ETL 4UH-HC PELLETRON

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1. Introduction

A 4MV electrostatic accelerator of single-ended type (4UH-HC Pelletron of NEC) was installed at ETL at the beginning of this year. Assembling and beam tests with full specifications were successfully completed during the first half period of the year. At present, normal operations and application works are put into practice.

This accelerator is designed for high-current beam and nano-second pulsed beam operation for the purpose of monoenergetic neutron production, fine beam analyses and ion beam irradiation.

2. Accelerator Description and Performance

This accelerator is a horizontal-type single-ended accelerator equipped with 4 column units, a rotating shaft for power generation at the high-voltage terminal, 4 metal-pellet chains (2 pairs) to deliver maximum current of 500 μA and 60 optical fibers for communications between the tank base and the high-voltage terminal (ion source control and read-back).

Two types of ion source can be mounted - (A) duoplasmatron ion source for light-ion and pulsed proton beam production and (B) an oscillating electron type (Danfysik 910) ion source for heavy-ion production.

A mini-computer (NOVA 4/X 128 kB, 12.5 MB disc) is equipped for controlling and monitoring of a NMR gaussmeter, a switching magnet and (in future) terminal electronics.

Performances of this accelerator is shown in Table 1. High-current proton beam was monitored with a Faraday cup located at 5 m downstream from the switching magnet. The characteristics of pulsed proton beam were measured by detecting γ radiation from Al +p reaction. In Fig.1 is shown the time spectrum of the 4 MeV pulsed proton beam obtained by this method.

The energy calibration and the energy stability test of the proton beam have been made by observing the threshold energy of the monoenergetic neutron production by ^{7}Li(p,n)^{7}Be and ^{45}Sc(p,n)^{45}Ti (E_{th} = 1.8804 MeV and 2.908 MeV). In Fig.2, neutron yields as a function of incident proton energy are plotted in the case of Li+p (target thickness of 124 μg/cm on Ta).

3. Application Studies

As already reported[1], establishment of neutron fluence standards and experimantal studies using ion beams are performed at ETL.

ETL is to participate in the international intercomparison of monoenergetic neutron fluence standards (E_n = 144-, 565-keV, 2.5-, 5.0-, 14.8-MeV). Absolute fluences of neutrons produced by $^7Li(p,n)^7Be$ and $T(p,n)^3He$ are measured with proton-recoil detectors. In Fig.3 is shown the output pulse-height distribution of methane-filled proportional counter in the case of 400 keV monoenergetic neutrons.

Irradiation studies of CTR wall materials - refractory metals and low Z coating materials - are carried out by applying ion beam analysis methods - RBS, nuclear reaction and electron spectroscopy.

Reference

1) Proceedings of the 3rd Symposium on Accelerator Science and Technology, p.287 (1980).

Table 1. Performances of ETL 4UH-HC Pelletron

Maximum column voltage	4.4 MV
Maximum beam energy	4.0 MeV (proton)
Maximum beam current	>100 μA (proton)
Voltage stability	± 2 kV
Pulsed proton beam	FWHM <2 ns
	Peak current 1 mA

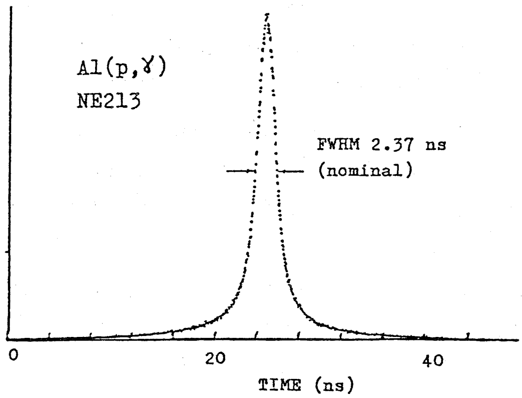

Fig.1 Time spectrum of pulsed proton beam obtained by γ detection from Al+p.

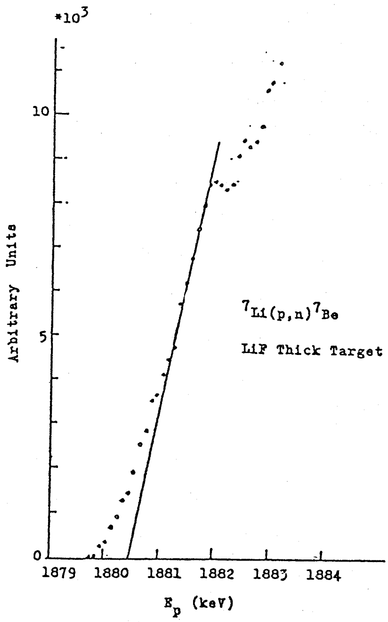

Fig.2 Neutron yields from $^7Li(p,n)^7Be$ as a function of incident proton beam energy.

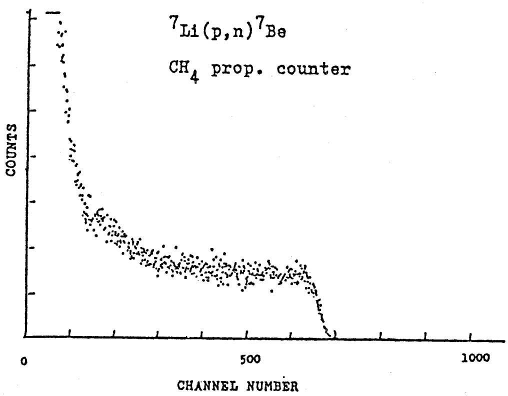

Fig.3 Output pulse-height distribution of CH_4 proportional counter by 400 keV neutrons.