# A PLAN OF THE ACCELERATOR TUBE AND BEAM TRANSPORT SYSTEM OF $e^+$ GENERATOR LINAC

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Summary

A positron generator linac for the 30 GeV $e^+$-$e^-$ collider[1] is in the planning stage. One of the new developments necessary for the linac construction is to produce long accelerator tubes. The tube is useful for a short pulsed electron beam to accelerate effectively upto maximum energy within a limit of the existing RF power supply. This paper reports basic design parameters and the conceptual structure of accelerator tube.

## 1. Introduction

The positron generator linac is constructed in the site located at the west side in the upstream end of the PF injector. It consists of an electron accelerator and a positron accelerator. The positron beam in the linac is generated by a technique similar to that used at other electron linac.[2,3] An electron beam is accelerated in the former, and to the energy of about 200 MeV, it strikes a radiator located on the axis of the machine. A small fraction of the positrons emerging from the radiator is focused and accelerated to an energy of above a hundred MeV in which the RF phase is shifted by about 180°. The intensity of the positron beam (in the energy range from 5 MeV to 15 MeV) is less than one percent of the that of the electron beam striking the radiator.

The design parameters in the linac are listed in Table 1.

| | electron linac | positron linac |
|---|---|---|
| Energy | > 200 MeV | > 100 MeV |
| Beam current (max.) | 10 ∿ 20 A | 10 ∿ 20 mA |
| Beam pulse width | < 2 ns | < 2 ns |
| Repetitation | ∿ 50 pps | ∿ 50 pps |
| Particle numbers | | $1.2\sim2.4\times10^8 e^+$/pulse |
| Operation freq. | 2856 MHz | 2856 MHz |
| Accelerator guide numbers | 3 ∿ 6 | 2 ∿ 6 |
| Accelerator guide length | 4 ∿ 6 m | 4 ∿ 6 m |
| Klystron numbers | 3 ∿ 4 | 2 ∿ 3 |
| RF power per klystron | ∿ 25 MW | ∿ 25 MW |

Table 1 Parameters of $e^+$ generator linac

## 2. Accelerator Tube

In order to increase the yield of positrons due to conversion process within a short time, accelerating the intense and high energy electron beam with a short pulse period is indespensable. We examined the effective acceleration method on condition that accelerator tubes with definite length are operated using the definite PF power supply. From the above beam specification we concluded that a single long tube with a single RF feed is better than multiple short tubes with multiple RF feed. An acceleration unit consists of accelerator tubes and waveguide system. The unit using the single tube becomes a simple structure in which waveguide system needs neither power divier nor phase shifter for high power driving.
Therefore, the construction cost per unit is inexpensive.

For operation with an intense beam loading, energy gain of electron beam decreases gradually from head to tail in the period of the beam pulse, because the overall beam energy is supplied from the energy stored only in an accelerator guide.[4] Another reason of the energy gain decrease is the existence of the wake field, which is induced in the guide by an intense beam.[5] The energy gain can be accurately calculated in such a transient condition.[6] We are carefully examinning the accelerator structure suitable for the above case.

The long accelerator guide is manufactured by the method of connecting a 2m accelerator guide to the other by the electro-plating forming, as shown in Fig. 1.

We are investigating characteristics in two different types of acceleration units. The one consists of a 6 meter accelerator tube and the another consists of two 4 meter accelerator tube.[7] In the former, the guide is connected to a klystron through a single waveguide. In the latter, the two tubes are connected to two waveguides, respectively. Output power one klystron is divided into two waveguides by a power divider and fed to each accelerator tube. In each type, the accelerator tube is jointed together eigher two disk loaded waveguides or three one of each the 2 meter long one. The 2 meter one is manufactured by the electro-plating forming. Figure 2 shows the specific characteristics of the electron linac with intense beam loadings in the above two types.

## 3. Beam Transport System

The beam transport system is devided into two sections. The focusing system of the former upstream section of the e+ radiator consists of magnetic lens, focus coils and quadrupole triplets. The magnetic lens and focus coils are used upstream of the buncher. The quadrupole triplets are used behind every accelerator guide. The latter section consists of focus coils, quadrupole triplets and an achromatic bending system. The focus coils are used on both sides of the radiator and on the first accelerator guides. The quadrupole triplets are used behind every guide as the former part.

The positron beam is transmitted by an achromatic beam transport system from the exit of the positron linac to the head of acceleration unit (1-5) and is accelerated at a high energy by the remaining acceleration units from (1-5) to (5-8) of the PF injector. An outline of the positron generator linac is shown in Fig. 3.

## References


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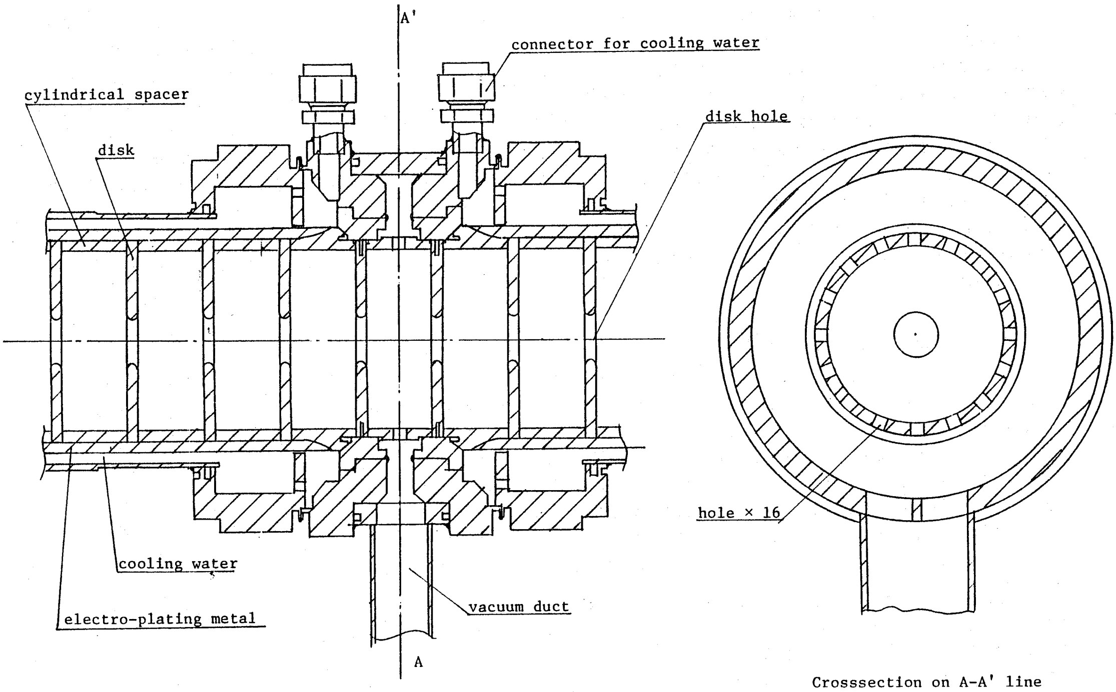


Fig.1 Cross section of an connection part in a long accelerator tube.

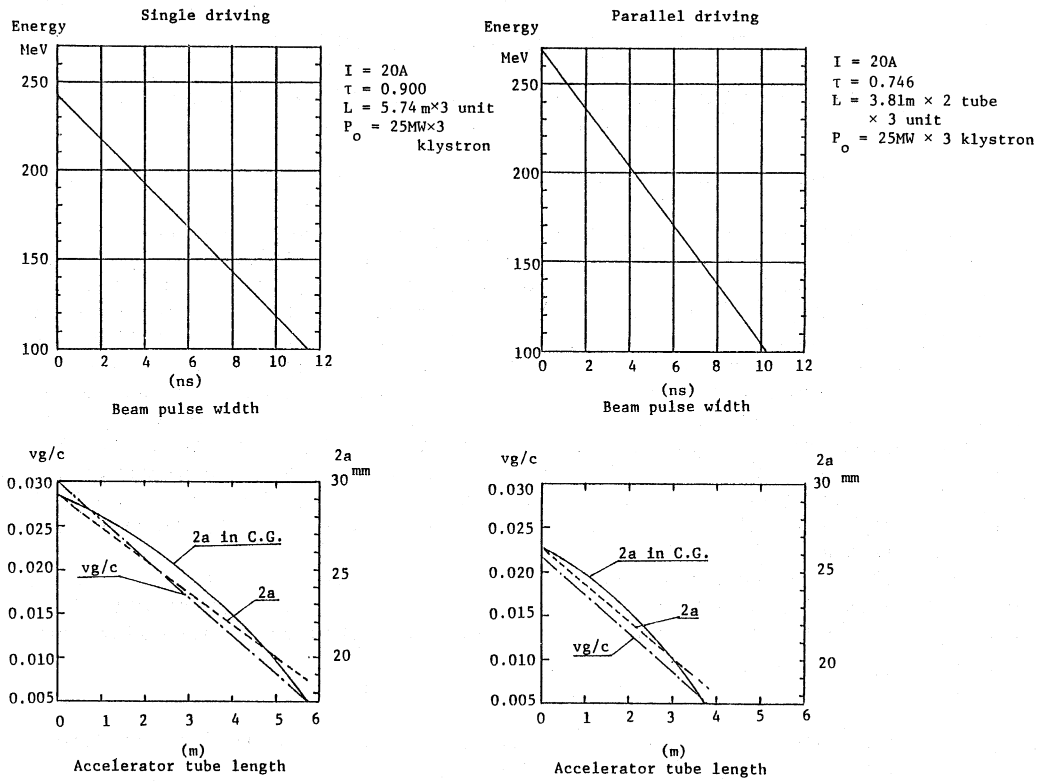


Fig.2 Specific characteristics of the electron linac with intense beam loadings in the two types.

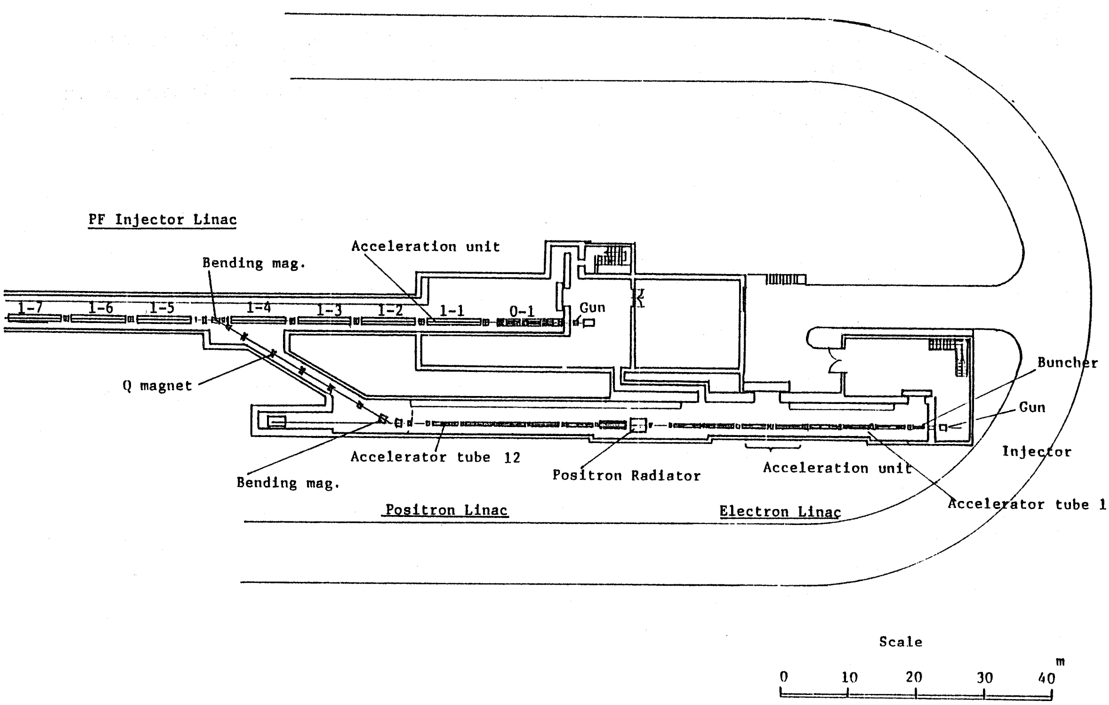


Fig.3 An out-line of the positron generator linac reference.