Ⅵ-2 MONITORING SYSTEM OF PICOSECOND PULSES OF 35 MEV TODAI LINAC

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I. Abstract

Picosecond single pulse operation of a S-band linear accelerator at Nuclear Engineering Research Laboratory of University of Tokyo (in Tokai-mura) has been carried out from June in 1977. It was reported that the pulse width was confirmed to be less than 18 ps by using a streak camera (Hamamatsu T V).[1)2)] This paper describes monitoring system combined fast detector heads and a sampling oscilloscope (rise time is less than 25 ps). Shapes of picosecond pulses have been measured by the monitoring system. The rise time of the pulse shape and the half width of the pulse were confirmed to be less than 30 ps and 60 ps, respectively. It was confirmed that the satellite could be distingiushed from the main pulse, by using this monitoring system.

II. Monitoring System and Results

Block diagram of the measuring system is shown in Fig. 1. The monitoring system composed of fast detector head, connecting cable, and sampling oscilloscope. There are three cases with different cable length. Fast detector heads are types of co-axial line target. Photo. 1 shows fast detector heads. External trigger is synchronized with microwave of the linac.

(1) Effect of Cable

Fig. 2 shows the dependence of the rise time of the pulse on the length of the connecting cable. The detector head is an GR-air line (one of 50 Ω co-axial line targets). Photo. 2 and Photo. 3 show the fine structure pulses of electron beam measured by using the GR-air line system with 7.5 m and 1 m semi-rigid connecting cable, respectively. The half width of pulses becomes shorter with decreasing the cable length.

(2) Response of Fast Detector Heads

Fig. 3 shows characteristics of fast detector heads. Co-axial line targets with smaller radius were confirmed to have faster response. Photo. 4 and Photo. 5 show pulse shapes measured by using Type-1 (1.4 mmϕ) and Type-3 (25 mmϕ), respectively.

(3) Pulse Shapes of Picosecond Single Pulse

Photo. 6 shows the pulse shape of the picosecond single pulse measured by using the fast detector head, Type-1 (1.4 mmϕ). The satellites can be confirmed before the min pulse.

III. Conclusion

(1) To remove the dispersive distortion due to the long co-axial cable, the sampling head is located near fast detector heads. The sampling head can be directly connected with detector head without connecting cable. The sampling head is located remotely from the main frame of the oscilloscope. The output signal from the sampling head is low frequency and can be transmitted to the main. osilloscope display circuits without distortions. The rise time of the pulse shape and the half width of the pulse were confirmed to be less than 30 ps and 60 ps, respectively.

(2) Rise time of Type-1 (1.4 mmϕ) is the fastest in this experiments.

(3) Characteristics of semi-rigid cable is best for the high-frequency signals.

(4) Total jitter of the monitoring system using the sampling oscilloscope is within 30 ps as judged by the width of traces of the sampling oscilloscope.

(5) Satellites located before the main pulse can be distinguished by using this monitoring system. However, satellites located after the main pulse cannot be distinguished easily.

Reference

(1) Y. Tabata, J. Tanaka, S. Tagawa, Y. Katsumura, T. Ueda, K. Hasegawa J. Fac. Eng. of Univ. of Tokyo (1978)

(2) Y. Tabata, S. Tagawa, Y. Katsumura, T. Ueda, K. Hasegawa, J. Tanaka J. Atomic Energy Soc. Japan, 20, 473 (1978)

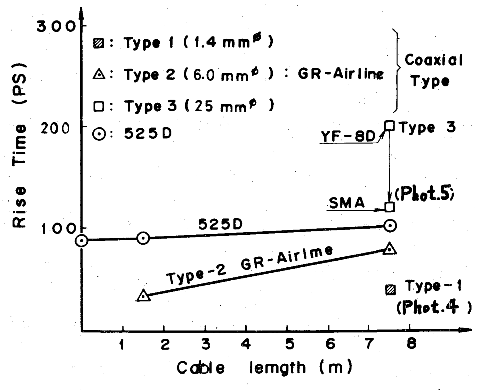
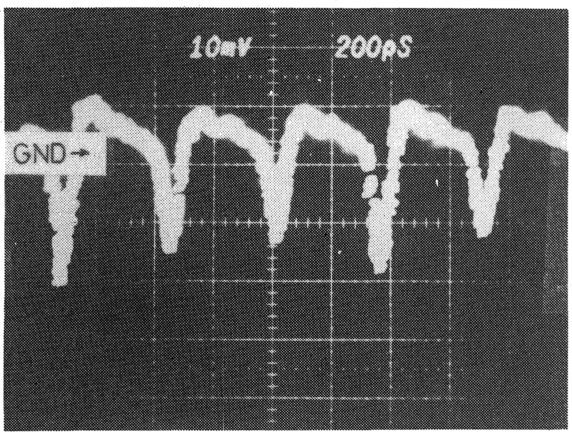
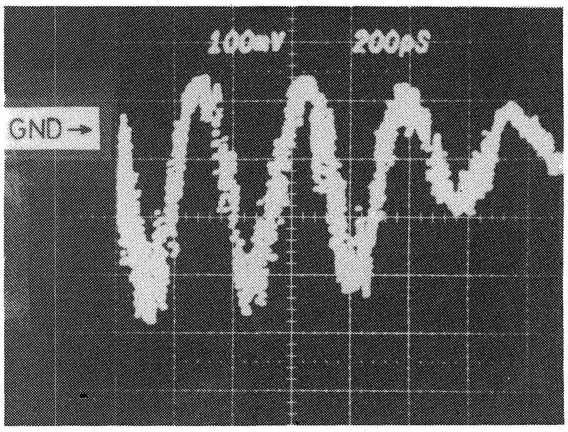


Fig. 3 Dependence of response on both detector heads and connecting cable length.



Phot. 4 Fine structure pulses measured by using Type-1(1.4 mmφ) co-axial detector head.



Phot. 5 Fine structure pulses measured by using Type-3(25 mmφ) co-axial detector head.

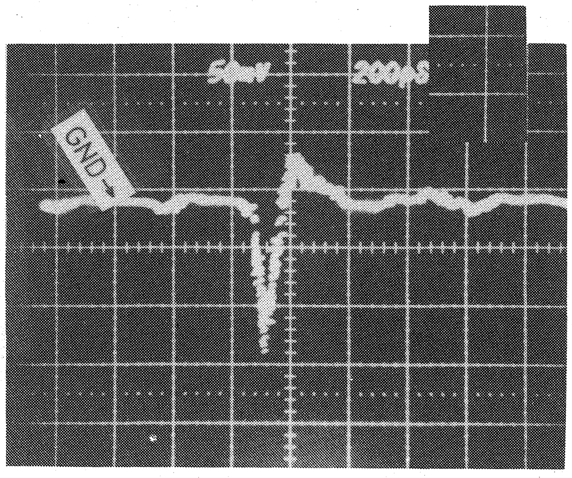


Photo. 6 Pulse shape of the picosecond single pulse with small satellites measured by using the Type-1(1.4 mmφ) co-axial detector head.

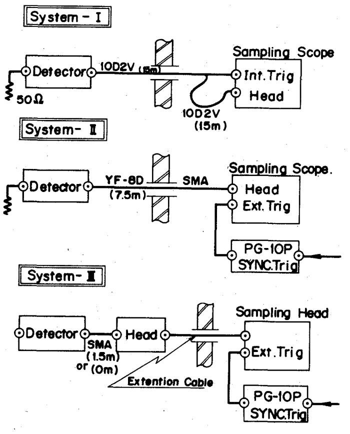
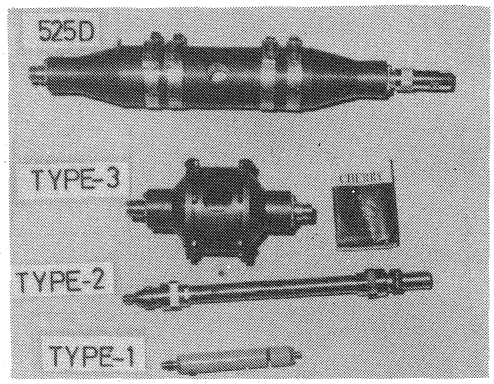


Fig. 1 Monitoring system



Phot. 1 Several detector heads; 525D, Type-3(25 mmϕ), Type-2(6 mmϕ, GR-air line), Type-1(1.4 mmϕ) from upper part.

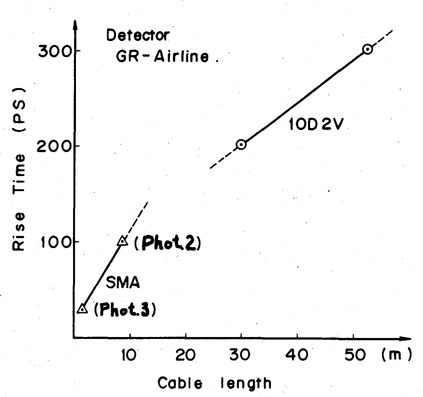
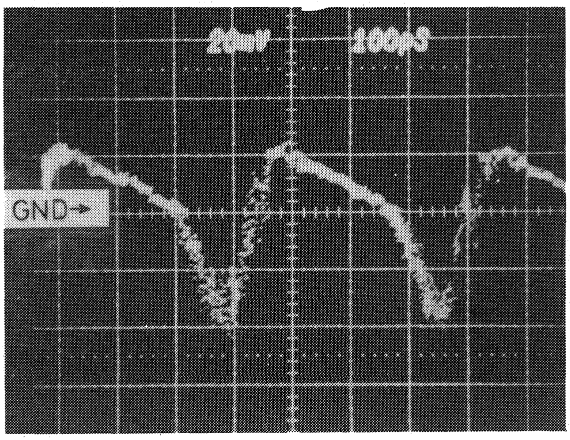
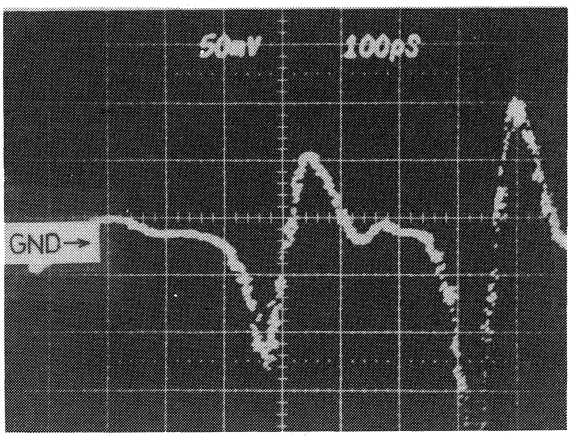


Fig. 2 Dependence of response on cable length



Phot. 2 Fine structure pulses measured by using a GR-air line with 7.5 m semi-rigid connecting cable.



Phot. 3 Fine structure pulses measured by using a GR-air line with 1.0 m semi-rigid connecting cable.