Physics – Uspekhi **53** (6) 641 – 642 (2010)

PERSONALIA

PACS number: **01.60.+q**

In memory of Georgii Timofeevich Zatsepin

DOI: 10.3367/UFNe.0180.201006k.0671

Georgii Timofeevich Zatsepin, the patriarch of cosmic ray physics and neutrino astrophysics, one of the most prominent Russian scientists, the founder of a science school of world renown in the experimental and theoretical physics of cosmic rays, neutrino physics, and astrophysics, departed this life on 8 March 2010.

Georgii Timofeevich Zatsepin was born on 28 May 1917 into the family of a famous surgeon, T S Zatsepin, in the Arbat district of Moscow. He was educated in the famous Moscow School No. 110 on Merzlyakovsky Lane (formerly private Flerov gymnasium), then enrolled in the Physics Department of the M V Lomonosov Moscow State University (MSU) and graduated from there in 1941.

G T Zatsepin was a brilliant representative of Russian and world science, opening new avenues of research in the field of cosmic ray physics, neutrino physics, and astrophysics. He began his researcher's career in 1944 at the P N Lebedev Physical Institute under the guidance of Academician D V Skobeltsyn. At the time, it was believed that primary cosmic rays were composed of electrons. The pioneering research in the Pamirs conducted by Georgii Timofeevich when studying a new phenomenon — extensive air showers (EASs) — and his discovery of the nuclear-cascade process and the explanation of the birth and development of EASs greatly contributed to the refutation of this view.

G T Zatsepin was the first to obtain the basic characteristics of nucleon–nuclear interactions at very high energies (10^{12}–10^{14} eV), which contradicted the then accepted concepts of strong interactions: the approximate constancy of the cross section of inelastic interaction of the primary nucleon, the retention by this nucleon of about half of its energy in inelastic collisions, the scaling behavior of inclusive cross sections of the pions' production in the fragmentation region, etc. It took a quarter of a century to have these patterns confirmed in accelerator experiments. At the same time, Georgii Timofeevich suggested and brilliantly developed the theory of the nuclear-cascade process. He created a new method of studying EAS — the method of correlated hodoscopes, which was implemented when consrtucting installations at MSU and the Pamir station.

G T Zatsepin also pioneered the study of the penetrating component of cosmic radiation, muons and neutrinos, and laid the foundation for new fields of research — neutrino astronomy and neutrino astrophysics.

In 1963, he headed the new Neutrino Laboratory at the P N Lebedev Physical Institute of the URSS Academy of Sciences by the end of the 1970s this laboratory was transformed into the Department of High Energy Leptons and Neutrino Astrophysics (OLVENA in *Russ. abbr.*) in the just-founded Institute for Nuclear Research of the USSR (now Russian) Academy of Sciences (INR RAS). After that, G T Zatsepin remained the head of this department. Under the supervision and guidance of G T Zatsepin and A E Chudakov, the world's first underground neutrino observatory (The Baksan Neutrino Observatory, BNO) was built in the Baksan Gorge in the North Caucasus for studying muons and neutrinos of atmospheric and astrophysical origin.

Georgii Timofeevich Zatsepin
(28.05.1917 – 08.03.2010)

The work at OLVENA developed methods for solar neutrino spectroscopy, which made it possible to experimentally prove the thermonuclear nature of solar energy that formed the basis for proving the existence of neutrino oscillations.

To study various components of penetrating radiation, the research staff of the department designed large-scale underground scintillation telescopes: the Kollaps (Collapse) in Artemovsk, the LSD under Mont Blanc, and the LVD, a two-kilotonne scintillation-track system located under the Gran Sasso mountain (jointly with Italy); inelastic interactions of muons generating hadrons at high energies and the

Uspekhi Fizicheskikh Nauk **180** (6) 671 – 672 (2010)
DOI:10.3367/UFNr.0180.201006k.0671
Translated by V I Kisin

phenomenon of underground generation of the nuclear-active component of cosmic rays were studied, and methods for studying the neutrino radiation accompanying stellar collapses were created, which made it possible to observe the neutrino signals from the supernova SN1987A explosion by two detectors of the Institute for Nuclear Research, Russian Academy of Sciences.

In the mid-1960s, G T Zatsepin, together with V A Kuz'min, predicted the effect of spectrum cutoff for ultrahigh-energy cosmic rays, which was later named the Greisen–Zatsepin–Kuzmin limit. At the same time, he and V S Berezinsky advanced the idea of generation of cosmogenic neutrinos, which is at present the main mechanism of generation of ultrahigh-energy neutrinos.

G T Zatsepin and A E Chudakov proposed using the Cherenkov radiation of EASs, and this predicated the success of terrestrial high-energy gamma-ray astronomy in observations of galactic and extragalactic cosmic objects.

His group developed a theory of generation of atmospheric muons and neutrinos, which was then confirmed experimentally using both scintillation telescopes and an underground setup developed under G T Zatsepin's guidance at MSU on the basis of a novel method using X-ray emulsion chambers. The theory of generation and the observation techniques for ultrahigh-energy neutrinos are currently being worked out.

Presently, researchers at OLVENA are running experiments initiated by G T Zatsepin in cosmic ray physics, neutrino physics, and astrophysics at the underground and ground-based detectors of BNO INR RAS in the North Caucasus: Kollaps in Ukraine, LVD in Italy, and on a high-altitude detector in the Pamirs.

G T Zatsepin educated large numbers of students, many of whom grew into renowned scientists. For a quarter of a century he held a Chair of Cosmic Rays at the M V Lomonosov Moscow State University Department of Physics and then continue teaching as Honorary Professor there. He was awarded the Lenin and State Prizes, the D V Skobeltsyn Gold Medal of the Russian Academy of Sciences, the M A Markov Prize of INR RAS, and numerous State distinctions and high awards from Russian and foreign scientific organizations.

The most striking quality of Georgii Timofeevich was his far-reaching and accurate vision of the future evolution of science, which is especially true for neutrino astrophysics, of which he was one of the founders.

Georgii Timofeevich's creativity, encyclopedic knowledge of physics, medicine, and history, and brilliant memory always attracted people to him — young and old alike. He was gifted in scientific acumen, dedication to science, and innate intelligence, and was kind and paid careful attention to people's problems.

We deeply mourn the loss of our colleague, our teacher, and an exceptionally good person and express our deepest condolences to the family and friends of Georgii Timofeevich Zatsepin. The indelible image of this remarkable scientist and human being will always live in the memory of those who knew him.

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