

Development of new ionization chamber for low energy heavy ions

N. Chiga,^{*1} A. Hirayama,^{*1,*2} K. Chikaato,^{*1,*3} K. Nakano,^{*1,*4} J. Suwa,^{*1,*4} S. Kawakami,^{*1,*5}
S. Takeuchi,^{*1,*2} D. Suzuki,^{*1} T. Sumikama,^{*1} and H. Otsu^{*1}

A new multiple-sampling ionization chamber (MUSIC) was developed for the ImPACT experiment¹⁾ in which measurements at 50MeV/nucleon were performed. A charge is read from pads divided into fifteen units in the beam direction. All fragments produced by the secondary reaction at the F8 focal plane were stopped inside of the MUSIC, and a ranges and the energy loss of the incident particles were measured in each segmented pad. To measure the fragments of different ranges at the same time, the length of the effective area in the beam direction is required to be approximately 750 mm, although the length of a previous MUSIC²⁾ at F11 was 480 mm. The previous MUSIC had many anode and cathode films on the beam trajectory; therefore, a large energy loss in the films near the Bragg peak cannot be measured. In order to overcome these demerits, the new MUSIC, which has an effective length of approximately 750 mm and consists of only counter gas in the effective area, was developed. The size of the new ionization chamber is summarized in Table 1.

Figure 1 shows a field cage and a readout pad with Frisch-grid. A high voltage of 4 kV is applied between top and bottom plates, and the electrons are drifted to the top (anode) side. An entrance window with vaped Au electrodes on a Mylar film with uniform thickness of 4 μm was adopted to uniform a thickness of substance. Fig. 2 shows a contour plot of the electric-field gradient inside the detector by GARFIELD³⁾. The electric-field gradient inside the cage was zero. The Frisch-grid was used to decrease the effect of charges induced by ions for readout pad. The Frisch-grid is made in consideration of the aperture to the pad and the uniformity of the electric field. The drifted electrons pass through the Frisch-grid and are detected in a readout pad. The readout pad show the backgammon electrode structure⁴⁾ for position sensitivity. The size of one unit is 50.5 \times 280 mm. The readout pad consists of 15 units of electrodes, and the total size of the effective area is 757 \times 280 mm. The MUSIC was successfully operated in the ImPACT experiments in autumn 2016¹⁾. Analysis of particle identification is in progress.

This work was funded by ImPACT Program of Council for Science, Technology and Innovation (Cab-

inet Office, Government of Japan).

Table 1. Specifications of ion chamber.

Effective area (X \times Y \times Z)	260 \times 170 \times 757 mm ³
Electric field cage size	369 \times 194 \times 780 mm ³
Gas box size	700 \times 440 \times 1000 mm ³

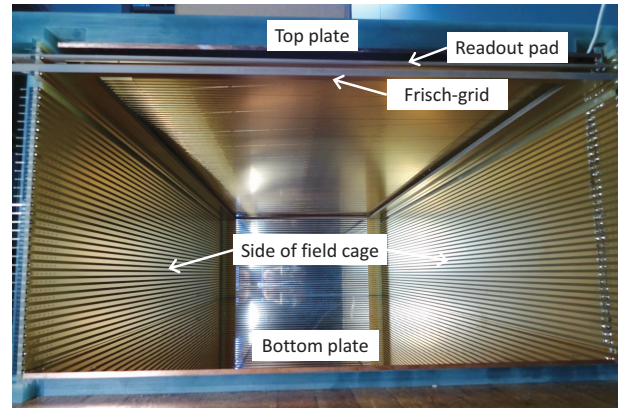


Fig. 1. Photograph of a field cage and a readout pad with a Frisch-grid.

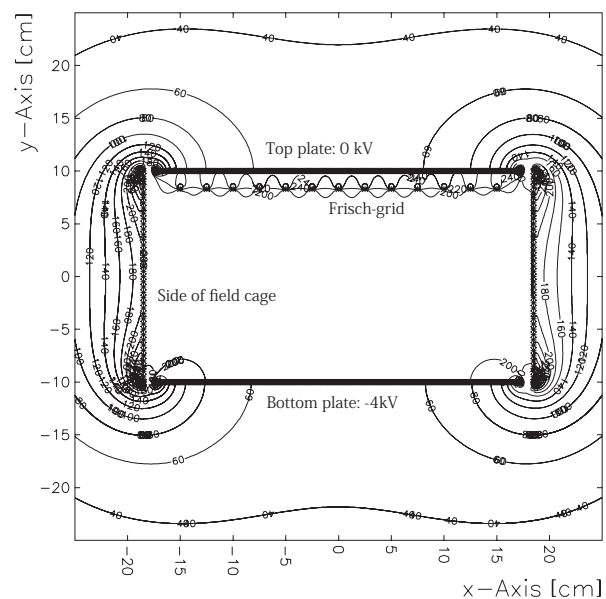


Fig. 2. Contour plot of the electric-field gradient calculated using GARFIELD.

*1 RIKEN Nishina Center

*2 Department of Physics, Tokyo Institute of Technology

*3 Department of Fundamental Sciences, Niigata University

*4 Department of Advanced Energy Engineering Sciences, Kyushu University

*5 Department of Applied Physics, Faculty of Engineering, University of Miyazaki

References

- 1) T. Sumikama et al., in this report.
- 2) H. Otsu et al., RIKEN Acc. Prog. Rep. **42**, 163 (2009).
- 3) R. Veenhof., GARFIELD, a drift-chamber simulation program, CERN (1994).
- 4) R. Allemant, G. Thomas: Nucl. Instr. Meth. **137**, 141 (1976).