^{41}Ca-AMS simulation and optimization with PHITS

○Lezhi Wang [1], Yasuto Miyake [2], Takeyasu Yamagata [3], and Hiroyuki Matsuzaki[1,3]

The Univ. of Tokyo [1], RIKEN Nishina Center [2], Univ. Museum, The Univ. of Tokyo [3]

Short Abstract: Long lived radioactive isotope ^{41}Ca (1.02E+05 years) is suggested to be a good tool for dating Pleistocene samples and indicate radioactivity of nuclear waste. With PHITS (Particle and Heavy Ion Transport code System), a beam simulation software using the Monte Carlo method, I successfully finished the simulation of the gas ionization chamber. According to the comparison between experiment result and simulation result, basic ion distribution of experiment spectrum is figured out. However, the detection limit is not yet ideal (isotope ratio ^{41}Ca/^{40}Ca $\approx 10^{-13}$), which means further optimization through PHITS simulation on gas chamber configuration is necessary. Modification of gas chamber configuration will be changed and simulated by PHITS to check the spectrum and compare with spectrums in MALT, finally design the ideal detection configuration for ^{41}Ca-AMS.

Keywords: ^{41}Ca-AMS, simulation, PHITS

Long lived radioactive isotope ^{41}Ca (1.02E+05 years) is suggested to be a good tool for dating Pleistocene samples, which is formed about 2.6 million to 11.7 thousand years ago, and indicate radioactivity of nuclear waste. Due to the extraordinary low ^{41}Ca concentrations in such samples, it cannot be detected by traditional methods like decay counting, instead, AMS (Accelerator Mass Spectrometre) is a good choice because of its ability in detecting rare isotopes. Among all AMS components, gas ionization chamber is basically one of the most important--the detector is placed inside this chamber. To develop a ^{41}Ca detecting system in our lab, simulation system with suitable detection limit for the ionization chamber is needed. With PHITS (Particle and Heavy Ion Transport code System), a beam simulation software using the Monte Carlo method, which is developed by JAEA, RIST and KEK, I try to program the ionization chamber in PC and so far successfully finished the simulation of the gas ionization chamber, well simulated the geometry of the inside chamber, plate, foil and so on. However, the detection limit so far is not enough to be used for extremely rare natural existing ^{41}Ca detection, so further optimization for this system on its configuration like geometry, gas pressure will be researched to make an optimization, and finally design the ideal detection configuration for ^{41}Ca-AMS.

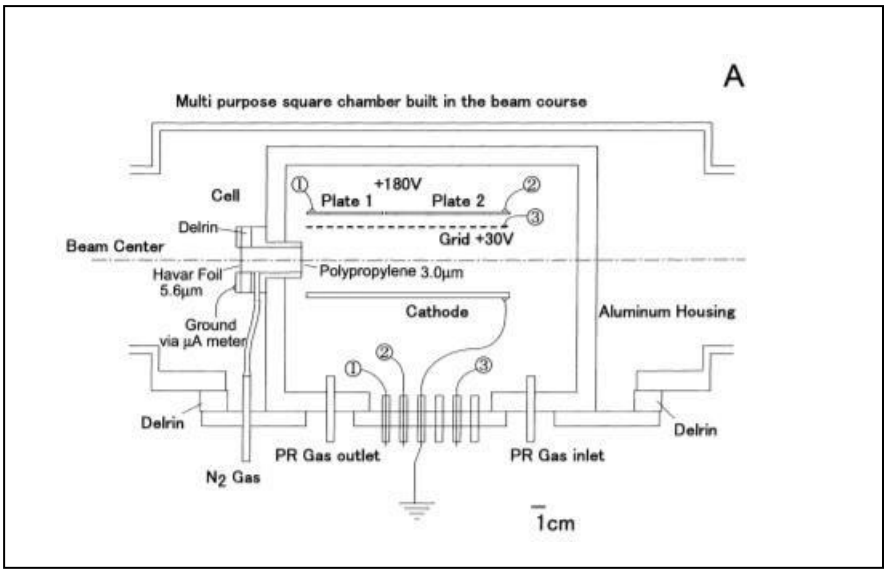

Fig1. Simplified layout of the gas ionization chamber

Reference

1) Hiroyuki Matsuzaki *et al.*, Development of a gas counter for AMS measurement of ^{10}Be and ^{26}Al of cosmic spherules., Nucl. Instr and Meth. B 172 (2000) 218-223.