Electron scattering off ^{208}Pb and ^{132}Xe at SCRIT electron scattering facility

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The SCRIT (Self-Confining Radioactive Isotope Target) electron scattering facility has been constructed at RIKEN to realize electron scattering off unstable nuclei[1)]. This year, commissioning studies of the spectrometers WiSES (Window-frame Spectrometer for Electron Scattering) and LMon (Luminosity Monitor) have been performed with several stable targets. The studies of LMon are reported elsewhere.[3,4)] Here, some results with WiSES for ^{208}Pb and ^{132}Xe targets are reported.

Since ^{208}Pb is one of the most extensively investigated stable nuclei and the form factor is precisely derived by electron scattering,[2)] it is the best target to check the spectrometer performance. The ^{208}Pb ion was extracted from the evaporation of natural lead heated up to 300°C and transported into SCRIT by ERIS[5)] and FRAC.[6)] The number of ions introduced was about 10^8 particles/pulse, and the achieved luminosity was about 10^{27} cm^{-2}s^{-1} on average. The acceptance of WiSES was evaluated by Geant4 simulation taking into account the influence of the radiation tail. Figure 1 shows the differential cross sections multiplied by luminosity for elastic electron scattering off ^{208}Pb. By changing the electron beam energy, a wide range of momentum transfer can be covered. The line represents a phase shift calculation with the nuclear charge density distribution modeled as a sum-of-Gaussian function.[2)] The luminosity is considered as a fitting parameter in the present analysis because the study of the LMon to determine the absolute value of luminosity is underway. The momentum-transfer dependence is well reproduced by the calculation.

Figure 2 shows the same plots for elastic electron scattering off ^{132}Xe. The number of introduced target ions and the achieved luminosity were approximately the same as those for ^{208}Pb. The parameters of a two-parameter Fermi distribution in the elastic scattering calculation are determined to reproduce our data. The contribution of inelastic scattering[8)] contaminated because of momentum resolution is negligibly small, as shown in the figure. Although ^{132}Xe is a stable nucleus and the root-mean-square radius is evaluated from the measurement of X-rays from muonic atoms,[7)] electron scattering has never been performed. This work is, therefore, the first to determine the charge density distribution of ^{132}Xe. This result will be published soon.

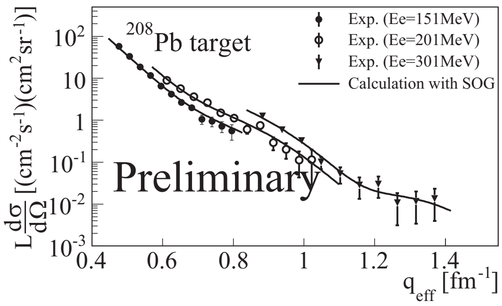

Fig. 1. Differential cross sections of ^{208}Pb(e,e) multiplied by the luminosity for the effective momentum transfer at E_e=151, 201, and 301 MeV. The line is a phase shift calculation with the nuclear charge density distribution modeled as a sum-of-Gaussian function.[2)]

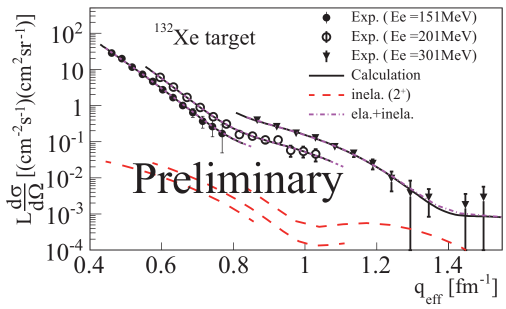

Fig. 2. Differential cross sections of ^{132}Xe(e,e) multiplied by the luminosity for the effective momentum transfer at E_e=151, 201, and 301 MeV. The lines are a phase shift calculation with the nuclear charge density distribution modeled as a two-parameter Fermi distribution (solid), contributions of inelastic scattering calculated by a beyond relativistic mean field theory[8)] (dashed), and their sum (dot-dashed).

References

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