Coexistense of cluster structure and mean-field-structure in medium-weight nuclei

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Nuclear structure dynamics has many degrees of freedom. As well known, relative motion between clusters is an important degree of freedom at least in light nuclei. It is usually considered that deformation of mean-field (for example, prolate shape, oblate shape and so on) is more important in heavier nuclei. However, it is an open problem whether cluster structure is important in medium- and heavy-weight nuclei or not. Recently, many superdeformed states are found experimentally in medium-weight nuclei. The relation between clustering and superdeformation is also an important problem.

We have studied positive parity states of ^{40}Ca by the antisymmetrized molecular dynamics + generator coordinate method. By Using two different kinds of constraints on the variational calculation, we have obtained basis wave functions with various structure such as mean-field-type structure, α-^{36}Ar cluster structure and ^{12}C-^{28}Si cluster structure. By superposing these wave functions, we have obtained a normal-deformed band and a superdeformed band. Each of them has a $K^\pi = 2^+$ side band due to there triaxial deformation. The moments of inertia and the electric transition strength are reproduced well, while theoretical excitation energies are higher than experimantal data. It was found that the normal-deformed band and superdeformed band have non-negligible α-^{36}Ar cluster component and ^{12}C-^{28}Si cluster component, respectively. We have also obtained a α-^{36}Ar higher-nodal band built above the normal-deformed band due to excitation of inter-cluster motion.

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