Experiment BECQUEREL-2020 at Accelerator Complex NUCLOTRON/NICA

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Abstract

The phenomenon of dissociation of relativistic nuclei observed with a unique completeness in the nuclear track emulsion (NTE) makes it possible to study ensembles of nucleons and lightest nuclei of interest to nuclear physics and nuclear astrophysics. Individual features of the nuclei under study are manifested in probabilities of dissociation channels. Advantages of the NTE technique include unsurpassed resolution in determining emission angles of relativistic fragments and possibility of identification of He and H isotopes among them by multiple scattering measurements.

On this basis the cluster structure of the light stable and radioactive isotopes is examined in the BECQUEREL experiment at the JINR Nuclotron. In solving these problems young researchers are trained, methods of analysis modernized and production of NTE recovered. In particular, by the invariant mass of relativistic He and H pairs and triples in the dissociation of the isotopes ^{9}Be, ^{10}B, ^{10}C and ^{11}C the unstable ^{8}Be and ^{9}B nuclei are identified, and in the ^{12}C and ^{16}O dissociation — the Hoyle state [1]. According to the results of the experiment, a doctoral and six PhD's theses are prepared and few reviews published. The next problem is searching in the dissociation of the nuclei ^{14}N [2], ^{22}Ne and ^{28}Si the Hoyle state and more complex nuclear-molecular states.

The main task of the proposed BECQUEREL Experiment will be application of the NTE technique to study the low-density baryonic matter arising in the heavy nucleus dissociation. The temperature and density of this short-lived state are determined by the ratio of relativistic isotopes H and He and neutrons and their emission angles. NTE layers exposed to the NICA beams will serve as the research material allowing investigating nuclear ensembles of unprecedented multiplicity and diversity. To understand the mechanism of multiple dissociations of nuclei it is proposed to analyze fragmentation of the NTE down to their complete destruction of composing nuclei by relativistic muons. NTE irradiation by muons will be performed at CERN.

Effective solution of the assigned tasks requires investments in automated and computerized microscopes as well as improvement of the NTE technology. The project will serve as the basis for updating the traditional cooperation on the NTE use.

References

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