

**PHYSICS DIVISION  
ARGONNE NATIONAL LABORATORY  
Special Heavy Ion Discussion Group**

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## **Shape Evolution of Neutron-Rich Midshell Nuclei Around $A \sim 160$ Studied by Gamma-Ray Spectroscopy**

Study of the nuclear deformation of unstable nuclei is important to understand how the shell effect drives macroscopic shape of nuclei to have different shapes at different proton or neutron numbers. Especially, nuclear properties of neutron-rich  $A \sim 160$  region is important since these may affect to calculations of the  $r$ -process abundance in astrophysics. Study of the shape evolution of unstable nuclei has been mainly based on quadrupole deformation so far. However, if higher-order deformations, such as octupole or hexadecupole deformation appear, it may change single particle structures significantly. Octupole and hexadecupole deformation are expected in neutron-rich isotopes and in neutron-rich isotopes, respectively. In stable nuclei, octupole and hexadecupole moments have been measured (beta3 in  $^{138}\text{Ba}$  and beta4 in  $^{148}\text{Nd}$  for example). However, the number of experimental studies on higher-order deformations in unstable nuclei are very limited so far, and it is not well known how such deformations appear and how those affect to the single particle levels. We have performed isomer and beta-gamma spectroscopy on neutron-rich  $Z = 56$  to  $66$  isotopes in which no excited states have been known before. Experiments were performed at RIBF, RIKEN Nishina Center by using in-flight fission of  $^{238}\text{U}$  for the production of neutron-rich nuclei far from stability. A cluster-type Ge detector array, EURICA was used to measure the gamma rays following isomer and beta decay of the implanted unstable nuclei. As a result, many new excited levels were discovered by both isomer and beta-gamma spectroscopy. In this talk, shape evolution of neutron-rich  $A \sim 160$  region including octupole and hexadecupole deformations will be discussed from the systematics of the excited states.

Thursday, October 6, 2016  
**11:00 a.m.**  
Building 203 Auditorium

**Please note different day, time, and location**