# Bruno Maksimovich Pontecorvo (on his seventieth birthday)

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Usp. Fiz. Nauk **140**, 735–736 (August 1983)

PACS numbers: 01.60. + q

The eminent Soviet physicist, academician Bruno Maksimovich Pontecorvo celebrated his seventieth birthday on August 22, 1983.

Pontecorvo was born in Italy in Pisa. Immediately after graduating from the University of Rome in 1934 he began actively participating in the work of the group led by the great Italian physicist, E. Fermi, and participated in work on investigating the properties of neutrons. In these classical experiments the phenomenon of slowing down of neutrons was discovered and the interaction of neutrons with nuclei was investigated.

During 1936–1940 Pontecorvo worked in the Radium Institute in Paris with Joliot-Curie. Here he completed a large group of investigations on nuclear isomerism, predicted the existence of isomeric states in stable atomic nuclei and discovered the first such isomer. He supposed that isomeric gamma-transitions should have high internal conversion coefficients and proved the validity of this assumption. In Paris Pontecorvo also discovered the phenomenon of nuclear phosphorescence.

During 1940–1942 Pontecorvo worked in the U.S.A. He developed and realized in practice a new method of prospecting for petroleum–the method of neutron well-logging. Neutron well-logging was the first practical application of neutrons. This method continues to be widely used at present.

During 1943–1948 Pontecorvo worked in Canada. He participated in the design and commissioning of the then most powerful research reactor based on heavy water. In Canada Pontecorvo carried out pioneering work on the study of properties of muons. He was the first to perceive the deep analogy between muons and electrons and was the first to advance the hypothesis of the universality of weak interaction. Pontecorvo proposed and conducted a series of experiments to investigate the characteristics of the decay of cosmic muons. These experiments proved that the charged particle formed in muon decay is an electron, that the muon decays into three particles and that the decay of a muon into an electron and a photon is forbidden.

For a long time the opinion was widespread that it is practically impossible to record free neutrinos. In 1946 Pontecorvo showed that it is possible to observe neutrinos from powerful reactors, and proposed radiochemical methods for detecting them (in particular, the chlorine-argon method). This proposal was characteristic of the scientific creativity of Pontecorvo. And

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in his later work he repeatedly proposed new experiments unusual in their methodology.

In his work in 1946 Pontecorvo considered as a neutrino source not only a reactor but also the Sun. As a result of Pontecorvo's chlorine-argon method a new field of investigations arose—neutrino astronomy. In 1947 the technique of proportional counters was essentially developed by Pontecorvo. Using the new methodology he for the first time observed the nuclear capture of L-electrons and obtained the then best available limit on neutrino mass.

In 1948 Pontecorvo returned to Europe. For some time he worked at Harwell. At the end of 1950 he moved to the USSR and began active participation in work at the then most powerful synchrocyclotron in Dubna. These were the years of the initiation of experimental high energy physics in the USSR. Under Pontecorvo's direction a large number of investigations was carried out. In this work the process of creation of a $\pi^0$-meson in neutron-nucleon collisions was observed for the first time and the process of the scattering of pions by nucleons was investigated.

In 1953 he proposed independently of A. Pais the hypothesis of coproduction of kaons and hyperons. In or-

 0038-5670/83/080745-02$01.80  

der to test this hypothesis Pontecorvo with his collaborators performed an experiment to search for the production of Λ-hyperons in collisions of protons with an energy of 700 MeV with nucleons. The fact that these processes were not observed allowed him to conclude that $K^0$ and $\bar{K}^0$ are different particles. From an analysis of the oscillations of neutral kaons Pontecorvo together with L. B. Okun' concluded that in the weak interaction strangeness cannot change by more than one unit.

After 1957 Pontecorvo's scientific interests became concentrated in the field of weak interaction physics. Pontecorvo's deep scientific intuition and talent manifested themselves clearly during these years. His paper "Electron and Muon Neutrinos" laid the foundation for the physics of high energy neutrinos. The calculations carried out by him indicated that neutrinos from high energy accelerators can be recorded by large detectors and showed that experiments with such neutrinos can provide an answer to the question whether muon and electron neutrinos are identical. The first such experiment was carried out at Brookhaven in 1962.

In 1961 Pontecorvo together with some collaborators carried out an important experiment on investigating the process of muon capture by $^3$He. The data obtained in this experiment confirmed the hypothesis of $\mu$-$e$-universality. In 1970 Pontecorvo with his characteristic love of nonstandard experimental arrangements proposed the "beam-dump" method of recording neutrinos (and muons) from the decay of particles whose lifetime is shorter than the $\pi$- and K-meson lifetimes.

Already in 1957 Pontecorvo advanced a very bold idea of neutrino oscillations. The majority of physicists at that time throught that the neutrino mass is zero. Always unencumbered by preconceived notions Pontecorvo supposed that neutrinos can have very small but nonzero masses, and that a mixing of neutrinos can take place. The intensity of neutrinos of a given type must in this case depend on the distance between the source and the detector. The hypothesis of neutrino oscillations has become very popular.

In his articles Pontecorvo has proposed different experiments to look for neutrino oscillations. Long before experiments on recording solar neutrino were performed he pointed out the importance of the oscillation phenomenon for the interpretation of these experiments and their unique sensitivity to the difference in neutrino masses. An extensive program of experiments in searching for neutrino oscillations is at present being carried out in many laboratories of the world.

Pontecorvo shows a great interest in astrophysics. In 1959 he was the first to point out the importance of the weak interaction between neutrinos and electrons for stellar evolution..

It is difficult to overestimate the role played by Pontecorvo in the development of a number of directions in modern day physics and in particular in neutrino physics. Pontecorvo exerts a great influence on the planning of scientific investigations at JINR (Dubna) and IHEP (Protvino). Pontecorvo serves as the chairman of the neutrino council of the Academy of Sciences of the USSR, which coordinates research on neutrino physics and neutrino astrophysics in our country. His contribution is invaluable in the creation of an atmosphere of demanding high standards of scientific results.

Pontecorvo's work has earned for him widespread international recognition. In 1953 he was awarded a State prize. In 1963 he was awarded a Lenin prize for his work on neutrino physics. In 1958 he was elected a corresponding member, and 1964 a full member of the Academy of Sciences of the USSR. In 1975 he was awarded the Eotvos medal of the Hungarian Physical Society. In 1980 he was awarded an honorary doctorate by the University of Budapest, and in 1981 he was made a foreign member of the Italian Academia dei Lincei.

Pontecorvo devotes much attention and effort to teaching. He occupies the chair of elementary particle physics at the Moscow State University, and lectures to students. He devotes much attention to the training and the subsequent work of each student. He takes his civic responsibilities seriously, he is a member of the Communist Party of the Soviet Union since 1955 and undertakes many social responsibilities. He is a member of the executive of the "USSR–Italy" Society and an active lecturer for the "Znanie" ("Knowledge") Society. He appears before the most varied audiences with interesting reminiscences and a deep analysis of the problems of elementary particle physics. On his initiative a complete collection of the work of E. Fermi has been published in the USSR. For this edition he wrote a biography of the great scientist and provided the articles with most interesting commentaries.

For his contributions to the development of nuclear physics in the USSR and for his activities on behalf of society Pontecorvo has been decorated by two Orders of Lenin and three Orders of Red Banner of Labor.

All those who have had the good fortune of having worked with or having met Bruno Pontecorvo carry away an indelible impression of his wonderful benevolence, love of science, clear and critical mind, ability to approach each problem from a novel angle, lack of preconceived notions in his opinions. Pontecorvo is a very interesting conversationalist, has a deep understanding and love of cinema, music, literature, art, tennis, hockey and football. An excellent tennis player, he is one of the founders of the tennis group in Dubna, one of the instigators of underwater hunting in the USSR.

Bruno Pontecorvo has many friends both in this country and abroad. We sincerely wish him good health, new joys, ideas, discoveries.

Translated by G. M. Volkoff