REVIEW

BECQUEREL Project

First of all, I would like to make a remark about the language used in the text. The secondary problem, in this case, comes to the fore because the authors' vocabulary extremely complicates the understanding of the merits of the project. If in the case of "coherent ensembles of clusters that play an intermediate role in nucleosynthesis", one can still guess that we are talking about well-known nuclear resonances, then "quantum-electrodynamic interaction", "the study of nuclear structure in a cone of relativistic fragmentation", "kinematic characteristics of nuclear-astrophysical interest", and many more remained a mystery to me.

The proposals of the authors of the project can be described as very vague. First, in the section *Expected Results and Their Significance*, the authors report they expect to receive an answer on "the universal nature of the formation of triples of α-particles in the Hoyle state in the dissociation of ^{14}N and ^{28}Si nuclei". I absolutely cannot understand what the expression "the universal character of formation" means, on the basis of which the conclusion of universality can be drawn, and also what the consequences of such a conclusion could be. Let us suppose that "universal" means that the cross-section of the state population is large. How large does it have to be to be proved as universal? On the other hand, the authors say that the hypothesis of the Hoyle state "as a universal object like ^{8}Be" has already been confirmed. So ^{8}Be is an object of unconditional universality? How is this to be understood? The statement that "the Hoyle state is not reduced to the excitation of ^{12}C, but may arise as a 3α-partial analog of ^{8}Be" further complicates the understanding of the motives and intentions of the authors. What does it mean that one of the excited states of ^{12}C is not reduced to the excitation of ^{12}C, but "arises as an analog"?

Confirmation of the "universality" of the Hoyle state has allegedly already been obtained on ^{12}C, ^{16}O and ^{22}Ne beams by measuring the proportion of events corresponding to this state in the full spectrum of the invariant mass of 3 α-particles. This share ranged from 10 to 20%. Taking into account other channels of fragmentation of the original nucleus, it will obviously be significantly smaller, but the question is what information does this value carry? If we are talking about studying the cluster structure of the nucleus, the relationship of this value with the structure exists only in the context of theoretical models that are used to describe the results of the experiment.

However, the authors do not report on how this results can be interpreted in the framework of the model. The authors rightly point out that low energies are more suitable for the study of nuclear structure, but "the pause in applying the advantages of the relativistic approach" as "motivation for the further irradiation of nuclear energy stacks" looks extremely doubtful.

The *Expected results* section says nothing about finding exotic resonant states that decay into 4 α-particles, however, this task is mentioned in other sections. Such a state could be interesting to find, but for its search, it is necessary to justify the choice of the reaction in which it would be populated with an acceptable cross-section. The significance of such a state for nucleosynthesis is extremely doubtful, even if the width of such a state will be comparable to ^{8}Be widths and the Hoyle state, and it will decay with the emission of γ-quantum, simply due to the fact that the probability of interaction of two ^{8}Be is very small (the equilibrium concentration of ^{8}Be at a density of 10^5 g/cm^3 is 10 orders of magnitude lower than the density of α-particles).

For heavy nuclei, the authors propose to "select and document several dozen multiple dissociation events, set the distribution of the charge topology of the lightest fragments, to derive the distribution of the neutrons on the transverse momentum." In my opinion, the need for such “documentation” is not provided properly. The authors talk exclusively about what they intend to measure, but never mention what the purpose of these experiments is. What should the "charge topology of the lightest fragments", measured with a very modest (several dozen events) statistics, tell us? Is it possible to talk about a "unique precision" of the representation of the "dissociation structure", by registering only light products of fragmentation of heavy nuclei? What will serve as a criterion for confirming or disproving the "hypothesis about the possibility of studying rarefied nuclear matter in the dissociation of heavy nuclei"? How do the authors intend to establish the connection of neutron emission angles with their spatial distribution on the periphery of heavy nuclei?

Measurements of the transverse momentum distributions of neutrons and clusters in certain cases are of interest, but such experiments have been performed many times and I would like to understand what aspects of the nuclear structure of which nuclei are of interest to the authors.

In conclusion, I have to note that the physical justification of the proposed program does not look very convincing, and as a demonstration of "sustained interest in the topic" it would be worth citing not the number of downloads of the review [2], but the number of links to it.

The absolute advantage of the discussed technique is the simplicity of its application. The processing of the received information is so time and effort consuming that, as far as I understand, a very large amount of raw data has been accumulated over the years of measurements. If I am not mistaken, and this is indeed the case, it may be wise to spend time analyzing the data already available in order to find interesting events before continuing to increase this volume.