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Study of Nuclear Fragmentation using Isomeric States

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Nuclear fragmentation has been established as one of the most effective methods for producing fast beams of unstable nuclei at radioactive beam facilities. In nuclear fragmentation, a projectile nucleus collides with a target nucleus, producing fragments with significantly different proton and neutron configurations than the projectile.
The objective of this study is to understand the reaction mechanism of fragmentation and explore new methods for producing a wider variety of unstable beams, including those of isomeric states. The availability of isomer beams is expected to broaden the scope of nuclear reaction and structure studies.
The present study focuses on the roles of momentum and angular momentum transfer in nuclear fragmentation. This was achieved by investigating the production of nuclei around ^{52}Fe.

The experiment was performed at the SB2 course of HIMAC in Chiba. The primary beams of ^{58}Ni and ^{59}Co at 350 MeV/u bombarded a 14-mm thick ^{9}Be target.
Fragments of ^{52}Fe, ^{53}Fe, and ^{54}Co are momentum-analyzed by a magnetic fragment separator. The de-excitation gamma rays from ^{52}Fe(12+), ^{53}Fe(19/2-), and ^{54}Co(7+) were detected by four Ge detectors. Momentum distributions of these high-spin isomeric states and their ground states were extracted from the data.

By selecting specific isomeric states and comparing their momentum distributions with those of the ground states, we identified a correlation between angular momentum and parallel momentum transfer. This finding is in line with a classical model where the angular momentum and parallel momentum transfer is modelled as occurring on the nuclear surface. We also found a correlation between isomeric ratios and angular momentum transfer.
In this presentation, we summarize these findings and discuss the current understanding of reaction mechanisms of nuclear fragmentation.

Type of contribution

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Are you a student or postdoc?

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