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An Abrupt Shape Transition between ^{84}Mo and ^{86}Mo : a New Island of Inversion at $N = Z$

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The shell structure of nuclei is the backbone of the nuclear theory. A large energy gap with the completely filled spherical orbitals defines shell closure and magic number. One of the intriguing experimental findings is the disappearance of shell closure at certain N and Z , which is not predicted from the classical shell model. This Island of Inversion (IOI) has been successfully explained through the shell model with variants of dynamical $SU(3)$ symmetry. The present work focused on the $N = Z$ nucleus ^{84}Mo in which we probed unexpected large deformation.

We measured the lifetime of the first 2^+ states in ^{84}Mo and ^{86}Mo using the plunger setup. The experiment was performed at the NSCL, Michigan State University. A 140-MeV/u ^{92}Mo beam bombarded a 235-mg/cm 2 ^9Be target to produce an ^{86}Mo secondary beam. The HPGe tracking array GRETINA and the TRIPLEX plunger were used to measure the first 2^+ state lifetimes. The extracted $B(E2; 2_1^+ \rightarrow 0_1^+)$ shows a salient difference between ^{84}Mo and ^{86}Mo , which departs from the similar $B(E2; 2_1^+ \rightarrow 0_1^+)$ trends between other $N = Z$ and $N = Z+2$ nuclides. DNO-SM and several theoretical approaches were employed to understand the behavior in the proton-rich Mo isotopes. The study revealed that the abrupt shape transition between ^{84}Mo and ^{86}Mo is due to the increase of energy gap between $g_{9/2}$ and $d_{5/2}$ orbitals, leading to different particle-hole configurations. The results can be interpreted as a fingerprint of the 3N nuclear force. The experimental finding and the interpretation set the boundary of IOI on the proton-rich side for the first time.

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