First confirmation of stopped RIs at parasitic gas cell with new approach

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We are developing a scheme of parasitic low-energy RI-beam production (PALIS)[1)] in the second focal chamber (F2) of BigRIPS to establish the effective utilization of rare isotopes and to perform comprehensive measurements of the physical properties of exotic nuclei.

From previous experimental results,[2)] we figured out that very intense radiation stays around the high-energy beam passage in F2. Under an intense radiation environment, a strong plasma can easily be created inside the PALIS gas cell, which prevents the stopped RIs from proper extraction. Therefore, we applied a new approach to transport the stopped RIs from the strong plasma via a long gas tube towards a lower-radiation environment. This concept is similar to the "helium-jet" technique, but the present approach does not use aerosols. In this beam time, we investigated the feasibility of this new approach by using alpha emitters produced by projectile fragmentation via a uranium beam and beryllium target.

Figure 1 shows a schematic of the experimental setup.

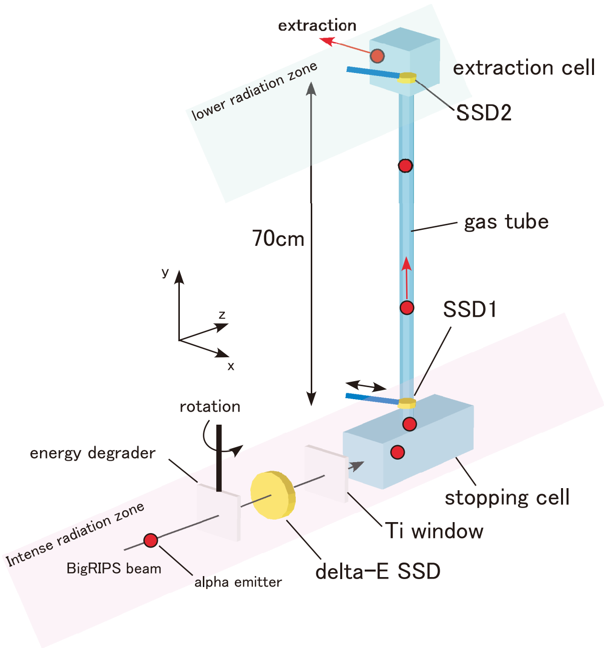

Fig. 1. Experimental setup.

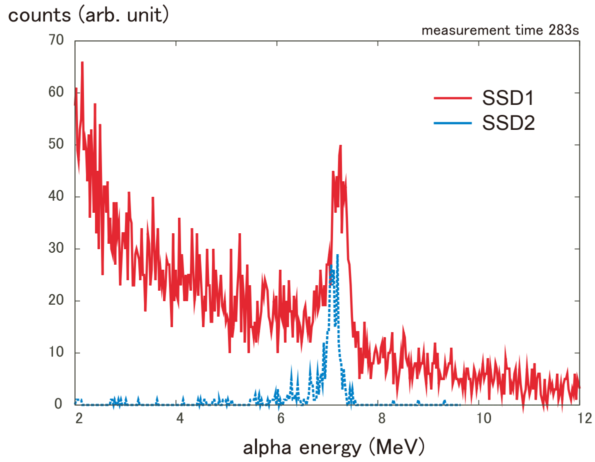

Fig. 2. Alpha spectra observed by SSD1 and SSD2.

The gas cell is separated into two parts: a stopping cell and an extraction cell which are joined with a 70-cm-long and thin gas tube. High-energy alpha-emitter beams were introduced to the stopping cell. The BigRIPS optical parameters were set to those in Sumikama *et al.*'s experiment.[3)] Firstly, we confirmed alpha rays created via decays from the alpha emitters that were stopped in the delta-E SSD by adjusting the energy degrader. By decreasing the degrader thickness, those observed alpha emitters were stopped inside the gas cell filled with argon gas at 0.5 to 1 atm. The alpha emitters stopped in the stopping cell were transported to the extraction cell by a gas jet, where the radiation intensity is at least 100 times lower than in the stopping cell. We observed a part of the alpha emitters that were accidentally incident on the silicon pin-diode (SSD1) surface facing the flow path at the entrance of the gas tube. Finally, we could confirm the alpha emitters by inserting another silicon pin-diode (SSD2) in the flow path at the end of the gas tube. Figure 2 shows the alpha spectra observed at SSD1 and SSD2.

The feasibility of the new gas cell structure was verified for the first time. In the next beam time, we will evaluate the extraction efficiency and apply laser ionization for those alpha emitters.

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