92:53

Personalia

EVGENIĬ L'VOVICH FEINBERG

(On his Sixtieth Birthday)

V. L. GINZBURG, M. A. MARKOV, A. L. MINTS, and D. L. CHERNAVSKII

(Usp. Fiz. Nauk 107, 335-337 (June, 1972)

EVGENIĬ L'vovich Feĭnberg is a physicist of broad vision, profound knowledge, and lucid physical intelligence. Some of his works have been devoted to fundamental questions of theory, while others have been concerned with concrete effects. He has also carried out a whole series of studies of applied nature in the fields of acoustics, radio propagation, and neutron physics. Many of Feĭnberg's studies were ahead of their time, and won recognition on their merits only many years later.

Evgeniĭ L'vovich Feĭnberg was born on July 27, 1912 at Baku into the family of a physician. In 1918, the family removed to Moscow, where Evgeniĭ L'vovich school and, later, the University. He graduated from Moscow State University as a physics major in 1935 and remained there as a graduate student. The sponsor of E. L. Feĭnberg's diploma thesis and his mentor in his graduate work was I. E. Tamm, one of the most famous and brilliant of Soviet theoretical physicists. There is no doubt that Feĭnberg's scientific development and his attitudes toward science, people, and social phenomena were most strongly influenced by none other than I. E. Tamm. Feĭnberg transferred to the P. N. Lebedev Physics Institute's theoretical division in 1938, when it was headed by I. E. Tamm, and has worked there to this day, since 1959 as head of the sector on the theory of particle interactions at high energies.

Feĭnberg's first major work was devoted to the ionization of atoms in $\beta^{\pm}$ decay. An electron (positron) emitted from the nucleus can ionize its own atom, in a process that would naturally be treated in about the same way as the ionization of an atom by a "foreign" electron in flight past it. At the same time, Feĭnberg pointed out that the effective charge of the nucleus changes so rapidly in β decay that the electrons in the atom are subject to a practically instantaneous perturbation; it is as though the entire atom were "shaken," with further ionization as a result. Further, it is precisely this "additional" ionization that sometimes assumes the principal role. This study formed the basis of Feĭnberg's 1939 candidate's thesis, was published in abridged form in 1939 (and in unabridged form in 1941), and became a classic—to this day it form the basis of a whole field of research. In recognition of a number of new experiments, some of which were not quite correctly interpreted, Feĭnberg returned to this problem 25 years later and analyzed the new data in a special article (Yad. Fiz. 1, 612 (1965) [Sov. J. Nucl. Phys. 1, 438 (1965)].

A second important trend originated by E. L. Feĭnberg emerged only with great difficulty and, incidently, at the worse possible time—in 1941 (the Russian version of this paper was not even published, since it was placed in one of the numbers of the "Journal of Experimental and Theoretical Physics," which was being printed in Leningrad, that were not issued on account of the war; an English-language version of the article appeared in the "Journal of Physics of the USSR" 5, 177 (1941)). This paper made the first reference to the existence and possible importance of coherent inelastic processes, such as the production of mesons by γ rays on nuclei or the capture of mesons by nuclei. Unlike the incoherent inelastic processes that had been studied earlier, the probability of which is proportional to the number of nucleons A, coherent inelastic processes occur with a probability that is proportional, say, to A^2 (the probability depends on energy, scattering angle, etc.). The very possibility of a coherent inelastic process is by no means trivial and was long overlooked. In 1953, working with I. Ya. Pomeranchuk, Feĭnberg constructed a theory of diffraction generation of particles in which this generation may be either coherent or incoherent (the direct relation of this paper to the aforementioned 1941 investigation is obvious). In a review published in 1956 (Us. Fiz. Nauk 58, 193 (1956)), Feĭnberg presented a profound and lucid treatment of the problem of coherence in inelastic processes. Growth has been extensive in this entire area, and hundreds of experimental and theoretical papers have now been devoted to it.

The optical analogy, the analysis of the coherence problem, and, in general, the profitable application of classical physical conceptions in the solution of quantum problems have been hallmarks of Feĭnberg's work, and by no means accidentally—they are an outgrowth of the atmosphere that always prevailed in the Mandel'shtam-Tamm school. This general approach was also reflected in the cited study of consideration of coherence in inelastic processes, which was done more than 30 years ago; it is no less strongly evident in Feĭnberg's article in the I. E. Tamm memorial collection entitled "Problemy teoreticheskoĭ fiziki" (Problems of Theoretical Physics) (in which he analyzes the problem of the electron's dragged field and its changes following double scattering). The same can also be said of numerous other Feĭnberg papers (those mentioned below in particular) and of his recognition of the need to take account of interference effects in bremsstrahlung in crystals—Feĭnberg suggested this problem to M. L. Ter-Mikaelyan as a subject for this candidate's thesis. Ter-Mikaelyan later developed a whole research trend devoted to consideration of interference effects when high-energy particles collide in a medium.

A third group of Feĭnberg's investigations was devoted to the propagation of radio waves along the earth's "real surface," i.e., with consideration of the irregularities and inhomogeneities of the soil. In this field, in which no small number of well-known theoretical and mathematical physicists have worked, Feĭnberg succeeded in finding new methods that combine the physical approach with use of sufficiently rigorous and accurate approximations. Particularly interesting results indicate the possibility of increasing received strength by moving the receiver farther away from the source but to a position near a surface with superior conductivity (for example, the surface of the sea). However, it is not possible here even to list all of the results obtained, since their exposition (together with results of other authors) forms the content of Feĭnberg's long monograph "Rasprostranenie radiovoln vdol' zemnoĭ poverkhnosti" (Propagation of Radio Waves along the Earth's Surface) (Moscow, AN SSSR, 1961). We note that Feĭnberg did the bulk of his research on radiowave propagation for practical purposes during the war, and that it also provided the topic for his doctorate thesis, which he defended in 1944. In 1950, Feĭnberg was awarded the L. I. Mandel'shtam prize for radiophysics for these studies.

A fourth trend to which Feĭnberg devoted much effort during its inception and development was the statistical method of analyzing noiselike acoustic signals received against a background of noise interference. Feĭnberg analyzed the interference (at the output of a multielement acoustic antenna) for linear tracking of all signals from all elements of the antenna and for nonlinear transformation of the same signals. Here he was the first (more than 25 years ago) to use correlation coefficients and correlation functions as quantitative measures of the coherence of sound observed at different times or at spatially separated receiving points. This study was later developed jointly with S. G. Gershman and led to the creation of a method of studying correlation coefficients that was put to practical use (see Akust. Zh. 1, 326 (1955) [Sov. Phys.-Acoust. 1, 000 (1955)].) We know that statistical analysis of noise fields and the use of correlation methods are now commonplace not only in acoustics, but also in radar, radio astronomy, optics, etc.

Cosmic radiation constituted the fifth group of problems that attracted Feĭnberg's attention. For many years, difficulties had been encountered in interpreting the variations of the cosmic rays and, in particular, the so-called temperature effect for the muon component. Feĭnberg pointed out ways to overcome these difficulties in 1946. He drew attention to the fact that the ionization losses and the altitude distribution of the air masses in the atmosphere affect the number of decaying muons. For example, if a muon loses its energy at the beginning of its path in the atmosphere, this affects the probability of its decay more strongly, owing to the relativistic time-lag effect, than if the same energy loss occurs at the end of the path (say, at the surface of the earth). This study served as a point of departure for extensive research on the cosmic-ray variations that was undertaken by L. I. Dorman. So much has now been learned here that several monographs have already been devoted to the subject. True, these include not only consideration of meterological effects, but also analyses of other kinds of variations. Our understanding of the mechanisms of some of these variations is also linked to the name of E. L. Feĭnberg, who, together with L. I. Dorman, pointed out the role of solar corpuscular streams with magnetic fields "frozen" into them as a source of galactic cosmic ray variations (this study was published in 1958). Feĭnberg has been even more interested in the study of cosmic rays as a key to the understanding of particle-interaction processes at high and ultrahigh energies. In 1951—1953, he stressed the importance of single-quantum exchange in peripheral collisions (when the colliding protons interact peripherally rather than head-on, they exchange, basically, a single pion). Subsequent development of the theory of peripheral collisions led to the quantum-field multiperipheral scheme that is now central to the theory of inelastic processes. In 1971 Feĭnberg published a major review devoted to the statistical theory of multiple particle production (Usp. Fiz. Nauk **104**, 539 (1971) [Sov. Phys.-Usp. **14**, 455 (1972)]). This was followed early in 1972 by submission of a long article devoted to analysis of recent experimental and theoretical studies of multiple processes in peripheral collisions. The literature is currently devoting much space to "scaling laws" for application to collisions of high-energy particles. Feĭnberg has pointed out that such scaling laws are indeed observed for the "leading" secondary particles, which carry off a significant part of the incident particle's energy. Further, this has long been known from cosmic-ray experiments. As for the bulk of the particles produced with comparatively small energies, the scaling laws do not apply for them in the energy regions studied.

Since Feĭnberg's published works number about 70, we have reluctantly limited the discussion to only some of them, and then on a grouped basis. Nevertheless, we mention further the research done by Feĭnberg immediately after the war in the field of neutron physics. For example, working with L. E. Lazareva and F. L. Shapiro, he proposed a method of neutron spectrometry based on monochromatization of the neutrons as they are moderated in heavy media (see Zh. Eksp. Teor. Fiz. **29**, 381 (1955) [Sov. Phys.-JETP **2**, 351 (1956)]).

Feĭnberg was elected a Corresponding Member of the USSR Academy of Sciences in 1966. He had been awarded a Badge of Honor in 1953.

Feĭnberg is an excellent lecturer and teacher who has the ability to set forth complex problems lucidly, physically, and elegantly. Unfortunately, due to the illnesses that have afflicted and continue to afflict him, he has engaged in regular teaching activity only for comparatively short periods: from 1935 through 1939 at the Moscow Power Institute, from 1944 through 1946 at the Gor'kiĭ University, and from 1946 through 1954 at the Moscow Engineering Physics Institute.

Feĭnberg's interests are not limited to physics—he is a critic of poetry and a lover of music. His articles "The Ordinary and the Extraordinary" (Novyĭ Mir, No. 8 (1964)) and "Why I Seldom Go To the Theater" (Teatr, No. 4 (1963)) are well known and attest quite eloquently to the latitude of his interests and his literary talents.

It would be difficult to list all of Feĭnberg's students. His "official" students include members of the Republic Academies, Doctors and Candidates of Sciences. But even greater numbers of people regard Feĭnberg as their teacher and preceptor on an "unofficial" basis, in spirit. These are those for whom conversations with him, his help in selecting a subject an approach to its study, or even a whole scientific career have been decisive in shaping their futures. This is, of course, a consequence of the fact that he is an unusually kind and considerate man, one who is always ready to help and sustain. These qualities are universally evident. He dispenses advice and ideas generously and selflessly, enjoys seeing them developed, and is highly pleased when he has been able to assist a good man. When accident victims had to be saved, Feĭnberg plunged boldly into a burning airplane; when a victim of injustice must be defended, he goes into action without sparing time or effort; when it is necessary to defend his scientific principles, he does so passionately and convincingly and without regard to persons. Here we are not indulging in abstract symbolism: each phrase is documented with an actual event. Some of them are known only to a few persons, because Feĭnberg does not like to "advertise" his good works; he performs them without "noise," on the orders of his conscience alone.

The question as to whether high intellect and scientific ability correlate with high human qualities has often been disputed. Although there is no clear consensus, the example of Feĭnberg is, to everyone who knows him well, an extremely weighty argument in favor of such a correlation.

The friends, colleagues, and students of Evgeniĭ L'vovich Feĭnberg warmly wish him health, new successes, long life, and rewarding work.

Translated by R. W. Bowers