CONSTRUCTION AND PERFORMANCE TEST OF A 100 MeV RACE TRACK MICROTRON

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Abstract

A 100 MeV Race Track Microtron has been designed and constructed. This machine will be used as the injector of a Superconducting Synchrotron Light Source. The 5 MeV, 3 GHz standing wave accelerating column has been constructed and the rf system has 2 MW magnetron, rf circuit, and power modulator with Blumlein type PFN. Two bending magnets (1 T, 4 % field gradients) with reverse field clamp had been constructed. A qudrupole magnet is used for beam fucusing in the common orbit. All components have been aseembled and the machine is under test.

1 INTRODUCTION

A compact superconducting synchrotron light source is planned in Seoul National University for many synchrotron light application experiments, such as the lithography[1],[2]. A 100 MeV Race Track Microtron has been designed and constructed as the injector because of compactness and resonable cost.

The Race Track Microtron has the simplest design and consits of an electron gun, a linac, two bending magnet with reverse field magnet, focusing magnets and a vacuum system. The design parameters of the Race Track Microtron are given in Table 1.

• Final electron energy	100 MeV
• No. of orbits	18
• Pulse length	1 μs
• Repetition rate	10 Hz
• Pulsed electron beam current	max. 10 mA
• Magnetic flux density of bending magnets	1 T
• Rf frequency	3 GHz

Table: 1 Design parameters of 100 MeV Race Track Microtron

2 ELECTRON GUN

The electron gun has been made of 10 mm diameter LaB_6 cathode with the spherical Pierce type electrode. It operates in the temperature limited region and supplies 45 keV, maximum 100 mA electron beam. The electric heater power is maximum 50 W. Figure 1 shows the manufactured electron gun and Figure 2 shows the heated cathode during the cathode heating test.

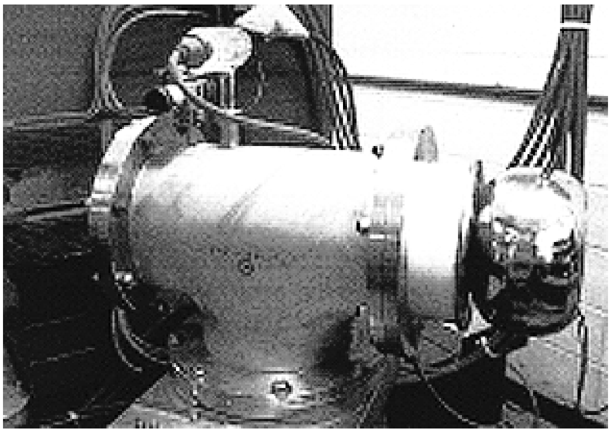

Figure 1: Electron gun

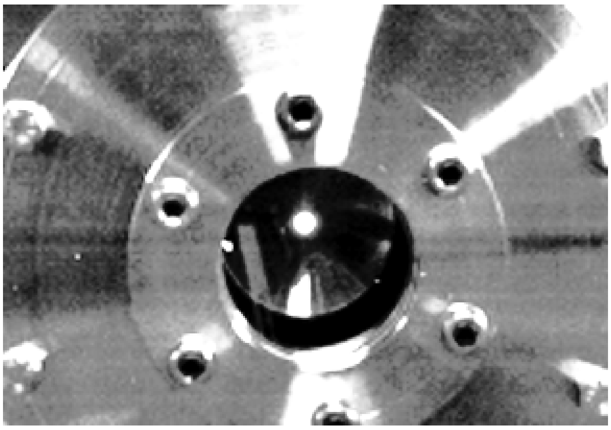

Figure 2: Heated cathode

3 LINAC

The linac structure is an electrically coupled π/2 mode standing wave type. Operation frequency is 3 GHz and the energy gain per turn for synchronous relativistic electron is 5 MeV

The disc and cylinder of the linac has been machined by NC lathe with diamond bite (Figure 3) and assembled by electroforming in the coppersurfate bath. Figure 4 shows the linac which is installed in the vacuum chamber.

The RF source of the linac is 2 MW Magnetron (EEV M5125). The power modulator for the Magnetron has been consisted of 10 stages Blumlein type pulse forming network (Figure 5), charging power supply, thyratron switch, end-of-line clipper and step-up pulse transformer (1:4). The output voltage of the power modulator is shown in Figure 6.

Figure 3: Disk and Cylinder of the linac

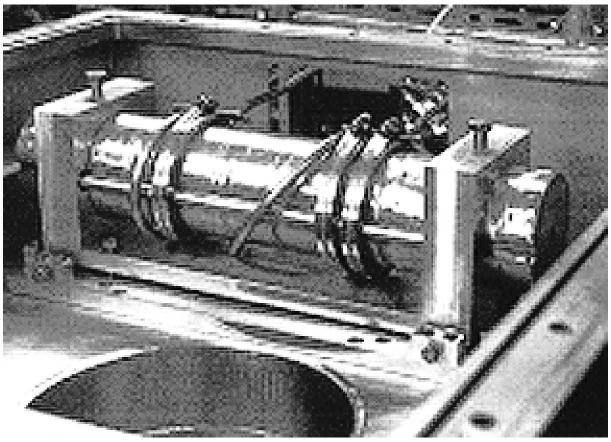

Figure 4: Linac

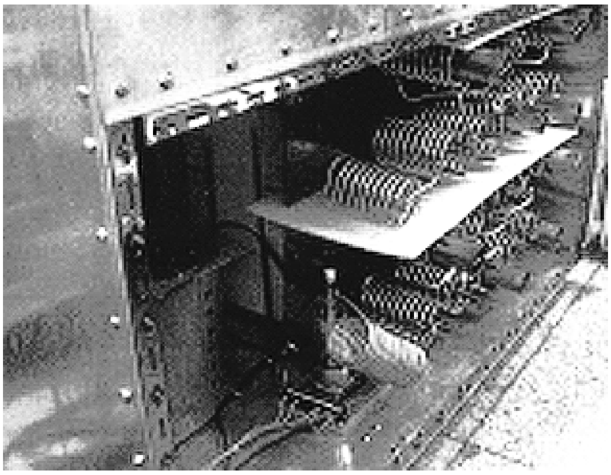

Figure 5: Power modulator

4 MAGNET

Two bending magnets with reverse field clamps has been manufactured with low carbon steel. In order to obtain uniform magnetic flux desity, the floating poles (Figure 6) are used. The pole gap lenth is 10 mm and The field gradient is 4 %.

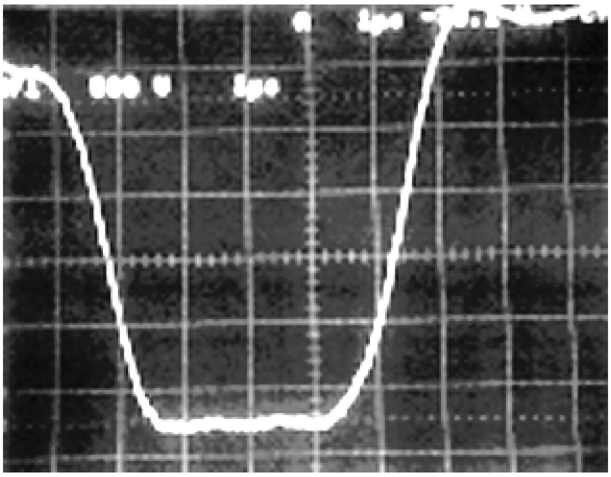

Figure 6: Output voltage of the power modulator

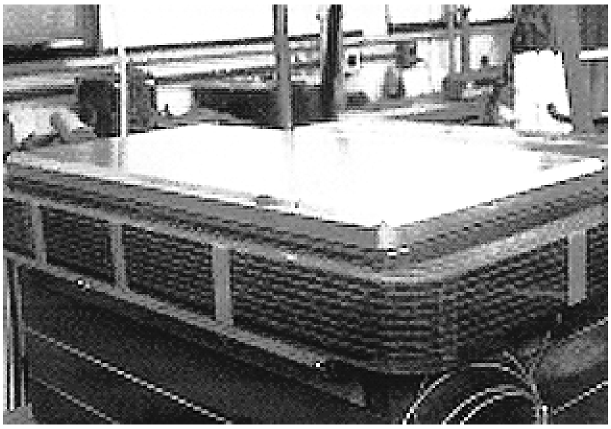

Figure 7: Pole of the bending magnet

The result of magnetic flux density measurement with a Hall probe at entrance side of the bending magnet agrees with the calculated value by POISSON Code within 1 %.

5 OPTICS MAGNETS

The electron beam generated in the electron gun is focused by a solenoid magnet which is installed between the electron gun and the chicane magnets.

Because of the large difference between the injection energy and the first orbit beam energy, it is easy to inject the beam into the linac through three chicane magnets. The injection angle is 45 degree.

The orbit electron beam is focused in horizontal direction by a quadrupole magnet which locates in the common orbit.

6 VACUUM SYSTEM

The main vacuum chamber in which the linac is installed is evacuated by 1,000 *l*/s turbo molecular pump. The base pressure of the chamber is less than 10^{-6} torr.

The electron gun is evacuated by 1,000 *l*/s turbo molecular pump independently. The working pressure is 2×10^{-6} torr.

7 SUMMERY

The 100 MeV race track microtron has been designed and the components have been fabricated. The assembly of the race track microtron is completed. The machine is tested and adjusted.

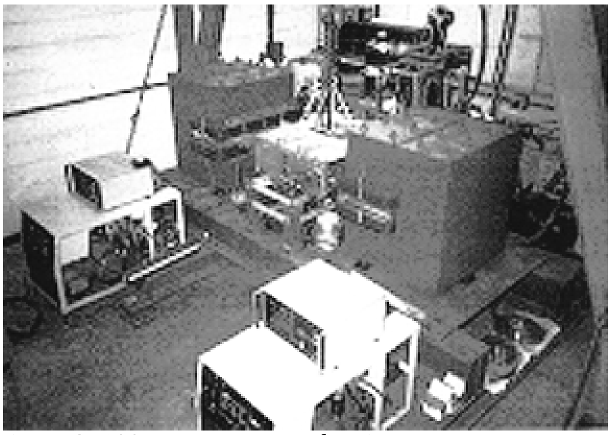

Figure 8: 100 MeV Race Track Microtron

REFERENCES

[1] Y.S. Cho, K.H. Chung, B.H. Choi, and G.S. Lee, "Design and Construction of Synchrotron Radiation Source, CESS Phas I", Proc. of the 4th European Particle Accelerator Conference, London (1994), Vol. 1, pp 606-608, World Scientific 1994.

[2] S.H. Kim, Y.S. Cho,, T.Y. Kim, and K.H. Chung, "Pulsed VUV Synchrotron Radiation Source", Proc. of the 1995 Particle Accelerator Conference, Dallas (1995), to be published.