Tenth All-Union School on Inelastic Interactions at High Energies (Bakuriani, Georgian SSR, 15–26 January 1984)

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From January 15 to 26, 1984, there was held at Bakuriani the regular Tenth All-Union School on Inelastic Interactions at High Energies. The school was organized by the Institute of Physics of the Georgian Academy of Sciences at the Bakuriani Base of the Tskhra-Tskaro High-Altitude Cosmic-Ray Station. A unique feature of the school is simultaneous participation in the work of the school by specialists in the areas of cosmic-ray physics, experimental high-energy particle physics, and theoretical physics. This also was responsible for the broad representation of all the principal scientific centers of the country: the Institute of Physics of Georgian SSR, the Institute of High Energy Physics of Tbilisi State University, Tbilisi State University, the P. N. Lebedev Physics Institute of the USSR Academy of Sciences, the Institute of High Energy Physics at Serpukhov, the Institute of Theoretical and Experimental Physics in Moscow, the Joint Institute for Nuclear Research, the Leningrad Institute of Nuclear Physics of the USSR Academy of Sciences, the Institute of Nuclear Physics of the Siberian Division of the USSR Academy of Sciences, the Research Institute of Nuclear Physics of Moscow State University, the Institute of Space Research, the Institute of Nuclear Research, the Moscow Engineering Physics Institute, the Moscow Physico-technical Institute, and the Kiev Institute of Theoretical Physics. A total of 94 scientists from 15 institutes of the Soviet Union took part in the work of the school. Thirty-four lectures were delivered and 11 experimental seminars and 10 theoretical seminars were given. The specific program of the school gave a central place to the problems of cosmic-ray physics and inelastic interactions of hadrons at superhigh energies. The coming into existence of maximum accelerator energies (the SPS collider) with typical energies with which cosmic-ray experiments are performed has made possible the joint discussion of data at energies $E \sim 10^2$ TeV.

A characteristic feature of the interaction of hadrons at such high energies is the jet nature of the events. In the report of V. G. Grishin the characteristic of hadron jets in soft and hard collisions were discussed in great detail. The known characteristics of the spectra of hadrons in jets recorded in hard and soft processes, to all appearances, are very similar and one can speak of their agreement. The same thing is indicated by the data of cosmic-ray experiments. Analysis of showers (EAS) recorded at the "carpet" installation of the Baksan neutrino observatory (the report of V. A. Tizengauzen) and the detailed study of these showers convince one that at energies $\sqrt{s} > 500$ GeV mainly gluon jets are produced. In comparison of the data with the results of measurements in the colliding rings of the SPS, good agreement is found. G. B. Zhdanov, who presented in his report the data of the Pamir Collaboration, demonstrated the jet nature of multiple production in the case of γ families observed in x-ray emulsion chambers. Comparison of data obtained in cosmic rays at various installations indicates a rise of the inelastic cross section with increase of the energy, and violation of scale invariance in the central and fragmentation regions. Analysis of this violation carried out by A. D. Erlykin indicates that it occurs even at energies above 10^{14} eV. Analysis of the A-dependence of the spectra at energies ~ 10 TeV carried out at the G. E. Chikovani High-Altitude Station at Tskhra-Tskaro (presented by D. M. Kotlyarevskiĭ) confirms the conclusion that there is violation of scale invariance. The data of this group indicate an appreciable difference from the predictions of the additive quark model. Experimental data at ultrahigh energies reported to the school were subjected to a comprehensive analysis from the point of view of contemporary models of hadron multiple production.

In this part of the school I. M. Dremin gave a review of contemporary data on total, elastic, and inelastic cross sections for interaction of hadrons. K. A. Ter-Martirosyan presented the quark-gluon model of multiple production of particles at high energies, which is based on a dual topological expansion and the theory of a supercritical pomeron. A discussion of double diffraction dissociation processes (I. I. Roĭzen) showed that they can provide a significant contribution to the total cross section at $\sqrt{s} > 500$ GeV.

Quark-parton models of multiple production were extensively reviewed at the school. P. É. Volkovitskiĭ discussed the hadronization model developed at Lund University. L. V. Fil'kov presented calculations carried out in the framework of quantum chromodynamics with application to a quark-gluon plasma, and indicated the possible manifestations of such a plasma in heavy-ion collisions and in cosmic rays. Interactions of relativistic nuclei were discussed by Yu. N. Shabel'skiĭ. I. L. Rozental' and Yu. A. Tarasov gave an analysis of data at high energies in the framework of a hydrodynamical model. The consequences of the hypothesis of quark confinement in application to hadron-nucleus interactions were described in a report by B. Z. Kopeliovich.

The specific nature of the interactions with nuclei in deep inelastic interactions was emphasized in the review paper by N. N. Nikolaev. In his report he described contemporary models which explain the experimentally observed departure from a simple A-dependence to the cross section for deep inelastic processes. One of the points of view in this problem was set forth by M. G. Ryskin, who discussed the role of parton rescattering in a nucleus. A. A. Tyapkin discussed the spectroscopy of bosonic systems of light quarks. The results which were presented of the partial-wave analysis of data obtained in the joint experiment of the State Commission on Use of Atomic Energy and CERN (the Dubna-Milan Collaboration) indicate the existence of new boson resonances.

In the section devoted to the production of new parti-

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cles, reports were given by É. P. Kistenev, L. G. Tkachev, and V. G. Kartvelishvili. Kistenev's report was devoted to the present experimental situation, including the production and lifetime of charmed particles. Data on the production of W and Z^0 bosons and on the nucleon lifetime (from the materials of the European Conference at Brighton) were reported by L. G. Tkachev. Estimates of the possibilities of observing the levels of bottomonium formed in hadron collisions (in the $\psi\psi$ mode) were given in the review by V. G. Kartvelishvili. The possibility of observing effects due to production of charmed particles in cosmic-ray interactions (long-range showers) was discussed by I. M. Dremin.

Papers on the problems of theoretical physics were extensively presented at the school. É. V. Shuryak gave a review of the various directions of the theory of strong interactions, involving study of the QCD vacuum: the quasiclassical approach (instanton theory), the lattice approximation, and the sum-rule method. Also discussed was the macroscopic approach involving the possibility of the existence of quark-gluon plasma. D. L. Chkareuli reported on the current state of models of composite quarks and leptons. He demonstrated the role of the condition of conservation of chiral symmetry for preons and composite fermions in selection of the symmetry group for a unified scheme which combines weak, electromagnetic, and strong interactions. M. I. Vysotskiĭ discussed the prospects for observation of new particles whose existence is predicted in models based on low-energy supersymmetry. An introduction to supersymmetric field theory was given by M. A. Shifman. He discussed important and interesting consequences of supersymmetry: vanishing of the vacuum energy, and exact relations for certain correlation functions.

The problems of neutrino physics were reflected in the papers by V. A. Tsarev and R. S. Shuvalov. Tsarev discussed interesting applied problems which can be solved by the methods of neutrino physics. These included the possibility of use of high energy neutrinos for purposes of global geodesy, tectonics, and neutrino tomography of the Earth, and in the search for oil, gas, and heavy minerals. Possible methods of detecting neutrino beams were discussed, including detection of the equilibrium flux of muons, a thermodynamic signal, and Cherenkov radiation. Problems of production of neutrino beams were discussed in the review by R. S. Shuvalov on the tagged-neutrino program at the IHEP accelerator. The advantages of the tagged-neutrino method in solution of physical problems were discussed.

A traditional feature of the school was a discussion of the problems of cosmology. A review of fundamental cosmological problems was given by A. D. Dolgov. He discussed possible methods of solution of the problems of the horizon, the homogeneity and isotropy of the Universe, the closeness of the density to the critical value, and the origin of the Universe.

In the parallel seminars a number of interesting experimental and theoretical reports were given on particle physics.

The excellent organization and well thought out scientific program of the school are due to the unquestioned merit of the organizing committee. An easy-going and friendly atmosphere prevailed at the school, and this permitted pursuit to the end of controversial questions and facilitated a deep and rapid understanding of such rapidly developing fields as high-energy particle physics.

Translated by Clark S. Robinson