STATUS OF THE PF STORAGE RING

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Abstract

The progress of the operation of the PF storage ring and the some property of the ring, which was studied through the operation, are described.

1. Initial Operation of the Ring

The construction of the 2.5 GeV electron storage ring which is dedicated to the synchrotron radiation utilization started on April, 1978, as a four years project. The construction had been going well and the minimum condition under which the ring could accumulate a little bit of beams was provided in the last stage of the construction period. On February 11, 1982, just after the successful operation of the linac, the first electrons went through the 150 m beam transport line and were injected into the ring. The progress of the initial operation of the ring is as follows.

Feb. 11.	0hr*	Beams were injected into the beam transport line.
Feb. 18.	52hr	The first turn of beams around the ring.
Feb. 27.	136hr	Beams made four turns.
Mar. 5.	190hr	Beams were stored at the energy of 1.6 GeV.
Mar. 9.	201hr	Stored beams were accumulated.
Mar. 11.	224hr	Maximum energy, 2.5 GeV, was achieved. 6.5 mA.
Mar. 18.	239hr	Stored current reached 100 mA at E = 1.7 GeV.

   * time elapsed in the scheduled machine time.

The beam lifetime was about 4 minutes limited by the average vacuum of 1×10^{-8} torr without beams, which rose by two orders of magnitude during injections. This was because the vacuum chamber was unbaked and none of the distributed ion pump was in operation.

The capture efficiency of the injection was quite good and the accumulated current per injection reached 20 mA. Though the injection rate was 1 Hz, the time required to accumulate beams of 100 mA was less than 10 seconds.

2. Second Run of the Ring Operation

After the initial operation of the ring, the vacuum chamber was baked. Though the aimed temperature of baking was 150°C, the temperature rose to only between 80°C and 120°C, because of lacking of the heater power. The cooling systems of the vacuum chamber including the light absorbers in front of clotches were also installed.

The second run of the ring operation began at June 2, and ended at July 17. The operation statistics is listed in the Table 1. During the user's time, beams were stored in the ring by 98 times. This means that the average stored time was one hour and 40 minutes. The last 80 hours of the ring operation without a break were fully dedicated to the user's experiments. The experiments started when the stored current reached to 100 mA and electrons were reinjected when the stored current was reduced to less than 15 mA.

The beam life time, τ, is in inversely proportional to the vacuum pressure, P, so as τP equals to 2.1×10^{-8} torr hours. The vacuum pressure is in pro-

Table 1 The operation statistics

	time(hr)	ratio(%)		time(hr)	ratio(%)
Ring study	222.4	54.7	Linac adjustment	25.2	11.3
			Ring study	166.2	74.7
			Machine failure	31.0	14.0
			Total	222.4	100.0
User's time	184.5	45.3	Experiment	161.6	87.6
			Machine failure	22.9	12.4
			Total	184.5	100.0
Total	407.0	100.0			

portional to the stored current, I, as P = a + bI. If R is defined as the time integration of the stored current, it was found that a and b is proportional to R^{-n} and n is nearly equal to 0.8. Figure 1 shows the beam lifetime versus the stored current. The vacuum pressure when the sotred current was 10 mA has been decreasing in the progress of the ring operation as illustrated in Fig. 2.
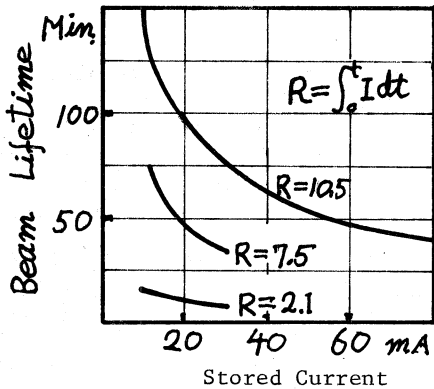

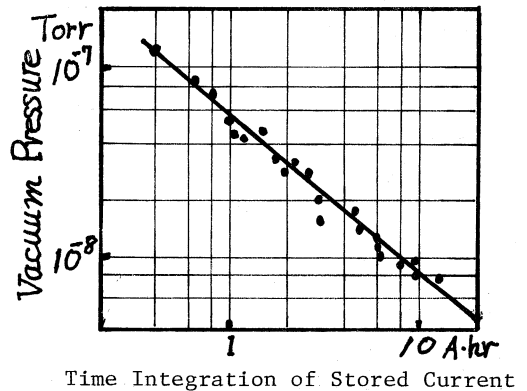Fig.1 The beam lifetime versus the stored current.

Fig.2 Decrement of the vacuum pressure in the progress of the ring.

From these figures, it was estimated that the 10 hours lifetime at the stored current of 100 mA will be achieved when R will exceed over 200 ampere hours, which will correspond to one year operation. After the second run, the surface of the vacuum chamber was treated with the Argon discharge cleaning and the 150°C baking. Now, the vacuum pressure is less than 10^{-10} torr and the desorption ratio, which denotes the number of gases released when one photoelectron hits the vacuum wall, also goes down to 10^{-6}. We are expecting that, in the third run of the ring operation, the beam lifetime will increase by one order compared to that in the second run.

As for the closed orbit, it position was measured and corrected, so as its distortion became within 2 mm. The time fluctuation of its position was also measured in the 50 hours operation. The full width at the half maximum of the distribution of the fluctuation was 0.2 mm which was much smaller than the beam size, 1.6 mm.