

## Search for a halo nucleus in Mg isotope through the measurements of reaction cross sections towards the vicinity of neutron-drip line

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During the past several tens of years, our knowledges about the features of exotic nuclei have been much enhanced. In 1980s, neutron halo structure of neutron drip-line nucleus, which is one of the most notable abnormal features of exotic nuclei, have been found [1]. Since 1990s, the vanishing of the  $N = 20$  magic number for neutrons have been extensively studied and discussed in so-called island of inversion region, which includes neutron-rich Ne, Na, and Mg isotopes. In those studies, the inversion of amplitudes between  $sd$ -normal and  $pf$ -intruder shells has been considered along with nuclear deformation.

In this presentation, precise reaction cross section data for Mg isotopes, which have been recently measured at RIKEN, RI-beam Factory to probe nuclear sizes of Mg isotope will be reported. Using secondary beams from intense  $^{48}\text{Ca}$  beam (345 MeV/u) and BigRIPS fragments separator, reaction cross sections for  $^{24-38}\text{Mg}$  have been obtained, and especially large cross section of  $^{37}\text{Mg}$  has been observed for the first time. The deformation features of Mg isotope and the possible halo structure originated from  $pf$ -intruder shell in  $^{37}\text{Mg}$  will be discussed from the present data. The results of the analysis with the microscopic double-folding model (DFM) and anti-symmetrized molecular dynamics (AMD) calculation [2, 3] will be also introduced.

[1] I. Tanihata et al., Phys. Rev. Lett. 55, 2676 (1985).

[2] K. Minomo, T. Sumi, M. Kimura, K. Ogata, Y. R. Shimizu, and M. Yahiro, Phys. Rev. C 84, 034602 (2011).

[3] T. Sumi, K. Minomo, S. Tagami, M. Kimura, T. Matsumoto, K. Ogata, Y. R. Shimizu, and M. Yahiro, Phys. Rev. C. 85, 064613 (2012).