

Construction of a Single-Wire Position-Sensitive Proportional Counter for Magnetic Analysis of Low Energy Electrons

著者	Kageyama K., Fujioka M., Hayashibe S., Ishimatsu T.
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Kageyama K., Fujioka M.*, Hayashibe S. and Ishimatsu T.
Department of Physics, Faculty of Science, Tohoku University
Cyclotron and Radioisotope Center, Tohoku University*

A single-wire position-sensitive proportional counter (PSPC) for magnetic analysis of low energy electrons is under construction. This counter is to be fitted to the iron free $\pi\sqrt{2}$ magnetic spectrometer at Institute for Nuclear Study, University of Tokyo. A calculation¹⁾ shows that this spectrometer can be used as a broad range spectrometer with a momentum resolution of 0.01 % over a momentum range of ± 2.5 % corresponding to a focal length of 150 mm.

The design aim of the PSPC is a position resolution of 1.5 mm (a momentum resolution of 0.05 %) for 23.9 keV conversion electron from ^{119}Sn over a length of 120 mm. One of the most important problems to attain this aim is to hold down the deterioration of position resolution due to electron scattering in the entrance window and the counter gas. To solve this problem, the entrance window is made of a polypropylene film of $100 \mu\text{g}/\text{cm}^2$ thickness supported on stainless steel meshes of 90 % transparency, and an anode wire is fixed at a distance of 1.5 mm from the entrance window.

The anode is a nichrome wire 10 μm in diameter, 160 mm in length and 11 Ω/mm in resistivity. Since the anode voltage is limited to a relatively low value for small thickness of the counter, it is needed to operate the counter at a gas pressure as low as 200 torr to obtain a gas multiplication high enough for satisfactory performance. A gas handling system was constructed to prepare a constant flow of counter gas at this low pressure, and performance tests of the system have been successful.

The position resolution of the present PSPC due to electron scattering has been estimated as a function of electron energy by using Molière's theory of multiple scattering.²⁾ Figure 1 shows the results for a gas pressure of 200 torr. The upper curve in fig. 1 is the estimated position resolution due to the window and counter gas, and the lower curve is that due to the counter gas only. It can be seen that in the case of the present PSPC the position resolution due to electron scattering is practically determined by the polypropylene window.

References

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- 2) Molière G., Z. Naturforsch. 39 (1948) 78.

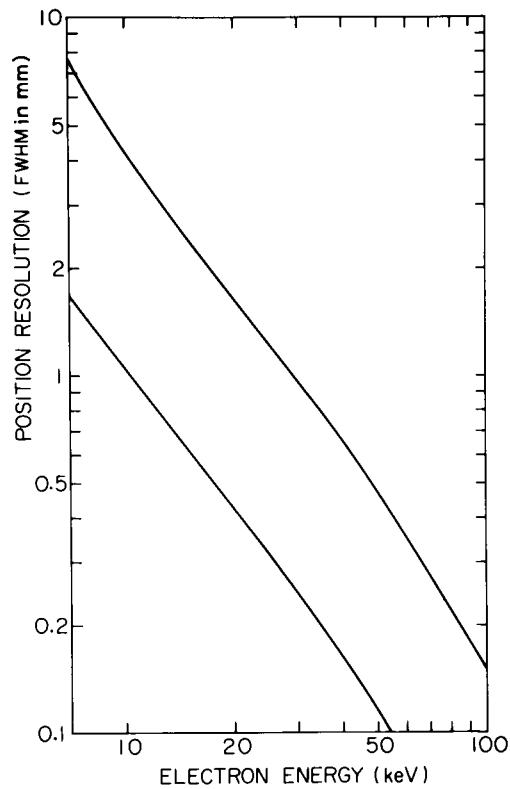


Fig. 1. Estimated position resolution of the present PSPC as a function of electron energy. The upper curve is the position resolution due to electron scattering in the entrance window and counter gas. The lower curve is the contribution of the counter gas.