Electron scattering spectrometer for the SCRIT project

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We have developed the magnetic spectrometer system[1)], WiSES (Window-frame Spectrometer for Electron Scattering), for electron scattering on short-lived nuclei at the SCRIT electron scattering facility. The WiSES consists of a dipole magnet[2,3)], FDC(Front Drift Chamber), RDC(Rear Drift Chamber)[4)], plastic scintillator hodoscope, and a helium bag. Figure 1 shows a schematic view of the WiSES and SCRIT system[5)]. The layer configulation of the drift chambers is XX'XX' for FDC and VV'UU'XX'VV'UU' for RDC. The gas of drift chambers are He+CH_4 (50:50) at this time. The combination of FDC and RDC enables reconstruction of the trajectory of electrons in the magnetic field and estimation of the momentum. Our goal of momentum resolution is $\delta p/p \sim 1\times10^{-3}$ for 300 MeV electron. The solid angle of the spectrometer is evaluated to be 83 msr by a simulation. The plastic scintillator hodoscope is used to generate trigger signals. A detail of the data acquisition system is reported elsewhere[6)]. The helium bag made of vinyl sheets of thickness 30 μm is installed between FDC and RDC to reduce the multiple scattering of electrons.

In December 2014, a commissioning experiment was carried out to evaluate the performance of the WiSES and the luminosity monitor system[7)]. A tungsten wire of diameter 50 μm was mounted in the SCRIT, and its position could be controlled remotely; this wire was used as a target. Because the differential cross section of electron elastic scattering on the tungsten target is well known, we can estimate the performance of the spectrometer by checking the reproducibility of the differential cross sections. In Fig. 2, preliminary results for the electron beam energy at 150 MeV are shown. Electrons elastically scattered from the tungsten wire are found as a peak in the vertex point and momentum distribution, and their resolutions are evaluated to be approximately 10 mm and 6×10^{-3}, respectively. These resolutions will be improved by further analysis. The obtained angular distribution is well reproduced by a simulation in which the differential cross section of the elastic scattering on the tungsten target is estimated by a DWIA calculation.

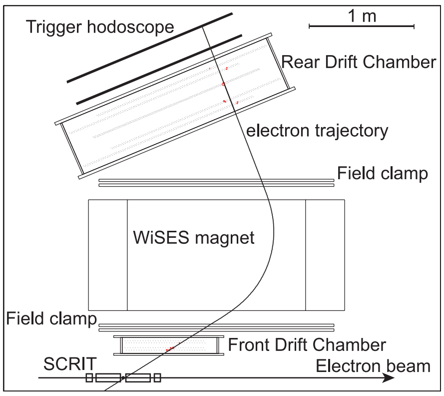

Fig. 1. Schematic view of the WiSES. A trajectory between FDC and RDC was reconstructed by a Runge-Kutta calculation. The space between FDC and RDC was filled with helium.

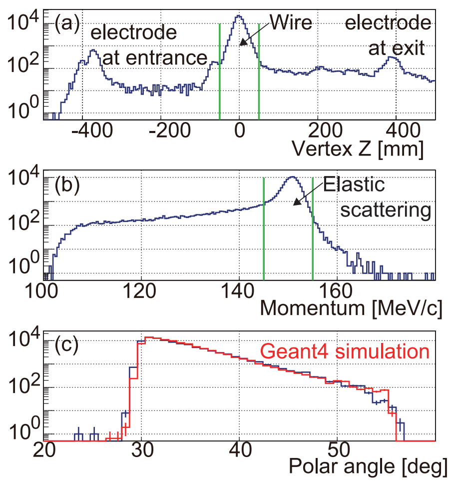

Fig. 2. Preliminary results for the electron energy at 150 MeV. (a) Vertex point distribution along the beam line. A clear peak of electrons scattered from the tungsten wire can be seen. (b) Momentum distribution of electrons from the tungsten wire. A clear peak corresponding to the elastic scattering can be seen. (c) Polar angle distribution of the elastically scattered electrons. The red line shows the simulation using the differential cross section estimated by a DWIA calculation.

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