

ACTUAL PROBLEMS OF COSMIC-RAY PHYSICS

NEW PHYSICS IN COSMIC RAYS AT PEV ENERGIES

Energies above 2 PeV which correspond to above 2 TeV in the centre-of-mass system could not be investigated at accelerators, and all experiments in this region were conducted in cosmic rays. For last several ten years many very interesting and unusual phenomena were observed (halos, alignment, Centauros and Anti-Centauros, penetrating cascades, long-flying component, etc.). Of course, cosmic-ray experiments have serious drawbacks in comparison with accelerator ones. As a rule, many parameters of interaction are unknown, even the type and the energy of interacting particles. Therefore interpretation of results of cosmic-ray experiments very often is not unambiguous. The striking example of such a situation is the existence of the knee in EAS energy spectrum in the atmosphere. More than 40 years of investigations did not give the final answer about its origin. And though at present the cosmophysical models of its origin are dominating, they cannot describe all experimental dependences obtained in different experiments.

Of course, some unusual events can be explained as chance coincidences or statistical fluctuations. Therefore, in order to prove that detected events are really unusual ones, extensive calculations are required. But there are many uncertainties on this way, since it is necessary to extrapolate our knowledge of interaction at accelerator energies to very high energies in cosmic-ray experiments. Additionally, it is necessary to remark that accelerator data are usually obtained for large transverse momenta p_t and small values of pseudorapidities η . In cosmic-ray experiments the situation is quite opposite (small p_t and large η). Therefore extrapolations in three variables are required: primary particle energy, transverse momentum and pseudorapidity. In these conditions, the attitude of the most part of physicists (especially of those working at accelerators) to unusual events observed in cosmic rays is rather skeptical. Besides, attempts to detect some unusual events at accelerators with energies below 2 TeV in the centre-of-mass system were unsuccessful.

Nevertheless, various unusual events are permanently detected in different experiments, and all attempts to explain them in the frame of existing theories and models remain unsuccessful. To discuss accumulated information and existing approaches to its explanation, during the 4th International Conference on Non-Accelerator New Physics (NANP'03) a special section «New Physics in Cosmic Rays around the Knee» was organized, at which 8 talks were presented. On the

basis of these talks, four papers were prepared in which main results presented at NANP'03 are summarized. Since in the talks at the conference various (sometimes opposite) points of view were described, the present survey consists of 4 parts prepared by different groups in order to reflect various approaches and points of view more exactly.

A. A. Petrukhin
Moscow Engineering Physics Institute
(State University)
S. A. Slavatinsky
P. N. Lebedev Physical Institute