Coulomb and Nuclear Breakup of Halo Nuclei

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We present recent experimental results on Coulomb and nuclear breakup of one-neutron halo nuclei, ^{11}Be, ^{19}C, and two-neutron halo nuclei ^{11}Li, ^{14}Be and ^{17}B at energies of about 70 MeV/nucleon at RIKEN. We have obtained the excitation energy spectra of these nuclei by measuring the momentum vectors of all the breakup particles and/or gamma rays in coincidence.

Coulomb breakup of halo nuclei is studied by using the heavy target of Pb. This aims at understanding 1) the reaction mechanism of Coulomb breakup, and 2) the application of Coulomb breakup to the spectroscopy of halo states. As for the first purpose, it is now well established that the direct breakup mechanism induces a very large E1 strength at very low excitation energies of about 1 MeV for halo nuclei. However there still remain issues on higher order excitation and the nuclear breakup contaminants in the dissociation process. We will discuss this problem by using the high-statistics data of the ^{11}Be breakup on Pb target. In particular the method of using the impact parameter information will be reported. As for the second purpose, we use the obtained $B(E1)$ distribution to extract the precise spectroscopic factor for the halo configuration. We will discuss the spectroscopy of ground states of two-neutron halo nuclei ^{11}Li, ^{14}Be and ^{17}B as well.

Nuclear breakup of halo nuclei is studied by using a light target of carbon. Its main purposes are 1) the reaction mechanism of nuclear breakup of halo nuclei 2) the study of discrete states above the neutron decay threshold. Kinematically complete measurements of breakup particles provide a unique opportunity to study the diffractive breakup, which is little known. The high statistics data on the ^{11}Be on C allows us to analyze the data in terms of the angular distribution as well as the relative energy spectrum in order to disentangle the reaction mechanism. In the breakup of ^{11}Be, we have observed two discrete states of ^{11}Be, indicating that the nuclear breakup is a useful spectroscopic tool. We will discuss the states in two-neutron halo nuclei as well.