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Lifetime measurements of RI beam and high-spin studies with degraded beams

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The development of RI beams has opened a wide region to study the nuclear structure far from the stability line. During the extensive studies of neutron-rich nuclei in the light mass region, new phenomena such as the disappearance of N=8, 20 magic numbers associated with the deformed ground states were revealed. Gamma-ray spectroscopy was employed for the study of the deformed structure. Based on the relatively low excitation energy of 2^+ state and the large B(E2) value, large deformation of the ground state was identified. Observation of the excited levels was thus far limited to the low-lying states, but the study of higher-spin states will be useful to understand the collectivity since a presence of a rotational band is one of the clear evidences of the deformed structure. In order to realize a high-resolution gamma-ray spectroscopy of exotic nuclei, we have developed a segmented Ge detector array, CNS GRAPE, and plan to investigate unstable nuclei in the heavier mass region. To study collective structures of unstable nuclei, we plan to perform life-time measurements of 2^+ and higher excited sates utilizing direct reactions with high-intensity fast RI beams. At present, RI beam factory (RIBF) at RIKEN has a potential to provide world's highest intensity. In addition, experiments using low-energy reactions are planned to study high-spin states. Previously, we have successfully developed an energy-degraded ^{46}Ar beam produced by the fragmentation of 64AMeV ^{48}Ca primary beam. It was used for a fusion-evaporation reaction with a ^{9}Be target. Gamma rays emitted from high-spin states were clearly observed. Same technique to make low-energy RI beam could be applied to heavier RI beams at RIBF and the study of high-spin states will be widely expanded. In the talk, lifetime measurements and studies of high-spin states of unstable nuclei far from the stability using high-efficiency position-sensitive Ge detector array at RIBF will be discussed.