

# STUDIES ON ELECTRON INJECTOR OF LINAC FOR PICOSECOND SINGLE BEAM

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## Abstract

A 35 MeV S-band linac with capability of producing picosecond single electron beams (pulse width  $< 18$  ps) has been used as irradiation sources of pulse radiolysis systems for research of radiation chemistry with a time response of 18 ps. Generally speaking, the intense irradiation sources are desirable for research of radiation chemistry. So the program to increase the intensity of picosecond single beam has been continued. The pulse width of emission from an electron gun must be less than 0.8 ns to produce a picosecond single beam without satellite pulses. To increase the intensity of picosecond single beam, the electron injector which can emit and transmit the intense and short electron beam is required. The development of electron guns and improvements of the focusing system will be discussed.

## Electron Gun

Electron gun which contain a grid-cathode structure taken from a planar triode was developed.<sup>(1)</sup> Short pulse response of the electron gun was measured using the grid modulator which has been used in the present linac system. The output current of  $\sim 4$  amps with pulse width of  $\sim 0.8$  ns (F.W.H.M.) is obtained. The output of the gun is shown in Fig-1. The perveance of the electron gun is  $\sim 0.18 \times 10^{-6}$ . The profile of the output beam is affected by the anode. To reduce the anode hole effect (as a concave lens), the anode hole with a mesh made of molybdenum is used. The electron beam profile with and without the anode mesh are shown in Fig.2. The electron gun has good high frequency response and is unexpensive. But the oxide cathode is used and has comparatively short life time at high current output. So the electron gun that contain a barium impregnated cathode is now being investigated.

## Beam Bunching and Capture Efficiency

Electron injector of the present system is shown in Fig-3. Electron beam emitted from the electron gun is bunched by the subharmonic pre-buncher (S.H.B) operated at 1/6 frequency of accelerating microwave and is further bunched by the prebuncher (traveling wave type) and also the buncher section of the accelerating waveguide I (Acc-I). When the emission with current of 5 amps and with pulse width of 0.8 ns is injected, the capture efficiency of 90 % is obtainable on calculation using one dimensional disk space-charge model. In the present linac system, the capture efficiency of only  $\sim 38$  % is obtained. So the improvement of a focusing system is also important for increasing the intensity of output beam and is now being investigated.

Beam Focusing System

As described, the transmission efficiency of the present injection system is not so good. The electron beam orbits, focused by various kinds of focusing systems, are measured at a test bench. In the present injector the beam diameter oscillate with considerably large amplitude, judging from the results obtained by using the test bench. The beam diameter affect the space charge force on Z-axis (accelerating direction). The larger the beam diameter becomes the weaker the space charge force on Z-axis becomes. The near parallel flow electron gun will be desirable to transmit the beam with constant diameter. The parallel flow electron gun has been developed by adjusting the shape of the gun electrodes. The beam profile of the near parallel flow gun is shown in Fig-2. The Brillouin flow which keeps the beam diameter 10 mm (same as the diameter of the cathode) is now being investigated.

Reference

- 1) H. Kobayashi et al. J. Fac. Engng Univ. Tokyo 1981, 36B, 85

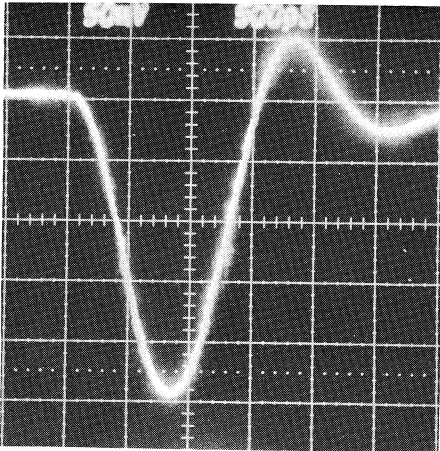


Fig.1 The output current of the gun. 1A/div, 500 ps/div

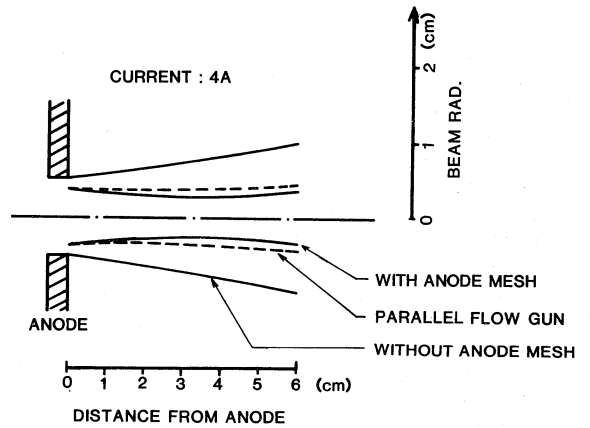


Fig.2 The beam profile of the gun

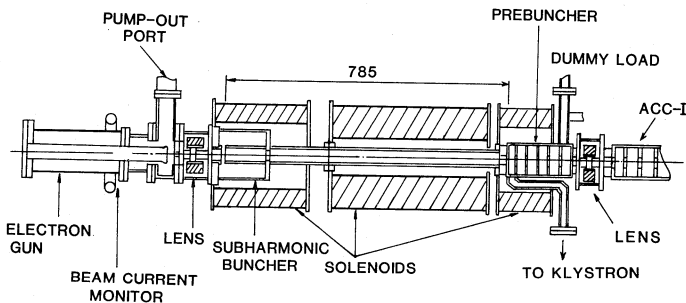


Fig.3 The block diagram of the injector