PRESENT STATUS OF THE 600-MeV ETL ELECTRON STORAGE RING "TERAS"

T. Tomimasu, T. Noguchi, S. Sugiyama,
T. Yamazaki, T. Mikado and M. Chiwaki

Electrotechnical Laboratory

Abstract

The 600-MeV electron storage ring "TERAS" is operated since Oct. 1981 at ETL in Tsukuba. The 500-MeV high current electron linac serves as an injector. The circumference is 31.45 m and λ_c is 52 Å. The maximum stored current is 150 mA and 1/e lifetime is 1.5 hours at present.

The 600-MeV electron storage ring has been constructed in only ten months at a cost of 200 M yen at the Electrotechnical Laboratory (ETL). The first storage of electrons was achieved on Oct. 7, 1981. The storage ring is a type of accelerating and storage like "ACO"[1]. Therefore, the ETL ring is called TERAS, the Tsukuba Electron Ring for Accelerating and Storage. Terasu is also a Japanese verb meaning "to illuminate". The 500-MeV high efficiency-high current electron linac being operated for high energy spectro-dosimetric experiments serves as an injector. 300-MeV electrons from the linac are provided by means of a 5°-deflected pulsed coil and a beam transport system 40 m long and are injected into the ring at a rate of a pulse per 0.64 seconds. Fig. 1 is the layout of TERAS and beam lines for experiments.

TERAS consists of eight 45° bending magnets (r = 2 m), four triplet focusing systems, a septum magnet, a kicker coil, an RF cavity and ultrahigh vacuum systems. The vertical focusing is provided by the edges (angle 11.7°) of the bending magnets B_d and four quadrupole magnets Q_d, while the horizontal focusing is provided by eight quadrupole magnets Q_f. The lattice order is $O/2\ B_dQ_fQ_dQ_fB_dO/2$. Furthermore, Four sextupole magnets are installed in next year. The circumference is 31.45 m. The harmonic number is 17. The Q-value of the RF cavity is 1100 and the RF power needed to store a beam current of 100 mA at 600 MeV is about 1.4 kW. More than 90 % of the electrons stored at 300 MeV can be accelerated up to 600 MeV in a few minutes using an interlocking controller of the power supplies for B_d, Q_f and Q_d. The final target of the energy gain is 2.6 ($\sim$800 MeV). Total pumping speed of the mounting and built-in pumps is about 8000 l/sec. The pressure in the vacuum chamber is kept less than 2×10^{-10} Torr at low stored current. The maximum stored current is 150 mA and 1/e lifetime is 1.5 hours. Fig. 2 shows relations between stored current and 1/e lifetime and between stored current and pressure. The main parameters of TERAS is shown in Table 1.

The six beam lines (8°) are used at present and another beam line (25°) is being prepared. BL 2 is used for calibrating photometry standard, BL 3 for calibrating soft X-ray standard and to study electronic materials using UPS, and BL 5 for super LSI lithography. Othe three beam lines are used for stored current monitoring. New beam line BL 1 is used for beam control and machine study. The two beam ducts (0°) are also being prepared to study laser Compton scattered photons and to yield channeling radiation[2].

1) The Orsay Storage Ring Group: Proceedings of the International Symposium on Electron and Positron Storage Rings, Saclay (1966)
2) T. Tomimasu: Japanese Patent (1974),
T. Tomimasu, T. Mikado and T. Yamazaki: Phys. Rev. B10, 2669 (1974)
M. A. Kumakhov: Phys. Stat. Sol. (b) 84, 41 (1977)
R. W. Terhune and R. H. Pantell: Appl. Phys. Letters 30, 265 (1977)

Fig. 1

Layout of TERAS and beam lines

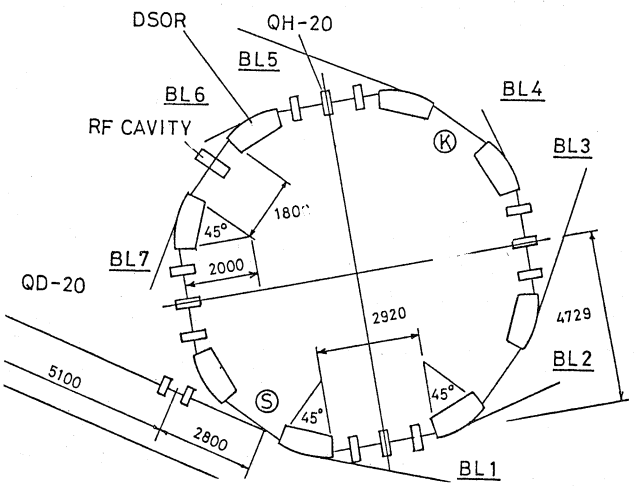

Table 1

( ) shows final target

Max. energy	600 MeV (800 MeV)
Stored current	150 mA (300 mA)
Circumference	31.45 m
Radius of curvature	2.000 m
Average radius	5.000 m
Lattice	$O/2B_dQ_fQ_dQ_fB_dO/2$
No. of dipole magnets	8
No. of quadrupole magnets	12
No. of sextupole magnets	(4)
Betatron freq.	$\nu_x \approx 2.2$
	$\nu_z \approx 1.3$
Rf freq.	162.1 MHz
Rf power	1.4 kW at 600 MeV-100 mA

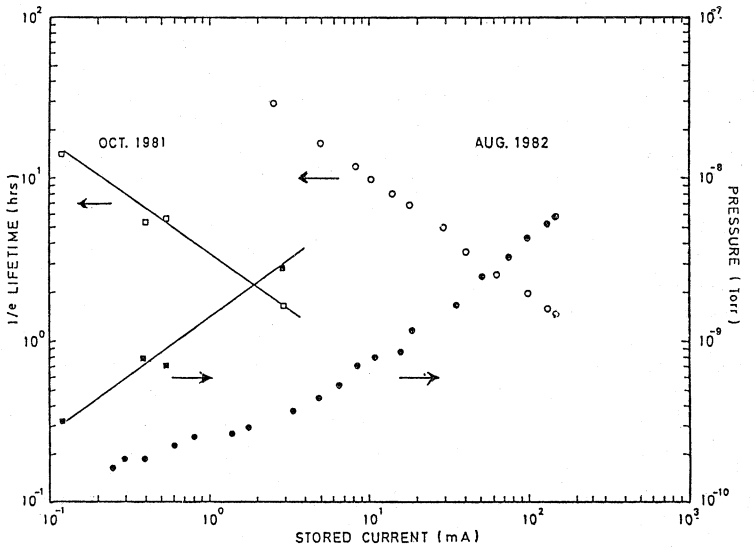

Fig. 2 Relations between stored current and 1/e lifetime and between stored current and pressure