Contribution ID: **21** Type: **Oral report**

Hoyle state and unstable nuclei in relativistic nuclei dissociation

Monday, 12 October 2020 16:45 (25 minutes)

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 cluster physics and astrophysics [1]. The advantages of the NTE technique include a record space resolution in determining emission angles for recognition relativistic ^{8}Be and ^{9}B decays among the He and H projectile fragments. The decays are identified by the invariant mass M^* defined by the sum of all products of 4-momenta P_i of relativistic fragments He and H. The components P_i are determined by the fragment emission angles under the assumption of conservation a projectile momentum per nucleon. Recently, in the events of relativistic dissociation of ^{9}Be, ^{10}B, ^{10}C, ^{11}C nuclei were identified unstable ^{8}Be and ^{9}B nuclei by invariant mass approach [2]. The successful identification of ^{9}Be nuclei allowed us to cross to the problem of identifying triples of alpha particles in the Hoyle state (HS) in the dissociation of relativistic nuclei. Production of α-particle triples in the HS in dissociation of ^{12}C nuclei at 3.65 and 0.42 A GeV in NTE was investigated [3]. Contribution of the HS to the dissociation $^{12}\mathrm{C} \to 3\alpha$ is (11 $\pm$ 3) %. Analysis of data on coherent dissociation $^{16}\mathrm{O} \to 4\alpha$ at 3.65 A GeV is revealed the HS contribution of (22 $\pm$ 2) %. These observations indicate that it is not reduced to the unusual ^{12}C excitation and, like ^{8}Be, is a more universal object of nuclear molecular nature. Reanalysis of data on dissociation of heavier nuclei (Ne, Si, Kr and Au) pointed out to significant contribution of HS in the nα-channels. The analysis of the NTE layers exposed to relativistic ^{14}N nuclei is resumed in the HS context. Video collection of relativistic nuclei dissociation events in NTE obtained using a microscope and a digital camera can be found [4].

References:

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Session Classification: Section 2. Experimental and theoretical studies of nuclear reactions

Track Classification: Section 2. Experimental and theoretical studies of nuclear reactions.