STATUS OF OPERATION OF THE VARIABLE FREQUENCY HEAVY-ION LINAC, RILAC

M. Odera and RILAC group

Riken: Inst. Phys. & Chem. Research. Wako-shi, Saitama, 351

Abstract

RILAC is a sole tunable linac in the world. High frequencies are used for light ions and low frequencies for heavy projectiles. It is being used by the various disciplines in IPCR. Its status of operation is described.

§1. Introduction

The variable frequency scheme of the RILAC has been introduced to facilitate focusing of the low velocity heavy-ions having a small charge to mass ratio. The scheme also relaxes the requirement of the high accelerating gradient, hence the large power consumption for acceleration of the very heavy elements. By further keeping accelerating rate lower than that of the average linacs, RILAC has been made capable of CW operation.

This frequency variable and CW operation scheme is also a consequence of the design study of the Riken multi-stage heavy ion research facility project, proposed in 1972. (Ref. 1) In that plan, a large separated sector cyclotron has been chosen as a post-stripper accelerator. The pre-stripper part should be able to function in a CW regime and its acceleration frequency be tunable to the same or submultiple of the cyclotron RF, so that longitudinal phase matching of the beam between the two accelerators can be made easily.

§2. Operation

Figure 1 shows statistics of operation for the latest 8 months. Shaded area is the time used for research and others for machine development. Time for preparation of the experiments, for ion source tuning and for maintenance and repair is not included. Figure 2 gives frequencies and ions realized in the specification map. As seen in those figures, Argon ions are used most in the variable energy mode. Table 1 gives research themes in FY 1981 and 1982. At present, atomic physics is the largest customer to use machine time.

Time required to guide beams onto the targets varies considerably, according to whether a good parameter set has been already accumulated or not in the previous operations. When the good set is not available in the computer memory, the calculated values are used as the starting sets and optimization of beam is made manually.

Transmission efficiency of beam through cavities is improving in time, by getting better parameter sets. At present, it is around 40 to 60 % for the first cavity and 10 to 20 % to go through all the cavities and the beam transport pipings 15 to 20 meters long.

Various unwanted ions having equal or nearly same charge to mass ratio to that of ions wanted are frequently found mixed in the output beam. The simplest way to discriminate those contaminant ions is measurement by a solid state detector inserted in the beam path. However, the detector will be destroyed at once unless the intensity of beam is attenuated by a factor larger than 10^7. Two mesh filters are inserted in the distant position along the injection beam line by the pneumatic cylinders from the operator console. By tuning the two dipole and one quadrupole triplet magnets in the interval between the two attenuators, the necessary reduction of the beam intensity can be made.

Effect of the secondary electron emission must be taken care of in the beam diagnostics. Accurate measurement of the beam by suppression of the secondary electron in a narrow space presents a problem. Other paper gives a case in which this phenomenon is used advantagiously. (Ref. 2)

Energy of ions can be changed by a large factor combining the three methods; change of accelerating frequency, turning off of the later cavities and tuning of the phase of the last cavity. The last method is the easiest and allows more than 30 % reduction of energy within a few minutes. Readjustment of the focusing elements allows more than 80 % of the beam intensity be obtained even for the largest phase excursion from the standard value. (Ref.3).

TABLE-1 Themes of experiments

Disciplines	Themes
Atomic physics	Auger-electron spectroscopy, Inner shell ionization and X-ray polarization, Beam foil spectroscopy, Recoiled-ion spectroscopy,
Nuclear physics	Coulomb excitation, Polarization of nuclei by use of slow HI,
Solid state physics	Internal field of ferro-magnetic materials, Secondary electron emission from metal, Radiation damage of materials, Modification of metal surface by ion implantation, Heavy ion channeling, Relaxation of dense excitation in crystal,
Chemistry & biology	Effect of chemical bond on satellite X-rays, Depth distribution of Hydrogen in amorphous silicon, Study of chemical bond by Mossbauer effect, PIXE by heavy ion, Effect of heavy ion irradiation on bacteria,

References

1) M. Odera and T. Tonuma: Proc. 6th Intern. Cyclotron Conf., Vancouver 1972, p283, AIP Conf. Proceedings No. 9 (1972)
2) M. Kase: Bunch Signal Sensitization by Use of Secondary Electron Emission, This Proceedings
3) M. Kase et al.,: Linac Energy Tuning by Phase Control of Last Cavity, This proceedings

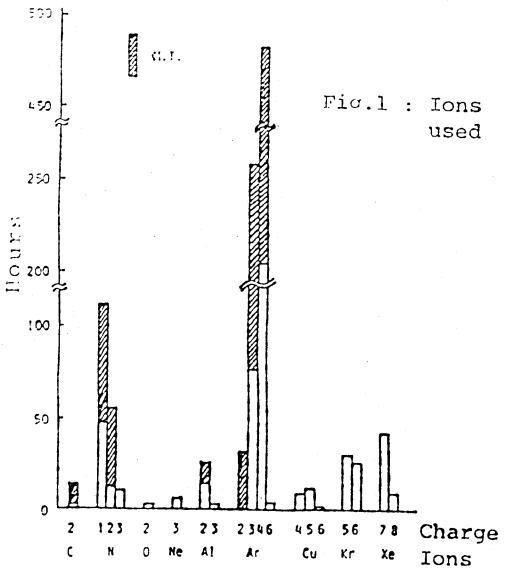

Fig.1 : Ions used

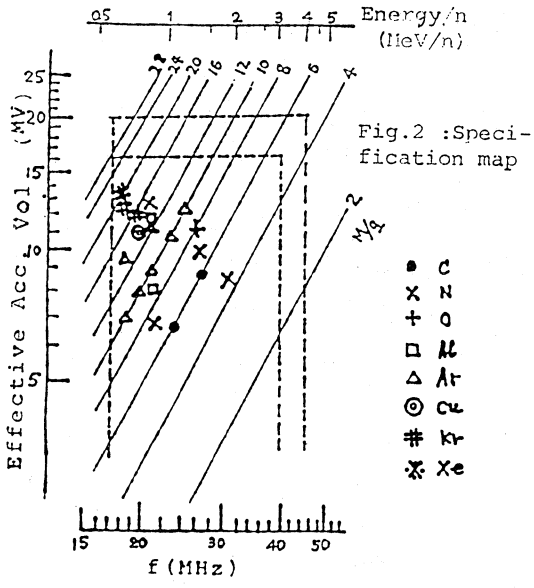

Fig.2 :Specification map