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V.Z. Goldberg, G.V. Rogachev
Cyclotron Institute, Texas A&M University, College Station, TX 77843, USA

The alpha clusterization manifests itself in remarkable and exotic structures in atomic nuclei. In particular, quasi rotational bands of levels with alternative parities and large alpha cluster reduced widths are well known in the light 4N nuclei (like 8Be, 12C, 16O…). The importance of this nuclear structure in astrophysics is also well recognized. Even if astrophysical reactions involving helium do not proceed through the strong α-cluster states, these states provide α width to the states that are closer to the region of astrophysical interest through configuration mixing.
While the phenomenon is known, a detailed explanation in the framework of the N-N interaction is absent [1,2]. The scarce experimental data on the single particle properties of the cluster states is partly responsible for this situation. Indeed, the α decay threshold is much lower than the nucleon decay in 4N nuclei, and, therefore, nucleon decays cannot be practically observed from the members of the cluster bands. In N≠Z nuclei, the nucleon decay threshold is close to that for α particle, and the penetrability factors do not inhibit the nucleon decay from the states in question. It is also possible to use mirror resonance reactions and apply the powerful approach of isospin symmetry to the investigations involving N≠Z nuclei. Of course, such studies involve unstable (Z>N) nuclei. Therefore, the experiments are difficult and need a new technique to study resonance reactions. The first measurements of the resonance reactions involving a pair of N≠Z nuclei were made in Ref. [3]. Since then, a few attempts to develop the field were made (see [4,5]].
I will review the history, the problems, and the prospective of these studies.

References

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Primary author: Dr GOLDBERG, Vladilen (Cyclotron Institute, Texas A&M University, College Station, Texas, USA)

Presenter: Dr GOLDBERG, Vladilen (Cyclotron Institute, Texas A&M University, College Station, Texas, USA)

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