Design and Construction of Synchrotron Radiation Source, CESS Phase I

Y.S.Cho, K.H.Chung, *B.H.Choi, **G.S.Lee
Seoul National University, Seoul 151-742, Korea
*Korea Atomic Energy Research Institute, Taejeon, Korea
**Korea Basic Science Center, Taejeon, Korea

Abstract

Design of two main parts of CESS (Compact Electron Synchrotron at Seoul national university) Phase I, race track microtron and storage ring is reported.

1 INTRODUCTION

CESS Phase I is composed of 100 MeV race track microtron and 100 MeV storage ring. The main purposes of this machine are to provide UV light for photo-chemistry application and to perform preliminary studies for planned X-ray light source at Phase II upgrade of CESS.

The accelerators are equipped with 1 Tesla bending magnets and 2.998 GHz standing wave linac columns as accelerating cavities for easy construction.

For easy radiation shielding and utilizing all radiated Synchrotron Radiation, both race track microtron and storage ring are stacked-up in space-saving structure. Overall schematic view of CESS Phase I is provided in Figure 1.

2 RACE TRACK MICROTRON

The main parameters of the race track microtron are shown in Table 1.

The pulsed electron beam with energy of 45 keV and maximum current of 1 A in 1 μs pulse, is extracted from 10 mmϕ LaB_6 cathode. The simulation result from EGUN code [1] is provided in Figure 2. The pulsed power supply is synchronized with RF power supply of accelerating column. The electron beam is injected into the race track microtron through the focusing magnet and chicane magnet.

Table 1: main parameters of the race track microtron

Injection energy	45 keV
Final energy	100 MeV
Beam current	100 mA
Energy Gain per turn	5 MeV
Accelerating cavity frequency	2.998 GHz
Magnetic flux density of bending magnets	1.048 T

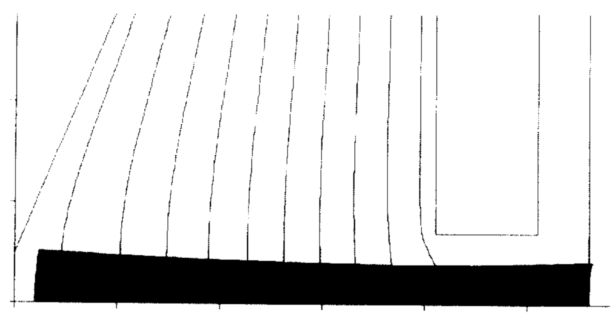

Figure 2: Simulation of the electron beam extraction

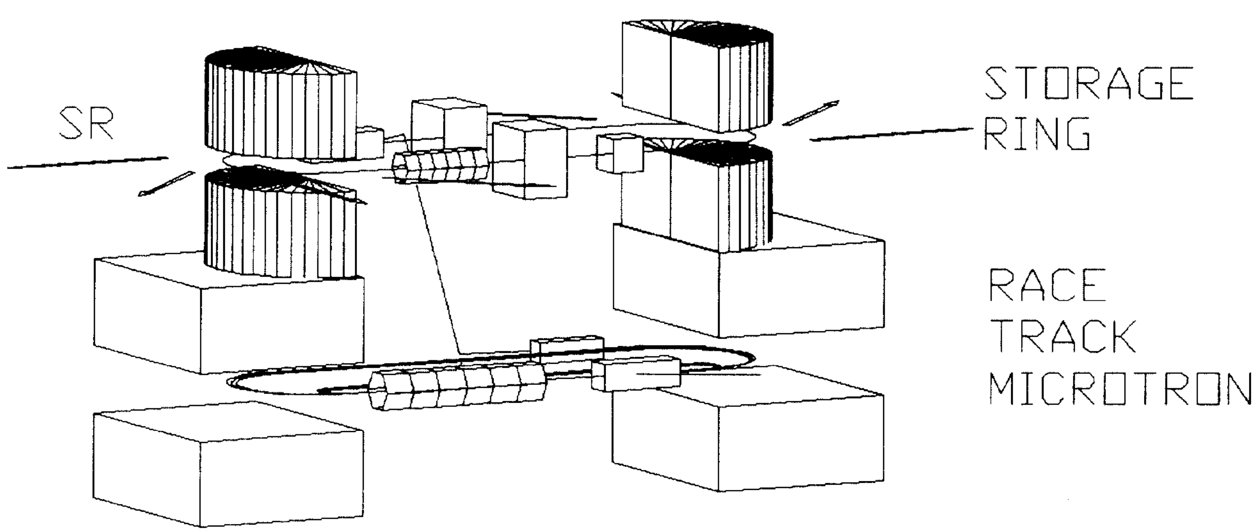

Figure 1: Overall schematic view of CESS Phase I

The magnet system of the race track microtron is composed of two 180° bending magnets, reversed field magnets [2], quadrupole magnets, vertical orbit correction magnets and extraction & transfer magnets. The pole gap of the bending magnets is 15 mm at the entrance side and 15.4 mm at the opposite side. These magnets are designed to be manufactured with low carbon steel and OFHC copper hollow conductor.

As accelerating cavity, $\pi/2$ mode on-axis coupled standing wave linac column with a biperiodic structure is designed. Table 2 shows the main parameters of the linac column and Figure 3 shows the electric field profile at $\pi/2$ mode which is simulated from POISSON code [3]. The accelerating cavities will be machined with OFHC copper rod, brazed and tuned mechanically.

Table 2: main parameters of the linac column

RF frequency	2.998 GHz
Intercell coupling coefficient	1.0 %
Input coupling coefficient	2
Loaded Q	3,000
Max. RF input	2 MW
Pulse length	2 μs
Max. repetition rate	10 Hz

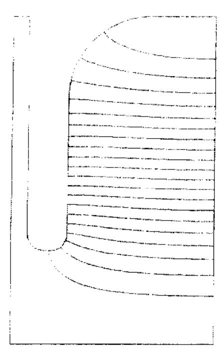

Figure 3: Electric field profile of the cavity

RF power to the accelerating linac column, will be supplied with 2 MW pulsed magnetron (tunable S-band).

The extraction & transfer magnets deliver 100 MeV electron beam to the storage ring which is installed above the race track microtron.

The vacuum of the eletron gun and the race track microtron is obtained by two 1,000 l/s turbo molecular pumps with air bearings. The designed operating vacuum pressure is less than 10^{-6} torr at all regions of beam paths.

Figure 4 is the schematic drawing of the race track microtron.

3 STORAGE RING

The storage ring has 1 super period FODO cell and the parameters of the ring are shown in Table 3. Figure 5 shows the calculated machine functions of the storage ring.

Two bending magnets of this storage ring are

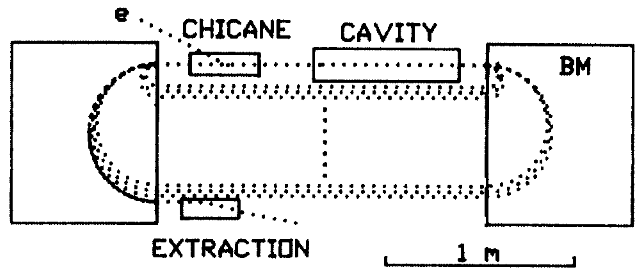

Figure 4: Schematic drawing of the race track microtron

Table 3: main parameters of the storage ring

Critical wave length	185 nm
Magnetic flux density of bending magnets	1.048 T
Stored current	100 mA
Energy loss per turn	27 eV
Life time	1 min.

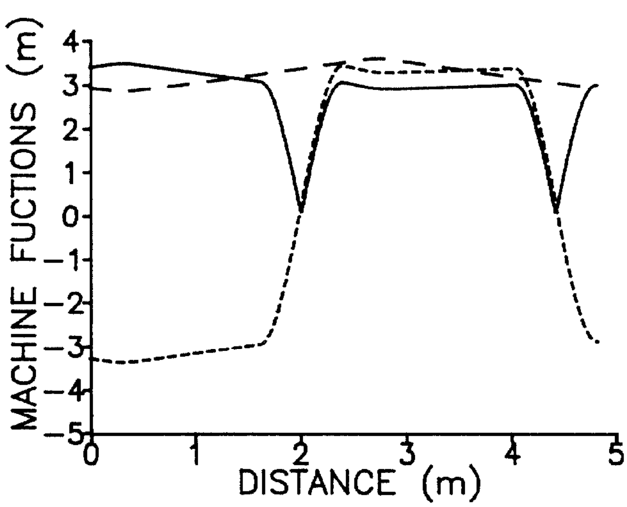

Figure 5: Machine functions of storage ring
Solid : beta x, Dashed : beta y, Dotted : eta

manufactured with the same material as those of the race track microtron. The gap of bending magnets is 35 mm.

The shape of the accelerating cavity is almost the same as the one at the race track microtron, but RF power to this cavity supplied with c.w. klystron amplifier.

The SUS316L beam duct will be evacuated with two 200 l/s sputter ion pumps and the designed vacuum pressure during operation is less than 10^{-8} torr.

The schematic drawing of the storage ring is provided in Figure 6.

4 CONCLUSION

The race track microtron and storage ring for CESS Phase I have been designed and the manufacturing of main components is in progress.

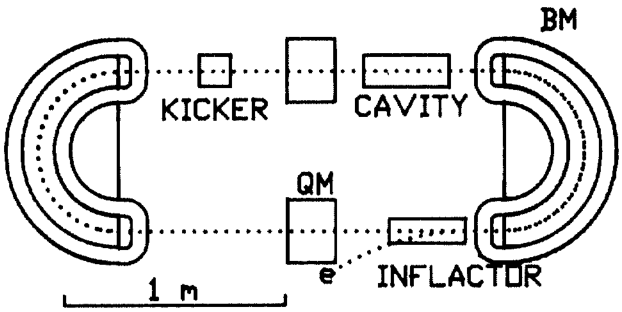

Figure 6: Schematic drawing of the storage ring

5 REFERENCES

[1] W.B.Herrmannsfeldt, EGUN - An Electon Optics and Gun Design Program, Stanford Linear Accelerator Center. October 1988.

[2] S.Rosander et al., The 50 MeV race track microtron at the Royal Institute of Technology Stockholm, TRITA-EPP-81-06, December 1981.

[3] Los Alamos Accelrator Code Group, Reference Manual for the POISSON/SUPERFISH Group of Codes, Los Alamos Laboratory document LA-UR-87-126, 1987.