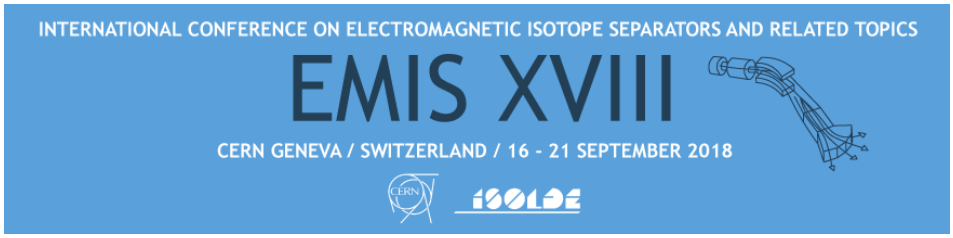

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New control method of slowed-down RI beam and new particle-identification method of secondary-reaction fragments at RIKEN RI beam factory

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The energy of the RI beam is one of the most important parameter for reaction studies. At RIKEN RI beam factory (RIBF), the energy around 200 MeV/u is easily available because the primary-beam energy is 345 MeV/u. Spectrometers and beam-line detectors are optimized to this energy region. On the other hand, for the transfer reaction, the multi-nucleon transfer reaction, and the fusion reaction, the energy around the Coulomb barrier is required. The lower energy is also awaited to determine the energy dependence of the spallation cross sections for the long-lived fission products (LLFPs) to search for a nuclear transmutation scheme of LLFPs [1]. The first experiment with ^{82}Ge beam was demonstrated to produce the slowed-down RI beam using the BigRIPS fragment separator at RIBF [2]. The beam energy with 13 MeV/u was successfully achieved. However, a control method about the absolute beam energy and the distributions of the energy, position, and angle was not established. The particle identification method designed for the higher energy couldn't be applied to the fragments with such low energy.
In the present study, we established new control methods by changing the material thickness, momentum selection, slit setting coupled with new ion optics mode. For example, the beam energy of 20.2 MeV/u was obtained for the 20 MeV/u setting of the ^{93} beam. A new particle-identification (PID) method was also developed. The combination of Bρ-TOF-ΔE-E-Range was obtained by using the momentum dispersive mode of the ZeroDegree spectrometer coupled with the multi sampling ionization chamber. The demonstration of PID with the 50 MeV/u ^{93}Zr beam will be presented. The capability to the lower energy will be discussed.

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[1] H. Wang et al., Phys. Lett. B 754, 104 (2016).
[2] T. Sumikama et al., Nucl. Instr. Meth. B 376, 180 (2016).

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