OPERATIONAL CHARACTERISTICS AND IMPROVEMENTS OF THE SHANGHAI 4UH PELLETRON

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ABSTRACT

This paper summarizes performance data and operational experiences gained with 4UH Pelletron.

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Ⅰ. INTRODUCTION

The 4UH Pelletron accelerator was initially commissioned at Shanghai Institute of Nuclear Research in June 1986 after the manufactuer's guaranteed performance

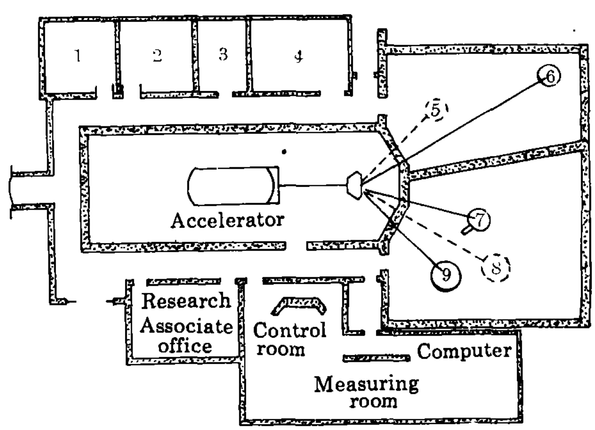

Fig.1 Plan of Pelletron Laboratory in Shanghai Institute of Nuclear Research

1. Cooling water treatment 2. SF_6 gas compressor 3. Distribution switch- board 4. Air condition compressor 5. Completely automated PIEX chamber 6. Scanning proton microprobe system 7. Multiple purpose chamber 8. Ultro vacuum chamber 9. Angular distribution measurement facility

ratings were reached[1-2]. Since then it has provided ion beams of P, He^+, $He^{++}$and pulsed D for experiments. The running time is now about 3500—4000 h a year. The machine has been used for methodological studies of ion beam analysis, application of IBA on bio- sciences, application of IBA on material sciences and nuclear physics research.

The plan of the laboratory is shown in Fig.1. The major experimental facilities of the laboratory include:

1. A completely automated PIEX analysis system.
2. A multiple purpose chamber used for RBS, channeling, ERD, NRA and TOF, with an optical system in the beam line providing 0.5×0.5 mm beam spot at the target.
3. An angular distribution measurement facility for in beam γ – ray spectrum study.
4. A scanning proton micro– probe system being installed and tested.
5. An ultra high vacuum chamber with a goniometer which is being built.

A DN– 760 data acquisition system is installed in the measurement room and can be used for a variety of on– line application. A PDP– 11/34 computer at the cyclotron laboratory is coupled to this laboratory by a data link.

II. PERFORMANCE

The proton energy range is 0.3 to 4 MeV, with its maximium beam current 15 μA at 4 MV with one charging chain. Energy spread is <1 keV. Ion beams available are P, D, He^+, $He^{++}Ar^+$, Kr^+ and Xe^+ with a R.F. ion source. It is easy to reach the terminal voltage of 4 MV after conditioning several hours. Proton and deuteron beams of 5– 6 μA, a helium beam of 4– 5 μA and an alpha beam of >50 nA all are easy to obtain, but it is very difficult to obtain a proton beam of 15 μA at 4 MV. One reason is that the percentage of H_1 to $H_1+H_2+H_3$ is very low (about 50%) in this machine which causes the beam current decrease.

III. OPERATION

In the accelerating tube minute leaks have occurred many times since its initial operation. The leaks were usually be successfully sealed off with glyptol (vacuum sealant) without affecting the behavior of tube conditioning. Fig.2 details the accelerating tube life time and leakages. It is clear that most of the minute leaks occurred in tube section * 6 and two occurred in section * 2 and * 4 from the terminal. They were replaced by three new tubes after the initial 2010 h operation. Since then no leakage have been found in section * 2 and * 4, but section * 6 still suffered five times, and section * 7 leaked once also. The leaks are located at the first ceramic ring in sections * 2 and * 4 and the second ceramic ring in section * 6 and the fourth ceramic ring in section * 7. It is believed that the phenomena as mentioned above are caused by tube defect.

During the three years and eight months period from May 1985 to March 1989, the machine had used a total of three turbo– molecular pumps, 1500 1/s, for pumping the accelerating tube. They failed after the first pump running 21000 h, the second 3300 h and the third 6300 h. The former two failures occurred due to bearing damage and the last one was due to the bolt at the center of the rotor top which worked loose and falled into the rotor's housing. It is evident that the first pump is of good quality, but the second and the third no.

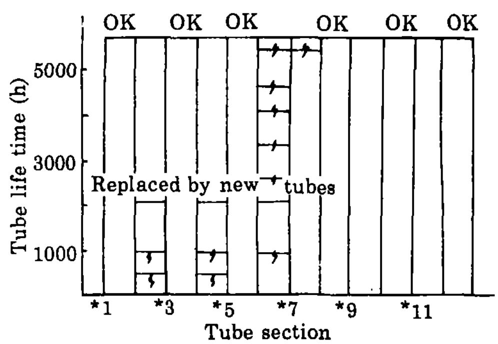

Fig.2 Accelerating tube lifetime and leakage

ϟ - Leaked tube OK–No leakage

The bias and focus power supplies failed many times and were all damaged at last. No trouble occurred since they were replaced by air type power supplied. The reason is that the new supplies scatter heat easily by air circulation and the old ones, cast resin type, are very difficult to scatter heat.

The mechanical problem with this machine is screws loose which cause small accelerator components, such as pillow bloke for driven pulley, inductor lead, cap- probe of the corona probe etc. to damage.

Ⅳ. IMPROVEMENT

The old pulleys and pickoff pulley rims for charging system transfer charges via their spring contact bands and contact spring contacting with pellets respectively. When they have been replaced by the conductive pulleys and conductive pickoff pulley rims from National Electrostatics Corporation, the charging current increases by 50%.

A new type gas- feed facility has been developed, its gas reservoirs are installed outside the pressure tank. Two gas reservoirs for ion source were originally installed at the terminal, one of them is now replaced by this new type gas- feed facility. After a preliminary test, a proton beam of 3.3μA at 3.5 MeV was obtained. However, when changing hydrogen with argon for test, the insulating tube which transfers gas to ion source was breakdown.

The turbo- molecular pump of 1500 1/s from Sargent- Welch Scientific Company has been replaced by a 450 1/s one from China. The running has shown that the new pump is satisfactory to meet the vacuum requirements of the accelerating tube and the high energy beam line.

REFERENCES

[1] Gu Han *et al., Annual Report of Shanghai Institute of Nuclear Research, Academia Sinica,* **5** (1985), 65.
[2] Gu Han *et al., Annual Report of Shanghai Institute of Nuclear Research, Academia Sinica,* **6** (1986), 125.