

Seventh International Seminar on Problems of High Energy Physics

V. V. Burov

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From 19 through 23 June, 1984 the Seventh International Seminar on Problems of High Energy Physics was held at Dubna. Representatives from 64 scientific centers in 15 countries participated in the seminar. The Soviet Union was represented by republican national (Erevan, Tbilisi, Tashkent, Alma-Ata, Kiev, Minsk, Frunze, Khar'kov) and regional (Moscow, Leningrad, Tomsk, Novosibirsk, Vladivostok, Serpukhov, Gatchina, Sukhumi, Dubna) scientific centers.

More than 200 people took part in the seminar.

In the introductory address, the chairman of the organizing committee, Academician A. M. Baldin, formulated the aim of the seminar and emphasized that the main attention would be devoted to the properties of quark-parton structure functions of nuclei or the distribution of quarks and gluons in nuclei. This is not only a traditional problem for seminars but has already for many years been one of the main directions of experimental and theoretical research at Dubna. The cumulative production of mesons discovered in experiments at Dubna gave the first information about the structure functions of nuclei as independent (not reducible to single-nucleon objects) objects of hadron physics. The interpretation of the cumulative effect as a signal of the presence in the nucleus of "droplets" of hadronic matter or many-quark configurations had both opponents and supporters over more than ten years. Traces of this discussion will undoubtedly be clearly expressed in this, the seventh, seminar. The proceedings of the previous seminars and a large number of papers, both theoretical and experimental, indicate that the problem of multiquark and gluon configurations in nuclei is very complicated and at an initial stage of study. Nevertheless, already at the fifth (1978) seminar the main features of limiting fragmentation of nuclei were emphasized.

At the sixth seminar (1981), results were given for the first time of experiments on deep inelastic muon scattering on nuclei in the cumulative region which gave convincing support for conclusions about the properties of the structure functions of nuclei. A particularly important change in the attitude of theoreticians to the problem of multiquark configurations in nuclei took place in 1983 after the publication of the results of the European Muon Collaboration (EMC) and of SLAC, which are in good agreement with the A dependence of the structure functions in the region $0.5 \leq X \leq 1$ obtained at Dubna. Many theoretical studies were published—not so much predicting new effects as interpreting the EMC results. Far fewer theoretical studies have been devoted to the cumulative region $X \gtrsim 1$. The data in this region indicate the existence in nuclei of superfast quarks and multiquark configurations. The seminar also included dis-

cussions of problems associated with the quantum chromodynamics of large distances and confinement questions [papers by A. A. Slavnov, I. M. Dremin, Yu. V. Novozhilov (USSR), D. I. Kazakov, M. K. Volkov, G. V. Efimov, A. V. Radyushkin, and N. Ilieva (JINR)].

In parallel sessions there were talks by M. Namiki (Japan), J. Ranft (GDR), V. K. Mitryushkin (JINR), N. V. Makhaldiani, and others devoted to lattice theory, which is a new, rapidly developing approach in quantum field theory, and on the experimental investigation of multiparticle processes in hadron-nucleus and nucleus-nucleus interactions there were ten original communications, which were fairly widely quoted in the work of the seminar.

There were discussions of models in QCD, in particular various aspects of nucleon structure and the problem of finding exotic multiquark states [L. Pondrom (USA), H. Weber (USA), N. N. Achasov (USSR), V. P. Merkur'ev (USSR), and S. V. Goloskokov (JINR)].

Some of the papers were devoted in part to a discussion of deep inelastic scattering of leptons by nuclei, their quark structure, and above all the EMC effect (12 papers in all). I. A. Savin (JINR) reported new experimental data of the group HA-4 for the ratio of the structure functions which completely confirmed the EMC effect, analyzed SLAC data for this ratio, and proposed an approach making it possible to reconcile these data with the EMC and HA-4 results.

Dias de Deus (Portugal), K. Riet (FGR), A. V. Efremov (JINR), W. Williams (Great Britain), H. Pirner (FGR), N. N. Nikolaev (USSR), J. Berry (USA), A. I. Titov (JINR), L. L. Frankfurt (USSR), and N. P. Zotov (USSR) discussed various aspects of the theory of the EMC effect. Riet presented new experimental data which can be interpreted as an appreciable excess of gluons in nuclei as compared with free nucleons.

Mention should also be made of the paper of A. Ereditato (CERN), who discussed the problems of muon pair production in πA interactions and stimulated much interest.

V. N. Baier (USSR) spoke on hard hadron processes, while processes with large momentum transfer were discussed by V. V. Abramov (USSR) and V. A. Matveev (USSR).

Experimental investigations of cumulative processes were considered. Yu. A. Panebrattsev (JINR) analyzed the experimental data obtained at the Laboratory of High Energies during the last decade.

G. A. Leksin and K. Sh. Eginyan (USSR) presented new data on deep inelastic nuclear reactions and nuclear fragmentation. Experimental data on the stripping of relativistic nuclei obtained by L. N. Strunov's group (JINR) were analyzed by A. P. Kobushkin (USSR).

The problem of the existence of dibaryons and other exotic many-quark systems has been discussed actively already for several years. Papers on this subject were presented by K. K. Seth (USA), N. Hoshizaki (Japan), and B. A. Shakhbazyan, Yu. A. Troyan, and V. D. Kekelidze from the Laboratory of High Energies. The history of the search for such resonances has been very dramatic. This was demonstrated with particular clarity by K. K. Seth.

If the experimentalists have been preoccupied with searching for proofs of the existence of multiquark systems, the theoreticians have not skimped the analysis of the properties of such systems [V. G. Neudachin (USSR), M. Namiki (Japan), H. Hogaasen (Norway), and others]. Several papers were devoted to the theory of nuclear forces [T. I. Kopaleishvili (USSR), S. Weber (USA), M. Wakamatsu (Japan), Y. Suzuki (Japan), E. Schmid (FGR), and others]. The presence of multiquark-system admixtures in ordinary nuclei makes it possible to interpret successfully the behavior of the form factors at large momentum transfers [M. Namiki (Japan)]; it also makes it necessary to investigate the structure of the admixture itself—multiquark bags—and this requires a generalization of chromodynamical models of elementary particles [H. Hogaasen (Norway), Yu. E. Pokrovskii (USSR)].

Considerable interest was stimulated by the papers of the groups of authors represented by M. I. Gorenshstein (USSR) and V. I. Yukalov (USSR) on unusual states of nuclear matter. The first discussed the detection of a new phase state of nuclear matter—a quark-gluon plasma—which could arise when there is strong compression of nuclear matter, for example, in collisions of relativistic heavy ions or even nucleons.

The second, based on theoretical methods of N. N. Bogolyubov's school, presented results which show that a state in which from the very beginning there exist two phases, nucleon and multiquark, is an entirely real ground state of nuclear matter.

At the end of the seminar, there was an analysis of the present state and prospects for both the experimental and theoretical development of relativistic nuclear physics. L. S. Schroeder (USA), M. Faessler (CERN), H. Lochner (FGR), and S. Nagamiya (Japan) gave extensive surveys of experimental investigations and discussed plans for the creation of new experimental facilities.

A number of papers were devoted to hadron-nucleus and nucleus-nucleus experimental investigations [L. A. Didenko (JINR), I. V. Chuvilo (USSR), and K. D. Tolstov (JINR)] made at the Laboratory of High Energies at the JINR. Theoretical models associated with attempts to explain the basic features of these experiments were discussed by V. V. Anisovich (USSR), F. Takagi (Japan), and Meng Ta-Chung (West Berlin).

In parallel session papers were presented on particle production in nucleus-nucleus interactions [B. Schurmann (FGR), V. D. Toneev (JINR), H. Ive (GDR)] and the manifestation of quark degrees of freedom in nucleons and nuclei [V. R. Garsevanishvili (USSR), A. E. Dorokhov (JINR), P. A. Usik (USSR), G. I. Lykasov (JINR), V. M. Dubovik (JINR), S. V. Trubnikov (USSR), A. N. Antonov (Bulgaria), and É. G. Boos (USSR)].

The work of the seminar took place in an environment of high scientific activity with an auditorium regularly overfilled, and, in the opinion of the participants, the seminar was very fruitful and successful.

The proceedings of the seminar have been published by the publishing Department of the JINR in the collection: VII Mezhdunarodnyĭ seminar po fizike vysokikh énergii. Mul'tikvarkovye vzaimodeistviya i kvantovaya khromodinamika (Seventh International Seminar on High Energy Physics. Multiquark Interactions and Quantum Chromodynamics), D1,2-84-599, Dubna (1984).

Translated by Julian B. Barbour