Nuclear Science and Transmutation Research Division
Nuclear Transmutation Data Research Group
Slow RI Data Team

1. Abstract

This team is in charge of the development of low-energy RI beams of long-lived fission fragments (LLFP) or minor actinides (MA) from the ^{238}U by means of degrading the energy of beams produced by the BigRIPS fragment separator.

2. Major Research Subjects

Studies of the slowing down and purification of RI beams are the main subjects of the team. Developments of devices used for the slowing down of RI beams are also an important subject.

(1) Study and development of the slowed-down methods for LLFP
(2) Operation of the BigRIPS separator and supply the low energy LLFP beam to the experiment in which the cross sections of LLFP are measured at the low energy
(3) Development of MA (such as Np) beams for the nuclear data
(4) Development of the framework to seamlessly handle device, detector, DAQ, and analysis for the easy control of the complicate slowed-down RI beam production and its development

3. Summary of Research Activity

A new OEDO beam line, designed for the slowed-down RI beams, was constructed under the collaboration with CNS, the University of Tokyo. Our group was responsible for the construction of the infrastructure such as the cooling water and the electrical equipment, and the movement and alignment of existing vacuum chambers, quadrupole magnets. The power supply for the Superconducting Triplet Quadrupoles (STQ) was made, which had a stability also under the low current condition.

Slowed-down ^{93}Zr beams with 20 or 50 MeV/nucleon were successfully developed at June 2016 for the first time. The methods to obtain the narrow energy, position, and angle distribution were developed. The methods of the energy adjustment and the particle identification at 50 MeV/nucleon were developed. The ^{93}Zr and ^{107}Pd beams with 50 MeV/nucleon were produced for the nuclear-transmutation experiments using proton or deuteron targets in October 2016. The commissioning experiment of the OEDO beam line was successfully performed at June 2017. The first transmutation experiments using OEDO beam line were performed with ^{93}Zr, ^{107}Pd, and ^{79}Se around 20 MeV/nucleon.

With our developments, the slowed-down RI beams became ready for the transmutation experiments. On the other hand, the procedure to make the slowed-down RI beams became highly specialized. In order to easily produce the slowed-down RI beam, the framework, called BYACO, is being developed to seamlessly handle the device, detector, DAQ, and analysis. The procedure of the RI-beam energy control was implemented in the web application. The BYACO system was used also for an RI-beam automatic tuning project by the BigRIPS team.

The extension of the RI-beam separation using the $B\rho$-ΔE-$B\rho$ method by the charge state of RI beam was found to be essential to produce the heavy RI beams. The simulation tool of this extended separation, called Q+ separation, was developed and implemented into BYACO in 2021. With this tool, we succeeded to produce a ^{237}Np beam as a secondary beam by collaborating mainly with the fast RI data team and the BigRIPS team.

Members

Team Leader

Toshiyuki SUMIKAMA

Visiting Scientist

SungHan BAE (Inst. for Basic Sci.)

Student Trainees

Hiroya FUKUDA (Kyushu Univ.)
Misaki SAITSU (Kyushu Univ.)
Masaya OISHI (Kyushu Univ.)