The Hoyle state in relativistic dissociation of light nuclei

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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. The advantages of the NTE technique include a record resolution in determining emission angles of relativistic fragments and the possibility of identifying the He and H isotopes among them. On this basis the cluster structure of the light stable and radioactive isotopes is examined in the BECQUEREL experiment at the JINR Nuclotron [1]. 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 [2,3]. The successful reconstruction of the ^{8}Be and ^{9}B decays allows one to take the next step — to search in relativistic dissociation for triples of α-particles in the Hoyle state [4,5]. In this context the analysis of available data on the dissociation of relativistic nuclei ^{12}C, ^{16}O and ^{22}Ne in NTE was carried out. The contribution of the Hoyle state to the dissociation of $^{12}\mathrm{C} \rightarrow 3\alpha$ is 11%. In the case of the coherent dissociation of $^{16}\mathrm{O} \rightarrow 4\alpha$ it reaches 22% when the portion of the channel $^{16}\mathrm{O} \rightarrow 2^{8}\mathrm{Be}$ is equal to 5%.

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[4] D. A. Artemenkov *et al.* Rad. Meas., 119, 199(2018); https://arxiv.org/abs/1812.09096.
[5] D. A. Artemenkov *et al.* https://arxiv.org/abs/1904.00621.