VIII All-Union School on High-Energy Inelastic Interactions (Bakuriani, Georgian SSR, 20–30 January 1982)

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The tenth anniversary of the first Bakuriani school on inelastic interactions coincided with the 25th anniversary of the G. E. Chikovani Tskhra-Tskaro mountain research station. D. M. Kotlyarevskiĭ's review of the history of the station, founded by Chikovani, and of the physical results obtained there served as a testimonial to Chikovani's important contributions to particle physics.

A total of 35 lectures were read at the school, and 16 theoretical and ten experimental seminars were conducted.

Cosmic-ray physics was represented by a review lecture by A. D. Erlykin covering the XVII International Conference (Paris, 1981), by two reports on the Pamir experiment (N. N. Roĭnishvili and G. B. Zhdanov), and reports by Yu. T. Lukin and Yu. A. Gromov. It was noted that the total cross section and the average inelasticity increase with increasing energy; there is an asymmetry in the collision; and the cross section for inelastic charge exchange of pions remains essentially constant.

The overwhelming majority of the experimental lectures were devoted to research on hadron-nucleus interactions using accelerators. L. I. Sarycheva analyzed the behavior of the inclusive cross sections for hadron production in nucleon-nucleus interactions at $E = 7$–400 GeV with the goal of determining the cross sections for the interaction of secondary particles with nucleons in a nucleus. It was concluded that the cross section for the interaction of secondary nucleons falls off with increasing energy of the primary particles. L. G. Tkachev reported research on hadron-nucleus interactions carried out with the RISK spectrometer (Joint Institute for Nuclear Research) installed at the Serpukhov accelerator. Experiments have been carried out in π^-p, K^-, and p^- beams with a momentum of 30 GeV/c. The average number of positively charged particles increases rapidly with increasing atomic number of the target nucleus.

A. A. Tyapkin reported data on the production of the new mesons π' and π'' with $M(\pi') = 1205$ MeV and $M(\pi'') = 1770$ MeV in the diffractive dissociation of π mesons ($p = 40$ GeV/c) by nuclei, according to experiments with the MIS apparatus at the Joint Institute for Nuclear Research. The discovery of these mesons is being interpreted as the appearance of a new class of quark states with radial excitation.

M. I. Solov'ev discussed the production of cumulative particles in πC, dTa, αTa, and CTa interactions on the basis of experiments with the 2-m propane chamber at the JINR. It has been found that the characteristics of the secondary particles change as a function of the cumulative number.

D. B. Pontecorvo discussed forthcoming research on the interactions of slow antiprotons with nuclei by means of the LEAR apparatus at CERN. JINR researchers are expected to participate in this project.

I. Ya. Chasnikov discussed research on quasinucleon interactions in nuclear emulsions at energies over the range 20–400 GeV.

L. N. Smirnova reviewed data on the inclusive characteristics of $\bar{p}p$ interactions at energies 10–100 GeV, analyzed them, and compared them with the corresponding pp data.

V. G. Grishin discussed data on the production of resonances at energies $\lesssim 2$ TeV and their analysis on the basis of quark models. It was shown that ~70% of the "direct" secondary hadrons are vector and tensor mesons.

P. A. Gorichev reviewed experimental data on deep inelastic electromagnetic and weak interactions and their analysis on the basis of the quark-parton model and quantum chromodynamics.

The people attending the school heard reviews by V. A. Nikitin of the International Conference at Lisbon (1981) and by I. M. Dremin of recent results on $\bar{p}p$ interactions at the energy $\sqrt{s} = 540$ GeV from the SPS colliding-beam installation at CERN.

Many of the reports were devoted to theoretical aspects of hadron interactions.

A. B. Kaĭdalov and P. É. Volkovitskiĭ analyzed the quark-gluon model for peripheral interactions at small momentum transfers and generated several predictions regarding the inclusive spectra in the fragmentation region. They also derived relationships between the masses of the various hadrons, interaction cross sections, and the decay widths of resonances.

In the more traditional Regge models it was shown (by K. A. Ter-Martirosyan) that new colliding-beam data can be described well by a model with a supercritical pomeron.

V. V. Anisovich demonstrated the role played by quark statistics in describing the relative yields of mesons and baryons in multiple production.

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I. M. Dremin pointed out the possible appearance of a broad halo of gluon jets around an initial hadron jet due to color confinement at large transverse momenta. L. V. Gribov also pointed out the importance of large transverse momenta in the cross section at high energies, working in quantum chromodynamics perturbation theory.

The color-tube model was used to calculate the distribution in the multiplicity of secondary hadrons in lepton reactions (E. G. Gurvich) and to explain cumulative processes in nuclei (B. Z. Kopeliovich).

Hadron-nucleus collisions were discussed in many of the lectures. It was pointed out that the finite hadron-formation time must be taken into account (N. N. Nikolaev). The important role played by the diffractive dissociation of nuclei in studies of the quark structure of hadrons was pointed out by Yu. M. Shabel'skiĭ and B. Z. Kopeliovich. V. V. Vechernin drew attention to the importance of the spectator mechanism in the production of fragmentation deuterons.

The dispersion sum rules of quantum chromodynamics have been used to analyze the properties of an exotic meson resonance which has been predicted (D. I. D'yakonov), and the form factor of the pion and the $\rho \to 2\pi$ decay widths have been calculated (A. V. Smilga). A. I. Vaĭnshteĭn has studied the power-law corrections in quantum chromodynamics and pointed out the need for a clustering of the sea quarks in a nucleon with a radius of the order of a third of the nucleon radius, apparently in connection with the successes of the constituent quark model. D. V. Shirkov discussed the dependence of the parameter Λ on Q^2 (especially near the thresholds for the production of heavy quarks).

The physics of the "new" particles was discussed in a review by A. K. Likhoded of the hadron production of particles containing heavy quarks.

V. A. Tsarev briefly reviewed supernuclei (in which one of the nucleons is replaced by a baryon with a heavy quark).

D. L. Chkareuli reviewed calculations of quark and lepton masses and the weak-interaction parameters in the grand unified models.

Several of the lectures touched on formal questions of quantum field theory (D. V. Shirkov, V. Ya. Faĭnberg, and A. I. Vaĭnshteĭn) and the string model (G. S. Iroshnikov and N. V. Borisov). A. V. Turbiner discussed exactly solvable quantum mechanical systems on which perturbations are imposed.

Several of the lectures were devoted to symmetry in quantum field theory. D. V. Shirkov introduced the concept of quantum symmetry, which leans heavily on the fundamental concepts of quantum mechanics. The role played by quantum symmetries in shaping modern field theory was discussed, and the usefulness of this approach was pointed out.

K. A. Ter-Martirosyan compared two models describing the families of elementary particles. The first model, constructed on the basis of supersymmetry, predicts too many "extra" particles. In the second model, all the particles are bound states of preons. It does not seem natural, however, that the gauge fields, including the photon and the gluon, are also composite.

M. I. Vysotskiĭ discussed models with a supersymmetry which is violated at an energy of about 100 GeV and showed that many new effects can be expected in the TeV region. The formation of new hadrons containing superpartners of the gluon and the photon—the gluino and the photino—is predicted in an already attained energy range.

A. A. Ansel'm discussed the interesting possibility of a new type of massless axion: a Goldstone boson which corresponds to a spontaneous breaking of the chiral lepton symmetry. An experimental search for this new particle was proposed.

The present state of the problem of neutrino oscillations was described by S. M. Bilen'kiĭ.

A. D. Dolgov discussed the relationship between cosmology and elementary particle physics. It follows from the fact that the energy density in the universe is near the critical density that in the early stage of the universe the difference between the density and the critical value was negligibly small, $\approx 10^{-16}\ (t/c)$. Such a precise correspondence might arise if the Friedman stage of the expansion of the universe was preceded by a de Sitter stage. Cosmological limitations on the number of types of neutrinos and their masses were discussed.

I. L. Rozental' discussed an instability of the structure of the universe upon a change in the basic physical constants.

S. S. Gershteĭn discussed the problem of the appearance of GeV-range protons in the solar cosmic rays. An interesting mechanism proposed for the acceleration of these protons is analogous to the collective-acceleration method used in accelerators.

In summary, as in all previous years, the school at Bakuriani was characterized by broad coverage of all the problems pertinent to high-energy particle interactions, passionate debates, lively evening seminars, and a natural friendly atmosphere. Combined with the good accommodations and the thoughtfulness of the organizers of the school, led by D. M. Kotlyarevskiĭ, the result was the unique spirit of the Bakuriani schools, which have done much to promote congenial communications among physicists from the various scientific centers and to promote further successful work by these physicists.

Translated by Dave Parsons