(LNS Experiment : #2608)

Performance Test of a Wire Sampling Calorimeter with Positron Beam

K.Y. Baik[1], T. Kamibayashi[2], G.Y. Lim[3], L. Ogata[4], T. Shimogawa[4], and Y. Tajima[2]

[1]*Department of Physics, Pusan University, Busan Korea, 609-735*
[2]*Department of physics, Yamagara University, Yamagata, 990-8560*
[3]*IPNS, KEK, Tsukuba,305-0801*
[4]*Department of Physics, Saga University, Saga, 840-8502*

We have performed a beam test for a wire sampling calorimeter made of alternating tungsten wires and scintillating fibers. The calorimeter shows energy resolution as σ/E=13.2 % at the 1 GeV, which is mainly due to sampling fluctuation of electromagnetic shower.

§1. Introduction

The motivation of a wire sampling calorimeter is to make a dense calorimeter (short radiation length (X_0)) having a high detection efficiency for low energy photons. By using tungsten wires as a converter, we can achieve its radiation length (X_0)) as 0.7cm shorter than that of the PWO crystal. We use scintillating fibers as an active detector that enables us to extract the scintillation light to the PMT with small attenuation. By using small cross-sectional fibers, we can achieve high detection efficiency especially for the low energy photons. It is another attractive feature of the wire calorimeter to adjust radiation length by proper selecting of the converter material and to produce a long calorimeter module quickly with low cost.

§2. Module Fabrication and Beam Test

Figure 1 shows a photograph of fabricated module consisting of alternating 1mm-square tungsten wires and scintillation fibers. Figure 2 shows energy resolution of the calorimeter as a function of incident positron energy. We got the energy resolution as σ/E = 13.2 % at 1 GeV, which is mainly determined by a sampling fluctuation due to poor visible ratio. The attenuation length of the calorimeter was obtained 102 cm, which agreed with the result of the single fiber test with a radioactive source.

§3. PWO Test

An additional test was performed during the beam time: a measurement of position dependency at the glued PWO crystal. A 50-cm long PWO crystal is a candidate of a beam collar calorimeter. Instead of fabricating such a long crystal, we try to glue two crystals that is an effective way. Since the light output is very sensitive to the condition of glue, we have tested several candidates of glues. The result of bench

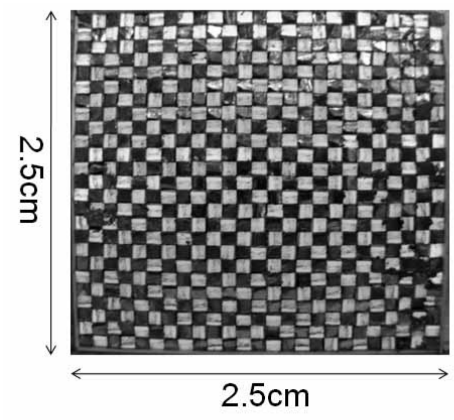

Fig.1. Cross-section of the wire sampling calorimeter made of 1mm-square tungsten wires and scintillation fibers.

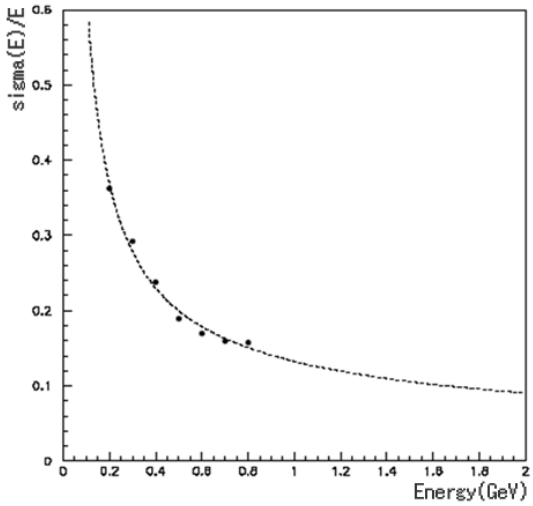

Fig.2. Energy resolution of the wire sampling calorimeter responding to the incident positrons.

test by using the cosmic rays was not conclusive due to its small energy deposit and poor statistics. With the positron beam, we could check the position dependency of the light yield. As shown in Fig. 3, the light output was dropped by 12% due to the joint, which will guide us to further study.

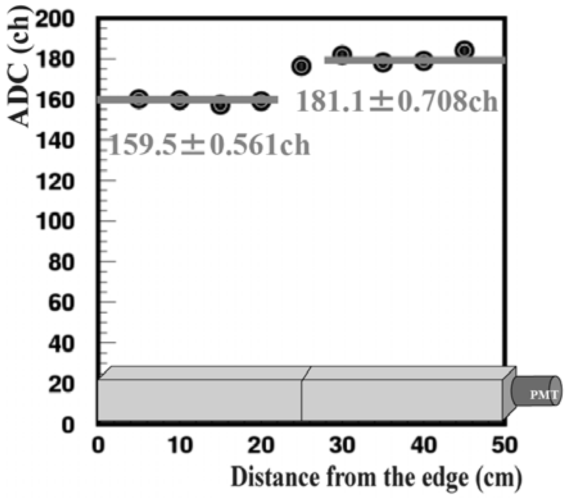

Fig.3. Position dependency of light yield. At the boundary of two adjoint crystals, 12% of light was lost.

Acknowledgment

The authors are grateful to Prof. H. Shimizu, Dr. T. Ishikawa and other LNS staffs for their various help and stable operation of the accelerator during the beam test. This work has been supported by a Grant-in-Aid (#18540302) from JSPS.