The result of electron scattering with Xe isotopes at SCRIT electron scattering facility

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Self-Confining Radioactive Ion Target (SCRIT) electron scattering facility[1)] was constructed to perform electron scattering experiments for short-lived unstable nuclei. SCRIT is a unique technique to achieve a luminosity of 10^{27} $cm^{-2}s^{-1}$ via the trapping of a few target ion that is, 10^8 particles/pulse, along the electron beam.

We have started a series of measurements of isotope ($Z = 50$) and isotone ($N = 82$) dependence of nuclear charge density distribution. These studies use the nuclei of Xe isotopes (^{138,136,134,132,130,128,126,124}Xe) and $N = 82$ isotones (^{138}Ba,[2)] ^{137}Cs,[3)] ^{136}Xe, ^{132}Sn) including the ^{132}Sn and ^{137}Cs, unstable nuclei. The Xe isotope has the second most stable nuclei after Sn; however, no electron scattering data is available, except for ^{132}Xe,[4)] which was measured at the SCRIT facility. These isotope and isotone dependencies should provide invaluable information for theoretical development.[5,6)]

In 2022 July, we conducted the electron scattering experiment using ^{136,134,132,130}Xe targets. The Xe target was ionized with FEBIAD-type ion source by injecting natural Xe gas directly into the ionization chamber inside the ERIS.[7)] The ionized Xe was mass-separated by a bending magnet installed after ERIS. After cooling and stacking inside the FRAC,[8)] almost 10^8 of mass-specific Xe ions/pules were transported to the SCRIT system at a frequency of 1 Hz. Experiments with ^{136}Xe were performed at both 150 and 250 MeV, whereas the experiments with ^{134,132,130}Xe were only performed at 150 MeV. Further, the beam current was 250 mA at the beginning of the data acquisition and reduced to 150 mA at the end. Figure 1 shows the yield distributions of ^{136}Xe with momentum transfer following acceptance corrections. The solid lines represent the calculated ones using the theoretical charge density distribution of ^{136}Xe[5)] using the phase shift calculation code DREPHA.[9)] The total experimental time and average luminosity of each experiment is presented in Table 1. Average luminosities were measured by a luminosity monitor.

The ^{124}Xe, which is scheduled to be launched soon, has a smaller abundance ratio than other Xe, thus, we have upgraded ERIS and have already achieved a production rate similar to that of ^{136}Xe. From 2023, we will conduct experiments on the remaining Xe and proceed with further analysis.

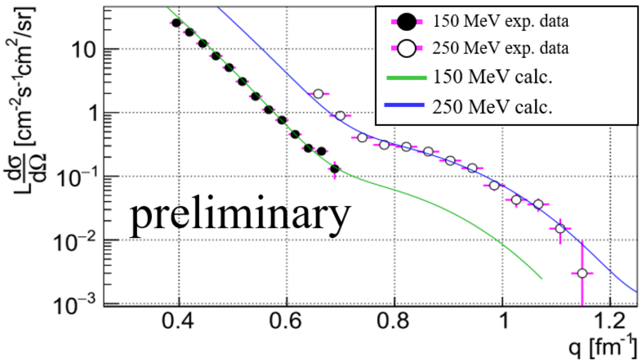

Fig. 1. Yield distributions of ^{136}Xe with momentum transfer following acceptance corrections. Filled and opened circles indicate preliminary results from this study. The solid lines are the phase-shift calculated values obtained using a theoretically calculated charge-density distribution of ^{136}Xe.[5)]

Table 1. Experimental situation.

Nuclei	Beam Energy [MeV]	Total Exp. time [s]	Lumi. ave [$\times 10^{27}$ $cm^{-2}s^{-1}$]
^{136}Xe	150	1.94×10^5	1.55
^{136}Xe	250	4.28×10^5	2.08
^{134}Xe	150	1.18×10^5	1.66
^{132}Xe	150	0.90×10^5	1.69
^{130}Xe	150	1.29×10^5	1.33
total		9.59×10^5	

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