Exotic shapes and exotic clusterization *

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The study of the possible clusterizations of extremely deformed nuclear states (e.g. superdeformed (SD) and hyperdeformed (HD)) are important from two aspects. On one hand they contribute to the understanding of the structure. On the other hand they can guide us in selecting the reactions which can populate these shape isomers. Recently we have applied symmetry-adopted methods for investigating different aspects of this problem.

The early chapters of the history of the HD state of the ^{36}Ar illustrates the efficiency of this approach. i) The first prdiction for the HD state came from an alpha-cluster calculation [1]. ii) The possible binary cluster configurations of this state (i.e. the reaction channels to populate it) were investigated systematically in [2]. The preferred ones turned out to be the ^{24}Mg+^{12}C and ^{20}Ne+^{16}O channels. iii) The recent analysis of experimental data revealed the exsistence of small-spin resonances in the ^{24}Mg+^{12}C scattering [3]. Together with higher-spin ^{20}Ne+^{16}O resonances [4] they seem to form a rotational band. Its moment of inertia is in a good agreemant with that of the predicted HD state. iv) The possible elongated shape isomers of the ^{36}Ar nucleus were determined from Nilsson-model + quasi-dynamical symmetry calculations [5]. This search gave the SD state in line with the other theoretical studies (at $4\hbar\omega$ excitation). It also gave a HD state which has a moment of inertia in agreement with the α-cluster model and experimental observation, and furthermore, it has the same U(3) symmetry, as suggested by the Brink-model.

The combination of arguments i-iv) makes the ^{36}Ar a good candidate for showing evidence for the ground, superdeformed and hyperdeformed states in a single nucleus. Work is in progress in order to find other favourable reactions (including gamma-decay) for the observation of the HD state. Applicatoin of the method to other nuclei are also mentioned.

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