Scientific session of the Division of General Physics and Astronomy and the Division of Nuclear Physics, USSR Academy of Sciences (29 January 1976)

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A joint scientific session of the Division of General Physics and Astronomy and the Division of Nuclear Physics of the USSR Academy of Sciences was held on January 29, 1976 at the conference hall of the P. N. Lebedev Physics Institute. The following papers were delivered:

1. *G. T. Zatsepin*, A Projected Deep-Water Neutrino Experiment (DUMANT).

2. *A. M. Baldwin*, The Physics of Relativistic Nuclei.

We publish below the brief content of the second paper.

A. M. Baldin. *The Physics of Relativistic Nuclei.* As a result of work done on the Dubna proton synchrotron (development of a new injection and slow beam extraction system, acceleration of compound nuclei, development of detecting systems), this accelerator has become the first relativistic nucleus accelerator. These methodological advances have made it possible to develop a broad new scientific area: relativistic nuclear physics.

Relativistic nuclear physics is defined as the region of multibaryon phenomena given by the condition $p^2 \geq m^2$, where p^2 is the squared momentum of the particle and m^2 is the square of its mass. Scale invariance and other crucial concepts of elementary particle physics are applicable in this region. Since the nuclei move at velocities exceeding the velocity of light in ordinary matter and the velocity of sound in nuclear matter, it becomes possible to observe unusual and extremely informative effects, such as shock waves and superdense states in nuclear matter.

With his co-workers, the author has predicted, observed, and studied cumulative effects: effects in which energy is transferred from a group of nucleons to a single pion, and which can be described by universal relationships. The cumulative effects reflect the local properties of nuclear matter under extreme conditions.

Three large track detectors (one-meter hydrogen and two-meter propane bubble chambers and a two-meter streamer chamber) which, in addition to the effects mentioned, enable us to make individual observations of nuclei and groups of moving baryons with determination of the charge and mass of each particle, are now in operation on the proton synchrotron. This is a fundamentally new opportunity for study of extremely short-lived nuclei, as well as hypernuclei and isonuclei (nuclei that incorporate hyperons and excited nucleon states in addition to neutrons and protons). The use of accelerated nuclei is also of great applied value (for verification of existing conceptions as to the nature of the cosmic radiation, the radiation hazard to cosmonauts and space vehicles, for medicobiological research, etc.).

In addition to the track instruments, the Joint Institutes of Nuclear Research (JINR) Laboratory of High Energies has built four large electron units, is completing the construction of a large experimental pavilion for the beams extracted for the proton synchrotron, and is working on plans for a specialized "Nuclotron" relativistic-nucleus accelerator that will eventually replace the proton synchrotron. These opportunities have been made broadly available to physicists of Socialist countries, and have, in recent years, also been attracting great attention in countries that are not participants in the JINR.

Translated by R. W. Bowers

