhD thesis, he continued working at the INR RAS in the Department of Theoretical Physics. Tkachev then worked in a number of leading world scientific centers, including Fermilab and CERN. In 2007, with valuable experience and wide international recognition as one of the leading experts in particle astrophysics and cosmology, he returned to his native institute (INR RAS), where he is working to this day.

Tkachev's scientific education fortunately allowed him to understand cosmology as both elementary particle physics and a gravitational science. This rare universality is the reason for his relevance in the international scientific community. Tkachev's research interests are fairly variegated, but the most renowned are his achievements in particle astrophysics and cosmology. He is the author of more than 200 research papers.

The theory of vacuum bubble dynamics developed by Tkachev together with V A Berezin and Kuzmin in 1983–1987 is directly related to eternal inflation and to how an uncountable number of universes are born in its course. Together with M E Shaposhnikov, he studied inflation in the minimal extension of the Standard Model with three right-hand neutrinos in 2007.

Tkachev's most famous works are on the theory of heating and thermalization of the early Universe after the end of the inflationary stage. He showed together with S Khlebnikov that the processes of fast decay of the vacuum-like state of the Universe during inflation and its subsequent heating allow a classical description. This made it possible to develop a numerical approach to the problem where the nonlinear effects of scattering of produced matter particles and their back-reaction on the dynamics of the Universe were taken into account. He discovered numerous possible consequences of these processes: nonthermal phase transitions, gravitational wave generation, nonthermal production of hypothetical particles, including gravitinos, and the tachyon preheating effect (together with G Felder, J Garcia-Bellido, L Kofman, and A Linde). Together with Felder, he wrote a publicly available numerical code



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LATTICEASY for a detailed study of this epoch of the early Universe, which has been widely used to the present day.

Tkachev then turned to various types of dark matter and its clusterization in galaxies. The peaks in the velocity spectrum of cold dark matter investigated by Tkachev and P Sikivie are of interest for experiments on its observation.

Tkachev devoted a number of studies to ultra-high-energy cosmic rays. He examined their propagation in intergalactic magnetic fields and elaborated methods for the search for their sources.

Tkachev is a universal physicist. He combines a profound understanding of theoretical problems with a feeling for how observations and experiments are performed. This has allowed him, being an acknowledged theoretician, to work as head of the INR Department of Experimental Physics, where the Troitsk neutrino experiment is being conducted on a unique setup designed under the supervision of academician V M Lobashev, and to take an active part in the work of this group.

Tkachev pays great attention to the training of highly qualified young scientists both at the INR RAS and at the associated chair at MSU. He carries on scientific organizational and expert work as a reviewer of leading scientific

journals, a member of the editorial board of the *International Journal of Modern Physics D*, an expert at the RFBR and RSF, a member of the INR academic and dissertation councils, a member of the Presidium of the Troitsk Research Center, a member of the Council on High-Energy Physics of the European Physical Society, a representative of Russia at the OECD APIF (Astroparticle Physics International Forum), and a member of the executive committee of the international collaboration “Telescope Array.” For his scientific achievements, he was awarded the Academician Markov Prize (2014).

Besides his dealing with most complicated problems, Tkachev has the gift of explaining their essence very clearly and distinctly to both students and nonspecialists. And yet he remains down-to-earth and considerate in his dealings with anyone and everyone. We wish him many long years of productive scientific activity, sound health and happiness, and new scientific results and discoveries.

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