**Oblate-prolate Coexistence in $^{68}$Se**

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Nuclear shape transition and oblate-prolate coexistence are investigated in $N = Z$ nuclei of $fpg$ configuration space ($2p_{3/2}$, $1f_{5/2}$, $2p_{1/2}$, and $1g_{9/2}$). We perform shell model calculations and constrained Hartree-Fock calculations for $N = Z$ nuclei, $^{60}$Zn, $^{64}$Ge, and $^{68}$Se, employing an effective pairing plus quadrupole residual interaction with monopole interactions. We found shape transition from prolate to oblate deformation and oblate-prolate coexistence. The ground state of $^{68}$Se has oblate shape, while the deformation for $^{60}$Zn and $^{64}$Ge is prolate. It is shown that the isovector monopole matrix element between $f_{5/2}$ and $p_{1/2}$ orbitals gives rise to the oblate deformation in $^{68}$Se, and four-particle four-hole ($4p - 4h$) excitations are important for the oblate configuration.

The conventional shell model calculations in the $1f_{7/2}, 2p_{3/2}, 1f_{5/2}, 2p_{1/2}$, and $1g_{9/2}$ for $N, Z = 30 - 36$ are hopeless at present because of the huge dimension of configuration space. So we need to restrict the model space to the $2p_{3/2}, 1f_{5/2}, 2p_{1/2}$, and $1g_{9/2}$ orbitals (henceforth called $fpg$-shell), while the dimension of configuration space is still huge. For instance, maximum dimension for $^{68}$Se is 0.165 billion. We study shape transition and oblate-prolate coexistence [1] in $N = Z$ $fpg$-shell nuclei, $^{60}$Zn, $^{64}$Ge, and $^{68}$Se using a large scale shell model. The shell model calculations with huge dimension are carried out with recently developed shell model code. The oblate deformation is rare comparing with the prolate deformation well established experimentally. The reason for the suppression of oblate deformation lies in the higher order effects both in liquid drop terms and residual interactions that all favor prolate shapes. Very strong oblate-driving effects would be needed to overcome this prolate tendency. As a candidate of the oblate-driving force, we present the isovector ($T = 1$) monopole interaction with matrix element $V_m(f_{5/2}, p_{1/2}; T = 1)$ [2].

To investigate nuclear shape transition and oblate-prolate coexistence in $N = Z$ $fpg$-shell nuclei, we adopt the contrained Hartree-Fock (CHF) calculations, and found that the $T = 1$ monopole interactions with the matrix element $V_m(f_{5/2}, p_{1/2}; T = 1)$ play an important role for the oblate configurations in $^{68}$Se, while they do not contribute to those of $^{60}$Zn and $^{64}$Ge. The shape transition and oblate-prolate coexistence in the CHF calculations are consistent with those of the Skyrme HFB calculations. The oblate configurations originate in the $4p - 4h$ excitations from $(p_{3/2}f_{5/2})$ to $(p_{1/2}g_{9/2})$.

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