

## Hoyle state and unstable nuclei in relativistic nuclei dissociation

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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  ${}^8\text{Be}$  and  ${}^9\text{B}$  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  ${}^9\text{Be}$ ,  ${}^{10}\text{B}$ ,  ${}^{10}\text{C}$ ,  ${}^{11}\text{C}$  nuclei were identified unstable  ${}^8\text{Be}$  and  ${}^9\text{B}$  nuclei by invariant mass approach [2]. The successful identification of  ${}^9\text{Be}$  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  $\alpha$ -particle triples in the HS in dissociation of  ${}^{12}\text{C}$  nuclei at 3.65 and 0.42 A GeV in NTE was investigated [3]. Contribution of the HS to the dissociation  ${}^{12}\text{C} \rightarrow 3\alpha$  is  $(11 \pm 3)\%$ . Analysis of data on coherent dissociation  ${}^{16}\text{O} \rightarrow 4\alpha$  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  ${}^{12}\text{C}$  excitation and, like  ${}^8\text{Be}$ , 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  $n\alpha$ -channels. The analysis of the NTE layers exposed to relativistic  ${}^{14}\text{N}$  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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4. The BECQUEREL Project. <http://becquerel.jinr.ru/movies/movies.html>.

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