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⑥ A NEW DIRECTION IN COSMIC RAY RESEARCH

⑩ by
A.A. Pomanski

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A NEW DIRECTION IN COSMIC RAY RESEARCH

A. A. Pomanski

In Yakutia there has been formed in recent years a large group of scientists engaged in a high level of theoretical and experimental research on cosmic ray physics. At Yakutsk there has been operating for many years a station recording the different components of the cosmic radiation; a branch of this station is carrying out the same work under the severe meteorological conditions beyond the Arctic circle (Tiksi Bay). Consequently it is natural that it was at Yakutsk that the first All-Union Conference on the space-physics aspects of cosmic ray research was held, on August 23-30.

Besides the papers read at the plenary and sectional sessions, lecture-reports were organized on the most immediate physical problems connected with the conference theme.

In a review paper, L.I. Dorman divided all observed cosmic ray variations into three classes: namely, variations due to atmospheric effects (in this research a particularly great contribution has been made by the Yakutsk scientists), variations connected with change of the earth's magnetic field, and variations of extraterrestrial origin. Study of the variations of the third class has made it possible to secure data on magnetic fields in interplanetary space and on the flux of solar cosmic rays, this being particularly important for guaranteeing the safety of space-ship flights. Experimental work was reported confirming the existence of magnetic fields and corpuscular streams in interplanetary space. New data were presented on the propagation of solar cosmic rays.

A question extensively discussed was that of the influence, on diurnal cosmic ray variations, of the magnetic cavity formed by interaction of the corpuscular stream with the geomagnetic dipole. Scientists were led to this effect by the discovery of a local source of diurnal cosmic-ray variations during magnetic storms. It has been solidly established that the diurnal variations are more sharply manifested in the recording of cosmic ray particles that have passed through a thin absorber. The conference participants emphasized that increasing the number of continuously recording stations will make possible a more reliable comparison of the results obtained.

Summing up the results of work instituted in 1956 at the Yakutsk ionospheric station, A.P. Mamrukov, the officer in charge, gave a description of the state of the ionosphere over Yakutia. New and original work was presented by the Yakutsk auroral group, which is conducting a complex of [interrelated] studies, extended over the whole of Yakutia, by radio methods in conjunction with optical methods. The most interesting results secured by this group are the discovery of a low-frequency radio emission from the aurora and upper strata of the atmosphere, the discovery of a coastal effect in the aurora, the establishment of the extremely local character of the aurora and its dependence on the local topography.

Occupying a large place in the work of the conference were questions connected with the origin of cosmic rays and the chemical make-up of the primary cosmic radiation. V.L. Ginzburg pointed to the importance of determining the fraction of electrons in cosmic rays. According to present concepts, the bremsstrahlung of cosmic electrons is responsible for all the noise in the cosmic radio emission. If this is so, then electrons and positrons should constitute approximately one percent of all cosmic rays. From this point of view it would be of exceptional interest to study the electron component during solar flares, when (as has now been reliably established) nuclei of various elements are generated.

In a review paper by S.I. Nikol'ski much attention was given to the spectrum of cosmic rays at super-high energies. Great interest was shown in his report of the recent findings of American physicists, who state that the greater part of cosmic radiation at energies above 10^{16} eV is of metagalactic origin. But in the opinion of V.L. Ginzburg and S.I. Syrovatski, all arguments at the present time point mainly to a galactic origin for cosmic rays. In particular, if the metagalaxy were filled with cosmic radiation, then the photon flux from the metagalaxy would be extremely large, which is not experimentally observed to be the case.

D.D. Krasil'nikov presented experimental data on the μ -meson spectrum, which has been obtained with great statistical precision up to energies of 10^{13} eV.

Very great interest was evoked by papers devoted to neutrino physics. In recent years the successful detection of neutrinos and anti-neutrinos from reactors and accelerators has brought to the fore the question of detecting neutrinos from the sun and stars. Since the stars in systems similar to our galaxy are emitting neutrinos, and the stars in anti-galaxies emit anti-neutrinos, B.M. Pontecorvo pointed out that by detecting discrete neutrino and anti-neutrino sources one could distinguish galaxies from anti-galaxies, something that cannot be done by optical methods. Ya. A. Smorodinski, speaking of the relationship of the neutrino to cosmological problems, noted the very great role of these particles in the evolution of the Universe.

The conference participants were made acquainted with the cosmic ray work conducted at the Yakutsk Geophysical Observatory. Particular note was taken of the neatness and high sophistication of the work that made possible the continuous recording of the different cosmic ray components (for example, the ASK-1 ionization chamber has been operating here without any shut-down since 1953).

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