DEVELOPMENT OF HIGH POWER KLYSTRON SYSTEM

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ABSTRACT

Conceptual microwave system for a linear collider test facility is described. The microwave system is composed of booster amplifier (pulse, 2856 MHz) and four or more high power klystrons. The output power of the klystrons is 100 MW. The power of each klystron is added and fed into accelerator waveguides.

Two sets of 5045 (SLAC) klystron and its modulator are now under construction as a prototype unit of this system.

1. Introduction

An e^+e^- linear collider in the TeV region is one of the various proposals for future accelerators beyond LEP energy. It requires traveling wave accelerating structures operating at a field gradient of about 100 MV/m or more. To realize this high field gradient, high power microwave sources are required with a peak output power of about 1 GW/m and with a frequency between 10 GHz and 20 GHz.[1] Since such a linear collider is much beyond the level which can be achieved with conventional technology, R&D has started in various laboratories like SLAC, CERN, KEK and so on.

In KEK, it was decided to construct a linear collider test facility ($\sim$ 1 GeV with a field gradient of about 100 MV/m) within three years with the aim of applying it in future e^+e^- linear colliders.[2] The conceptual microwave system for this test facility will be described in section 2. The prototype unit using SLAC S-band 5045 klystron will be also described in section 3.

2. Conceptual microwave system

Figure 1 shows a conceptual microwave system for our test facility. This system is composed of one booster amplifier (pulse, 10 kW, 2856 MHz) and four high power klystrons (pulse, $\sim$ 100 MW, 2856 MHz). Since it is not possible for us to get high power microwave sources in X- or C-band at the present stage, we decided to operate our test facility in S-band (2856 MHz). If we can improve the power output of each klystron up to 200 MW, accelerating field gradient of $\sim$ 90 MV/m will be achieved in this test facility.

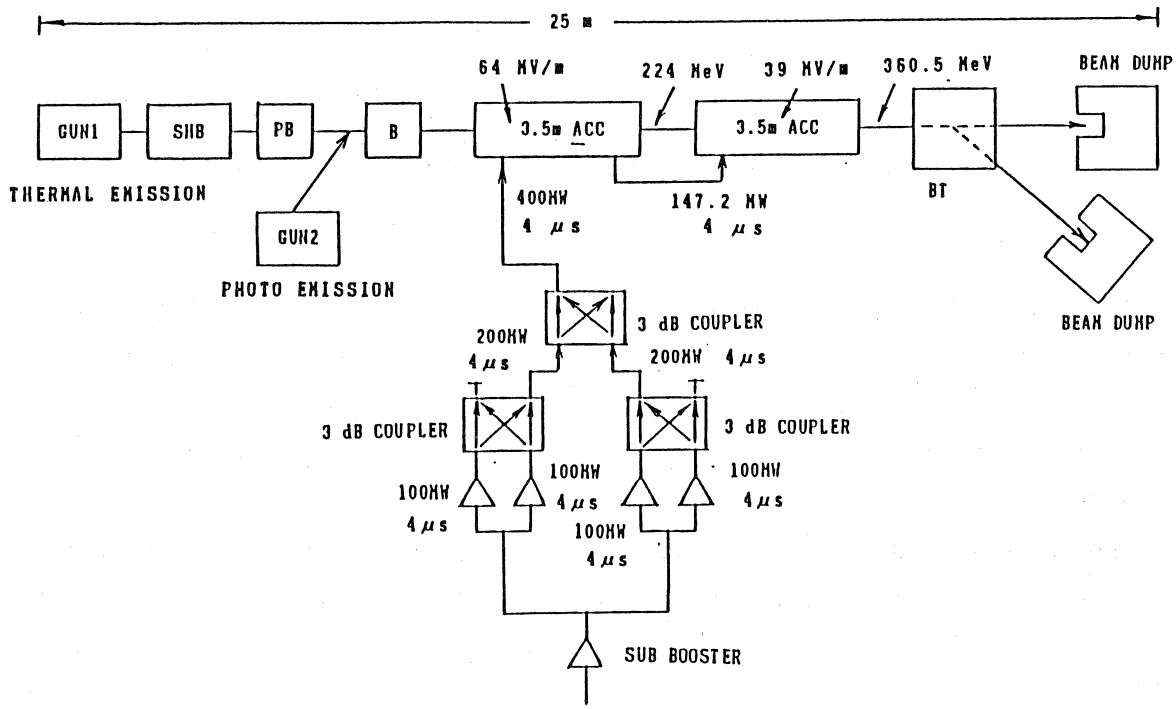

Fig. 1 Conceptual microwave system for the linear collider test facility

3. Prototype klystron unit

Two 5045 klystrons (SLAC)[3] are introduced as a prototype microwave source for the test facility. Table 1 shows the specifications of 5045 klystron. When the microwave pulse width is shortened down to 1 μsec, 5045 type klystron can produce more than 100 MW.

Table 1 Specifications of 5045 klystron

RF power (peak)	67 MW
Voltage (peak)	350 kV
Beam current (peak)	410 A
Microperveance	1.98
Efficiency	47 %
RF pulse width	3.5 μsec
Pulse repetition rate	120 pps
RF gain	50 dB

Two pulse modulators are now under construction, which supply modulated power to the high power 5045 klystron. Specifications of the modulator are listed in Table 2.

Table 2 Specifications of 5045 klystron modulator

Peak power output	250 MW	
Average power output	25 kW	
Output pulse voltage	32.2 kV	
Output pulse current	8,120 A	
Output impedance	4 Ω	
Pulse width	3.5 μsec	
Repetition rate	30 pps	
Pulse height deviation from flatness	< 1 %	
Pulse amplitude variation and drift	short term	< 0.5%/5min
	long term	< 1%/hour

These two modulators will be fabricated at the end of this fiscal year. Using these prototype microwave sources, we are now planning to make tests of high gradient accelerating structures and to develop high power klystrons.

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References

1) R. Palmer; Proc. of the 1987 workshop on new developments in particle acceleration techniques, Orsay, France, 29 June - 4July, 1987.
2) K. Takata; This meeting.
3) T. Lee et al.; SLAC PUB 3214 (1983).