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ABSTRACT

Level density and thermodynamic properties of 69Zn nucleus

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Thermodynamic properties of 69Zn nucleus have been investigated by utilizing the nuclear level density (NLD), which were experimentally obtained from the γ-gated particle spectra. The experimental NLDs have been compared with the results of different microscopic calculations such as exact pairing plus independent-particle model (EP+IPM) at finite temperature, Hartree-Fock BCS (HFBCS), Hartree-Fock-Bogoliubov plus combinational (HFBC), etc. It is seen that the experimental NLDs can be well explained by the results of EP+IPM. Intriguingly, the heat capacity calculated using the best matched EP+IPM NLD exhibits a sharp S-shape, the signature of pairing phase transition, which is not expected in such odd-even hot or hot-rotating system as reported earlier. It was shown that the S-shaped heat capacity in such odd-even 69Zn nucleus is explained due to the deformation induced pairing correlation. In addition, several combination of NLDs and γ-ray strength functions (γSF) are used in TALYS code to constrain the NLD and γSF in calculating the neutron capture reaction 68Zn(n,γ)69Zn cross-section in nuclear astrophysics, which could help us to further optimize the uncertainties in the n-capture reaction rate and hence abundance of the elements.