Abstract

Recent development of high-energy heavy-ion accelerators enables us to obtain the secondary radioactive ion beam of the very neutron-rich nuclei, which provides us the unique oppotunity to investigate the structures of nuclei far from the stability line. For some light nuclei on the neutron drip-line, some exotic phenomena that have not been observed for the stable region have been found. "Neutron halo" is one of such phenomena. This nucleus has a novel twofold structure composed of a core with normal nuclear density and a halo with very weak binding of the valence neutron(s).

Some halo nuclei have two-neutron halo system. This is a three-body system("core+n+n" where any two-body sub-systems("n+n"and "core+n") are unbound. This type of nucleus is called "Borromean", whose binding mechanism is not well understood. In this study, we report on the invariant mass spectrum of unbound nucleus ^{13}Be which is a component of Borromean halo nucleus ^{14}Be.

In the experiment, we measured the mass of ^{13}Be produced in the one-neutron stripping reaction of ^{14}Be at 70.18 MeV/nucleon on a carbon target. ^{13}Be breaks up into ^{12}Be + n system immediately, and we have measured the coincidence by using a magnetic spectrometer and neutron counters and deduced the invariant mass of ^{12}Be + n system in order to search for the resonance of ^{13}Be. In the relative energy spectrum we observed a asymmetric peak at about $E_{\mathrm{rel}} = 300$ [keV]. The spectral shape indicates the non-resonant continuum of ^{12}Be + n. This implies that ^{14}Be has s-wave valence neutrons, and thus ^{12}Be + n system is structureless due to no centrifugal barrier on this neutron. In this study, we have extracted the scattering length of ^{12}Be + n to be $a = -0.76 \pm 0.07$ [fm]. Such a small value indicates that the effective interaction between ^{12}Be and n is small. This result may be important to understand the binding mechanism of ^{14}Be.