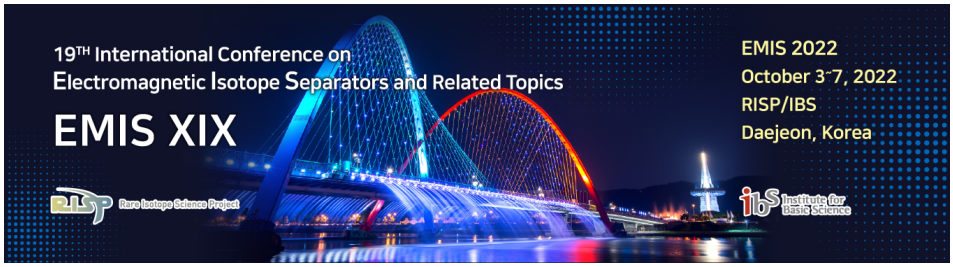

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Development of new ionization chamber specialized in high-Z beam

Tuesday, 4 October 2022 11:50 (20 minutes)

RI Beam Factory (RIBF) at RIKEN Nishina Center for Accelerator-Based Science provides various RI beams from 238U 345 MeV/u primary beam. Here we report the new experimental results on high-Z beam production. The ionization chamber (IC) for energy-loss measurement is an essential detector for deducing the atomic number (Z) in flight in the BigRIPS spectrometer to identify the particles. The conventional IC with a low-cost gas mixture of 90% argon and 10% methane does not provide sufficient Z resolution for high-Z beams, especially Z>80 region, around 200-250 MeV/u which is a typical energy at RIBF.

Because the high-Z beam is more likely to capture electrons in material than the low-Z beam, which mostly keeps fully stripped, the number of charge-state changes in the IC gas affects the energy-loss distribution. For example, He-like state of U beam at 200 MeV/u, which is the most abundant charge state in material, changes the charge state approximately four times in the IC with the argon-based gas mixture, which is not sufficient for the energy-loss measurements. To enhance the Z resolution of the high-Z particles, xenon gas with an larger cross section of the charge-state changing is promising. Approximately 70 times of the charge-state changes of U beam at 200 MeV/u in the IC with a gas mixture of 70% xenon and 30% methane are expected to narrow the width of the energy-loss distribution.

The Z resolution of the IC with the argon-based and xenon-based gas mixtures was measured at BigRIPS using cocktail beam in the Z=60-90 region with 200-240 MeV/u. The results show the xenon-based gas mixture dramatically improves the Z resolution for Z>70 particles compared with the argon-based gas mixture. Furthermore, the xenon gas was found to be effective for the Z identification in this energy region, since the same energy-loss is obtained for even different incident charge states. In conclusion, the xenon-based gas IC strongly promotes the beam delivery of the high-Z region with the clear particle identification from BigRIPS spectrometer.

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