THE OSAKA UNIVERSITY ELECTRON LINAC

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The 35 Mev Osaka University Electron Linac is special designed to generate ultra short and intense electron pulses for studies on transient phenomena in various fundamental scientific fields. The machine has been manufactured by System Science and Software (U.S.A.) and been operated since the begining of April, 1979. In this paper general specifications of the machine and its facilities are described.

The linac facility is located in the 2nd basement of the linac building and it consists of accelerator room, switch yard, control room and two irradiation rooms. The Klystron modulator and cooling system are installed at the 1st basment. The control and Klystron rooms are enclosed by the electromagnetic shieldings in order not to leak high level electro-magnetic noise from the Klystron modulator.

Specifications of the accelerating waveguide are listed in Table 1. The overall block diagram of the linac RF system is shown in Fig. 1. The Klystron is a Thomson-CSF TV 2022A, whose maximum output power is 20 MW and operating freqency is 1300 MHz. RF power from the Klystron is supplied into the buncher section and the accelerator waveguide through the power devider of which power ratio is about 1 : 3 under the optimum operation. In order to generate a ultra short time single pulse, a subharmonic prebuncher (SHPB) which is excited by the 216 MHz 20 KW RF source, is installed between the gun and the prebuncher. And pulsed electron beam of which half width is less than 3 nano second generated with the gun is injected towards the SHPB where the electron bunch can be velocity modulated and then focuses at the inlet of the prebuncher. The specifications of this linac discribed in Table 2.

The main transprot system is constructed in the switch yard area. For the observation of single pulsed electron, the Cerenkov light output produced by a fraction of pulsed electrons in a small Xe gas cell which is inserted in the transport tube, is used as a measurement of the pulse shape of bunched electrons. Just behind the Cerenkov radiator, 3 way bending magnet having three exits ports at 0°, 90° and 270° with respect to the strght transport line is installed. The energy spectrum measurement is carried out with the 90° bending, and the pulse radiolysis with pico second pulsed electrons, with the 270° bending. The electron beam passed straight or 45°-45° bending can be introduced into No. 1 or No. 2 irradiation room respectively. The beam spot size at each output window is about 3-5 mm dia.

The beam loading curves of the steady state mode (pulse duration 1.5 micro second) are shown in Fig. 2. Zero current beam energy with 13.8 MW RF input is 30 MeV. In case of 10 MW input, the minimum energy is decreased to 10 MeV. The loading curves of the transient mode are illustrated in Fig. 3. However, from the loading curve of 3 nano second pulse a relation between the energy shift and beam current is not measured distinctively. Figure 4 shows a typical Cerenkov light of pico second single pulse which was observed with a streak camera (Hamamatsu TV). The pulse width has been estimated to be 39.5 pico second and the total charge, about 14 nC without satellites.

Table 1. Specifications of the accelerating waveguide

Shunt impedance, r	40 Mohms/m
Figure of merit, Q	19,000 ($2\pi/3$ mode)
Attenuation length, 2IoL	0.834 nep (3.62 db)
Length, L	3.0 meters (40 cavities)
Initial atten. coeff., Io	0.0944 nep/m
Initial norm. group vel., Vg	0.0075
Electric field intensity, E	11.63 Mv/m
Fill time, τ	1.96 μs
Stored energy, J	24 joules (18 MW)
Operating Frequency, f	1300 MHz (λ=23.06 cm)

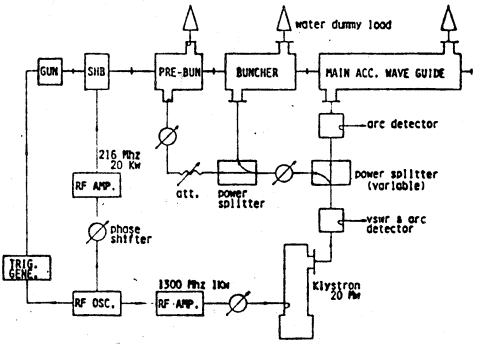
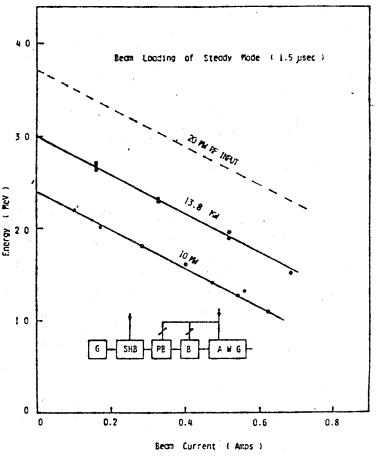


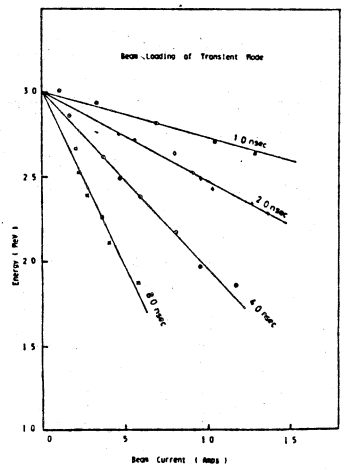
Fig. 1

Table 2. Specifications of the linac

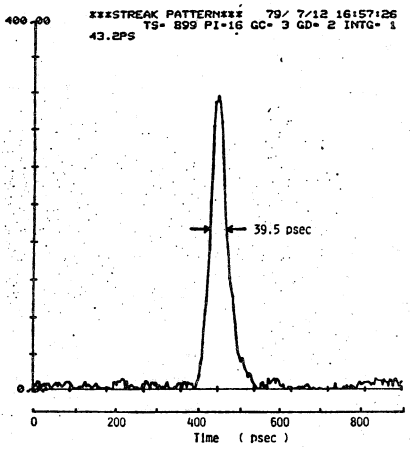
(Injector)			
Electron gun	Model 12 (ARCO Type)		
Applied voltage	100 KV DC		
Pulse dulation	3 - 100 ns (17 steps)		
	0.1 - 2.5 μs (continuous)		
Emission current	25 Amp. (20 ns), 6 Amp. (3 ns)		
(Modulator)			
High voltage	23 KV		
Thyratron	KU 275 C		
Repetition rate	10 - 360 PPS	420 - 720 PPS	
Pulse dulation	5 μs	2.4 μs	
PFN	18 section	9 section	
(beam)			
	Singl pulse mode	Transient mode	Steady state mode
Pulse dulation	40 Ps	3 - 100 ns	0.1 - 2.5 μs
Peak current	16.5 nC	16 Amp.	0.6 Amp.
Enrgy	35 MeV	35 MeV (zero current)	
ΔE/E	1 %	3 %	3 %



Flg. 2



Flg. 3



Flg. 4