Lev Borisovich Okun' (on his sixtieth birthday)

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Professor Lev Borisovich Okun', a Corresponding Member of the USSR Academy of Sciences, celebrated his sixtieth birthday on July 7, 1989.

Lev Borisovich was born in the town of Sukhinichi, in the Kaluga Province. He graduated from the Moscow Institute of Engineering Physics in 1953. His scientific career has been inseparable from the Institute of Theoretical and Experimental Physics, where he enrolled as a graduate student in 1954 and where he has headed the theory laboratory for the past 12 years. Lev Borisovich defended his Candidate of Science Dissertation in 1956 and his Doctoral Dissertation in 1961. A year later he became a professor at the Moscow Physicotechnical Institute; in 1966 he was elected a Corresponding Member of the USSR Academy of Sciences.

Lev Borisovich published his first scientific paper in 1953. We need not describe the radical changes that have since transformed the physics of elementary particles. But through the years he chose to work on problems that were always "in the thick" of current research and synonymous with progress in the field. His exceptionally clear understanding of the theory, combined with his profound experimental knowledge and inexhaustible supply of original ideas, were always directed at the pressing problems of the day. His research has influenced all areas of particle physics for over thirty years. He originated many of the ideas and concepts that not only advanced the cause of modern high energy physics, but even entered the general physics vocabulary. For instance, it was Lev Borisovich who introduced, in 1962, the term "hadrons" which has become the universally accepted designation for strongly interacting particles.

Already in one his first studies (completed together with B. L. Ioffe and A. P. Rudik in 1956), Lev Borisovich proposed the fundamental notion that the correlation of spin and momentum implies violations not only of spatial parity but also of charge parity. This significant result was registered as an invention in 1956. In that same year L.B. Okun' and co-workers demonstrated that conservation of CP-parity implies that the long-lived K^0-meson can decay into $3\pi^0$, even though this process is forbidden by charge parity conservation. The subsequent observation of this decay furnished one of the demonstrations of C-parity violation in weak interactions.

In that same time period, Lev Borisovich investigated the general properties of strong interactions at high energies, which led to several classic results. Thus, together with I. Ya. Pomeranchuk, he introduced the concept of peripheral scattering phases in strong interactions and obtained the asymptotic relations between the interaction cross sections of hadrons belonging to the same multiplet. This result became known as the Okun'–Pomeranchuk theorem and stimulated numerous investigations world-wide. These studies of strong interactions culminated later, in the late 1970's, when Lev Borisovich and co-workers made well-known contributions in the theory of charmonium and the sum rules in quantum chromodynamics.

LEV BORISOVICH OKUN'

From the late 1950's and until the present day the development of composite hadron models has occupied a place of pride in the research of Lev Borisovich. His investigations of the Sakata model in the late 1950's and early 1960's played an important role in the development of the quark model. In 1958, on the basis of the Sakata model he predicted the existence of two more pseudoscalar mesons (η and η^0) in addition to the seven that were known at the time. In that same cycle of papers he was the first to justify within the Sakata scheme the isospin and charge selection rules in weak interactions, which are now well-established in modern theory. This research was elaborated further by Lev Borisovich and co-workers in 1975, when they derived the symmetry relations in the decay of charmed particles.

In his research into K-meson properties, Lev Boriso-

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vich proposed new and nontrivial theoretical and experimental research directions that have contributed to the basic arsenal of modern high energy physics. It suffices to list some of the accomplishments of L. B. Okun' and coworkers: proof of the weakness of transitions in which strangeness changes by two (1957, together with B. M. Pontecorvo); proposal of specific experiments for determining the sign of the mass difference between neutral K-mesons (1960), which were subsequently employed in a number of investigations; analysis of the contributions made by various interactions to the $K_L \to \mu^+ \mu^-$ decay (1971–72); theory of the $K \to \pi e^+ e^-$ decay (1976).

In 1964–68, after the discovery of CP-violation, Lev Borisovich carried out a large cycle of investigations which addressed the various problems arising from that discovery. In particular, Lev Borisovich devoted much effort to the study of weak interactions at high energies. Begun as early as 1964, these studies addressed particle creation in weak interactions, asymptotic behavior of weak scattering cross sections, and cross sections for the creation of intermediate vector bosons in hadron colliders.

Lev Borisovich was one of the first to apply the currently ubiquitous idea that many details of elementary particle models, which inaccessible in collider research, can be verified by cosmological studies. In 1965, together with Ya. B. Zel'dovich and S. B. Pikel'ner, he calculated the background quark concentration for the case of free and stable quarks. This calculation yielded the classic method of calculating the background concentrations of various hypothetical particles. In a 1974 paper co-authored with Ya. B. Zel'dovich and I. Yu. Kobzarev, he examined the cosmological implications of the so-called domain walls that appear in the spontaneous breaking of discrete symmetry and concluded that these domain walls would lead to an unacceptably large perturbation of the isotropy of the microwave background. This conclusion imposed a rather severe constraint on models involving spontaneous breaking of discrete symmetries, including the CP-symmetry.

These last two studies have contributed to two new research directions. In the course of calculating the background quark concentrations, Lev Borisovich proposed the search for "wild" (anomalously heavy) isotopes of hydrogen and other elements. The experiments carried out at the Institute of Theoretical and Experimental Physics, as well as other institutes and laboratories world-wide, estimated the concentration of "wild" isotopes to be many orders of magnitude below the level predicted by the background concentrations of hypothetical stable particles, and hence also imposed constraints on various theoretical models. In the course of his domain wall research, Lev Borisovich completed (together with M. B. Voloshin and Yu. B. Kobzarev) in 1974 a study of the quantum decay of the metastable vacuum, which exerted a profound influence on all subsequent theoretical research of this nontrivial phenomenon, often invoked in modern theories of the inflationary Universe.

One of the favorite research topics of Lev Borisovich was the examination of our understanding of fundamental laws of nature. He analyzed the precision of basic theoretical principles: the massless nature of the photon, conservation of electrical charge, atomic electroneutrality, the Pauli exclusion principle, CPT-invariance. He formulated and analyzed the hypotheses of the existence of so-called "mirror" matter, of new long-range forces, and of the anomalously large electric and magnetic dipole moments of neutrinos.

Scientific consultations with Lev Borisovich have proved invaluable to his colleagues, as they often uncovered the essential physics of the discussed phenomenon. For an example, we can turn to the 1975 Institute of Experimental and Theoretical Physics seminar by A. M. Polyakov, who presented his recent solution of the Yang–Mills equations. In the course of the discussion Lev Borisovich remarked that this solution implied the existence of a magnetic monopole, known today as the t'Hooft–Polyakov monopole. Lev Borisovich has shared his uniquely clear understanding of elementary particle physics with his own students, with students of the Moscow Physicotechnical Institute where he has lectured for over thirty years, and with the numerous readers of his monographs which have proven extremely popular in our country and abroad.

The standing of Lev Borisovich in the international physics community is extremely high. He is constantly invited to give keynote and review addresses at the largest international conferences. He has served for six years (the maximum allowed term) on the scientific steering committee of CERN from 1980 onward.

On behalf of his colleagues, students, and friends we congratulate Lev Borisovich on his birthday and wish him success in all his endeavors.

Translated by A. Zaslavsky