THE TEST RUN OF THE AMS SYSTEM AT PEKING UNIVERSITY*

Chen Chia-erh, Guo Zhiyu, Yan Shangqing, Xiao Min, Zhang Zhengfang, Yang Fengling, Li Renxing and Yu Jingxiang
Institute of Heavy Ion Physics, Peking University, Beijing, 100871, P. R. China

Li Kun, Liu Hongtao, Jiang Dongxing, Zhang Ruju, Lu Xiangyang, Li Bin, Qian Weishu, Yuan Jinglin, Yang Zheng and Liu Kexin
Department of Technical Physics, Peking University, Beijing, 100871, P. R. China

Si Houzhi
Shanghai Institute of Nuclear Research, P. B. 800-204, Shanghai

The AMS Facility based on an EN tandem accelerator has been constructed and installed at Peking University. Features of high intensity multi-target Cs sputter source, fast alternating injection system, beam transport and analyzing elements, particle detection and data acquisition system are described. The commissioning and operation of the whole system are also presented.

1. Introduction

The EN tandem based AMS facility at Peking University has been constructed, installed and put into test run recently. It is to be used for detecting long-lived radioisotopes of interest in geoscience, archaeology and other fields. The application include ^{14}C dating of Malain Loess to get information of long term variation of the ancient climate as well as the palaeo-environment and soil erosion process in loess areas. ^{14}C dating of Homo Sapiens of fossils found in China and of Chinese oracle bones are planed. The possibility of ^{10}Be dating for deep sea sediment will also be investigated.

A number of efforts have been made in the original design so as to eliminate fractionation effects as much as possible[1]. However, a number of improvements have been made since then, especially the beam line for high energy section is shortened remarkably comparing with the original design, so as to improve the ^{14}C measurement precision and the beam transportation[1]. As shown in fig.1, the present system is installed at the best location in the experiment hall of the multi-user EN tandem. The ion source and δE-E detector also have been improved since the last report. The commissioning and test run of the system are given in the following section.

2. Commissioning and operation of source and injection system

An improved version of the ion source with a target wheel of 18 samples was developed based on the structure of GIC 860. The spherical tungsten ionizer is used for well focusing Cs^+ beam to improve the emittance of delivered negative beams. To reduce memory effect and cross contamination, a shielding structure surrounding the sputter region are specially designed. The performance of the source is satisfactory. 350μA of $^{12}C^-$, 10μA of BeO^- and 5μA of Al^- has been obtained. Low memory effect was proved by the fact that ion yield attenuates more than 1000 and 500 times within 10 minutes for C^- and

* Supported by National Science Foundation of China

0-7803-0135-8/91$01.00 ©IEEE

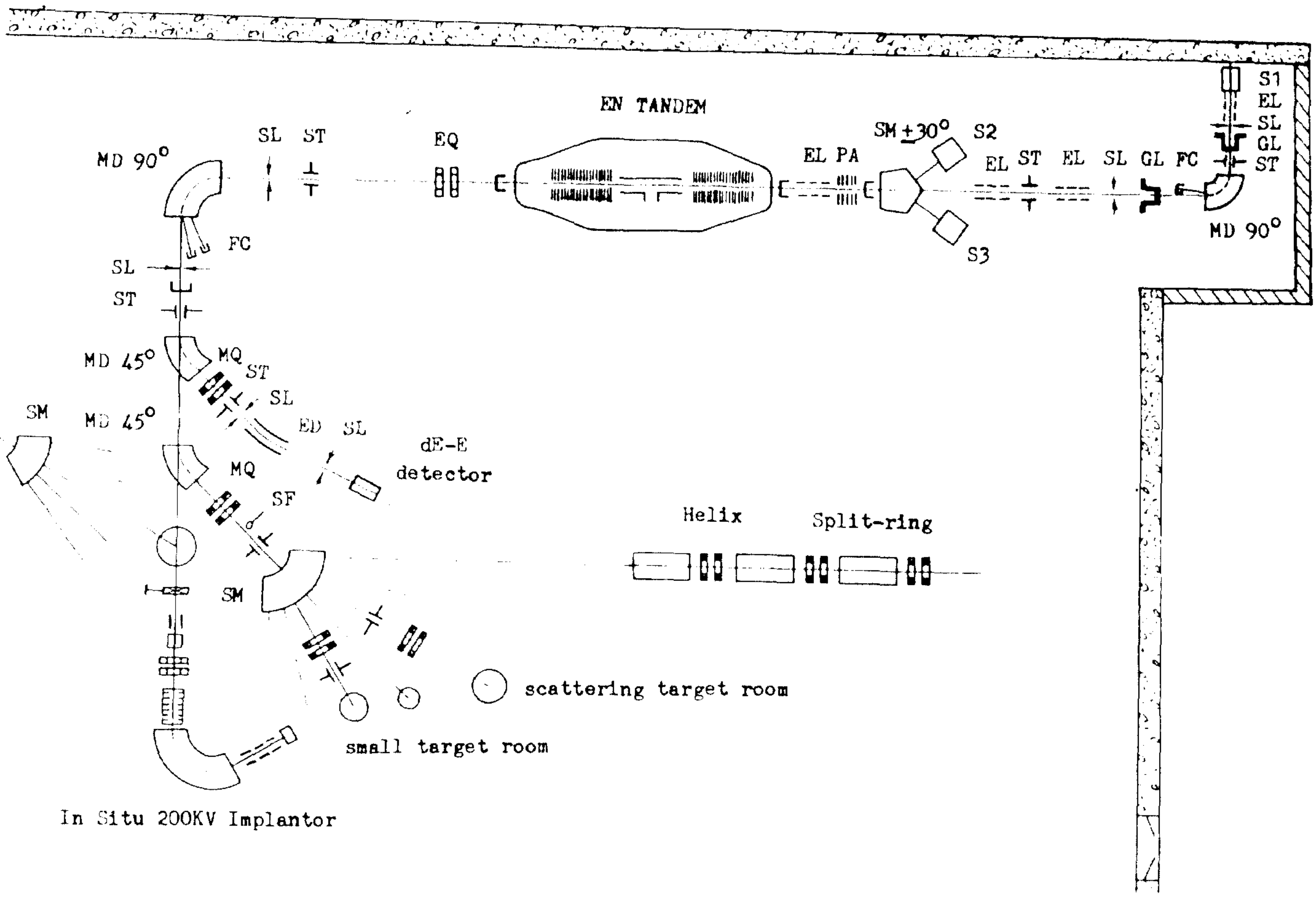

Fig.1. Layout of the AMS facility and EN experimental area at Peking University

BeO^-, respectively. For beam less than 100μA, the normalized emittances is (2-4)π mm-mrad-Mev$^{1/2}$. A conservative estimation of the ionization efficiency was made to be 5.53% for $^{12}C^-$.

A dedicated low energy injector has been installed. The analyzer magnet and other beam optic elements are located to realize the optimum beam transport from the ion source to the stripper in the middle of the accelerator. To reduce the fluctuation of beam transport efficiency and the isotope fractionation effect, a fast switching control and data acquisition system has been developed[2]. The system is designed to inject the related isotopes in sequence and to measure the analyzed isotope ion current or particles in accordance with injection automatically. The injection system has been tested with the new sputter source. A spectrum obtained with a graphite target is shown in Fig.2.

3. Beam test of the high energy section

To avoid the additional fractionation effect, the quadrupole doublet and a pair of steerer following the accelerator are fully electrostatic components. The ions are analyzed by a 90° analyzing magnet and a 20° electrostatic deflector having a resolution of $M/\delta M$= 1000 and $E/\delta E$= 500 respectively. A 45° magnet is inserted before the electrostatic deflector to bend the beam and to reduce the scattering background (Fig.1.). In an initial commissioning a stable

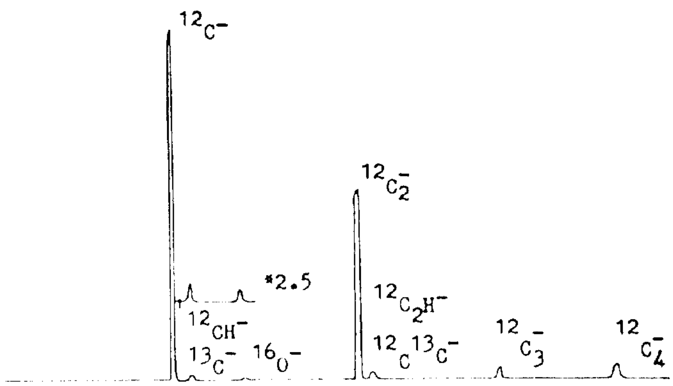

Fig. 2. Spectrum of the new sputter ion source with a graphite target on AMS injector

beam current of 0.6 μA ^{12}C and 5nA ^{13}C has been obtained on the Faraday cup before the δE-E detector. The ions were accelerated by the tandem at a terminal voltage of 3MV, and the charge state of three plus was selected. In a combined operation with the low energy and high energy systems, 2 μA beam of carbon have been obtained after the accelerator.

The heavy ion counter telescope consists of a gas-filled Frish grid ionization chamber and a silicon surface barrier detector. The signals of the energy loss δE and the residual energy E_r of the detected particles are digitized by a series of standard nuclear electronics then transferred to an IBM PC/XT computer with interfaces and software for display storage processing and manipulations. Multiple display modes including two-dimentional map mode and an isometric mode are available. A monoparameter energy spectrum for each element is obtained by projection. The performance has been tested with a δE-E telescope to identify the elements of Li, Be, B, C, N, O and F etc(Fig.3).

References

[1] C. E. Chen et al, NIM B52(1990) 306-309.

[2] Lu Xiangyang et al, to be published in Proc. of Beijing Inter. workshop on AMS.

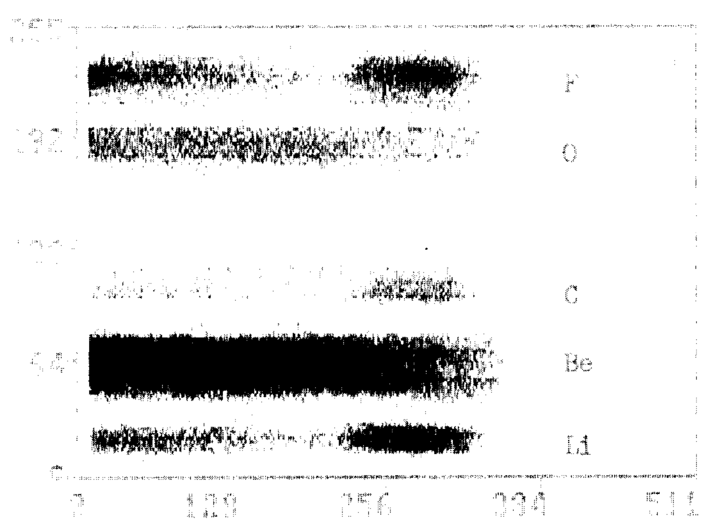

Fig.3 A testing two-dimentional map of AMS data acquisation system with δE-E detector