Deformation of Ne isotopes in the island-of-inversion region

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Exploring the so-called "Island of inversion (IOI)", the region of unstable nuclei from ^{30}Ne to ^{34}Mg, is one of the most important current subjects in nuclear physics. In the IOI region, the low excitation energies and the large $B(E2)$ values of the first excited states are reported. This suggest strong deformations and indicates that the $N = 20$ magic number is no longer valid. This novel quantum property has triggered extensive experimental and theoretical studies on the IOI region.

In this study, we determined deformations of $^{20-32}$Ne with the fully-microscopic antisymmetrized molecular dynamics (AMD) model that has no adjustable parameter. The quadrupole deformation parameter determined is around 0.4 in the IOI region. This large deformation is found to give large reaction cross sections $\sigma_{\rm R}$ of the Ne isotopes. As a reaction model, the double folding model (DFM) with the Melbourne g-matrix [1] is adopted.

The results of $\sigma_{\rm R}$ calculated by the microscopic reaction model are shown and compared with experimental data [2] in Fig. 1. One sees the results agree well with data for $^{20,28-32}$Ne, if the projectile density is constructed

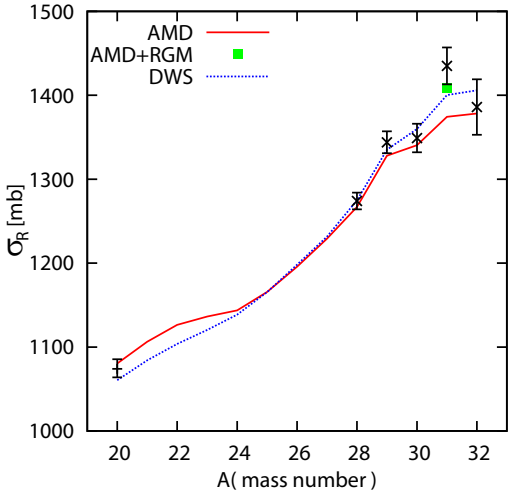

Figure 1: Reaction cross sections of Ne isotopes on ^{12}C at 240 MeV/nucleon. See the text for detail.

either (I) by the AMD with angular momentum projection (AMP) calculation (AMP-AMD) with the Gogny D1S interaction (solid line) or (II) by the Woods-Saxon mean-field model with the deformation obtained by the AMP-AMD calculation (dotted line). Method I has no adjustable parameter, but the tail of the density is inaccurate. We thus made a tail correction to the AMD density for ^{31}Ne by using the resonatin group method (RGM), AMD-RGM, which reproduces well the $\sigma_{\rm R}$ for ^{31}Ne (green square). An important conclusion is that method II is a handy way of simulating results of Method I including the tail correction. For other results and complete discussion, see Ref. [3].

References

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