

V-1 THE CHARACTERISTICS OF TODAI-LINAC

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Abstract

When using single picosecond pulse mode, the following things are very important,

- (1) To get a stable main pulse without satellite
- (2) To get a pre-trigger, which has small jitter against the output beam

Satellite occurs under the condition that the width of injected beam pulse from the gun is longer than 0.7 ns or jitter of injected beam is large. It is very difficult to measure the jitter of each component especially in operating, because there is not the non-destructive monitoring system for short pulse at each component of linac.

But some informations can be obtained from computer simulation and measurement of the relation between output beam and each parameter.

I. Timing system for easy adjustment

Fig. 1 shows the present timing system. A new phase shifter for the timing adjustment of injected beam from the gun is newly attached. This new phase shifter is made of several pieces of very short cable and remote controlled relays. Phase of injected beam is varied by step of 100 ps. It takes long time to adjust the optimum timing when the timing of injected beam is fixed, but attachment of new phase shifter can take shorter time for optimum adjustment.

II. Problem of satellite

When the microwave of S.H.B is not fed, the envelope of the output beam shows the shape of injected beam. (Fig. 2)

Single pulse can be obtained from 5 fine structures. So the S.H.B gathers these 5 fine structures into single fine structure. In this case the F.W.H.M. of injected beam from the gun is 0.7 ns.

In daily adjustment, at first the bias voltage of the electron gun should be set at the point where just only five fine structure can be accelerated, when the microwave power of S.H.B is not fed.

After the microwave power of S.H.B is fed and the timing of each component is adjusted optimum, then the main pulse accompanied with very small satellite can be obtained.

On the other hand Fig. 3 shows the shape of pre-bunched beam by S.H.B at the first

cavity of the pre-buncher section, which is simulated by a computer. In this case the F.W.H.M of injected beam from the gun is 0.7 ns and the shape is triangular. The whole width of bunched beam by S.H.B at the first cavity of the pre-buncher section is about 500 ps.

The main pulse accompanied with 1 % satellite is obtained by calculation.

Fig. 4 shows the case in which the F.W.H.M of injected beam from the gun is 1 ns. In this case the beams spreads over five periods of 2856 MHz at the first cavity of the pre-buncher section. As a result, the main pulse accompanied with 7 % satellite will be obtained by computer simulation.

Usually, the main pulse with 7 % satellite is not suitable for experiments. As a conclusion, the width of injected beam from the gun should be shorter than 0.7 ns judging from daily adjustment and calculation.

III. The stability of the injected beam from the gun and satellite

As previously stated, the width of bunched beam pulse at the first cavity of the pre-buncher section is rather wide. This means that if injected beam from the gun has some jitter, satellite will increase.

Fig. 5 shows the dependency of the intensity of satellite on the phase shift of injected beam from the gun against S.H.B. The intensity of satellite does not change 70 ps-phase shift as shown in Fig. 5 and neither change within short time (1~2 hours) operation of the linac. So the jitter of injected beam from the gun is found to be less than 70 ps within short time.

IV. Jitter between the output beam and pre-trigger

Two reasons are estimated as a cause of jitter between the output beam and pre-trigger. In Todai-Linac system, both pre-trigger and very fast pulse for the grid pulser are made in a very fast pulse generator.

One reason is estimated that jitter occurs between pre-trigger and fast pulse for the grid pulser in the very fast pulse generator.

The other reason is estimated that jitter exists between microwave (119 MHz) and synchronized trigger. This synchronized trigger drives the very fast pulse generator. So, if the jitter between microwave and synchronized trigger exists, the injected timing of beam from the gun is different from the phase of microwave of S.H.B. But S.H.B gathers injected beam in the almost same phase of pre-buncher even if the timing of injected beam from gun is different within small range.

And beam will be accelerated on the same phase of pre-buncher, ACC-1, and ACC-2. As a result, jitter occurs between output beam and pre-trigger. It is estimated that the synchronized trigger contains main part of total jitter because the synchronized circuit is thought to be weak in noise. And in fact, jitter depends on the amplitude of noise.

When a streak camera is used, total jitter is about 40 ps and when a sampling scope is used, total jitter is about 30 ps.

V. Conclusion

Picosecond single pulse operation of Todai-linac has been well done during this one year from June , last year. At beginning, it took very long time to adjust the mode of picosecond operation and adjustment was very difficult. But recently the adjustment becomes very easier and takes shorter time. Main pulse which is stable and accompanied with very small(usually satellite is not recognized) satellite can be obtained.

Next problem is to increase output beam. For that purpose we are investigating an electron gun which has very good frequency response and high current output.

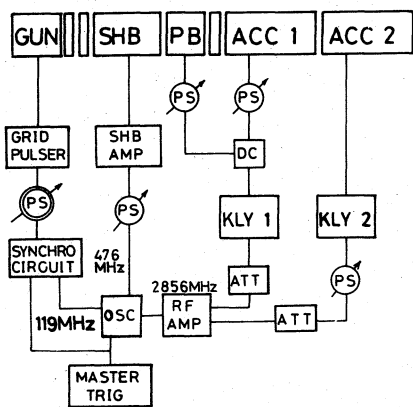
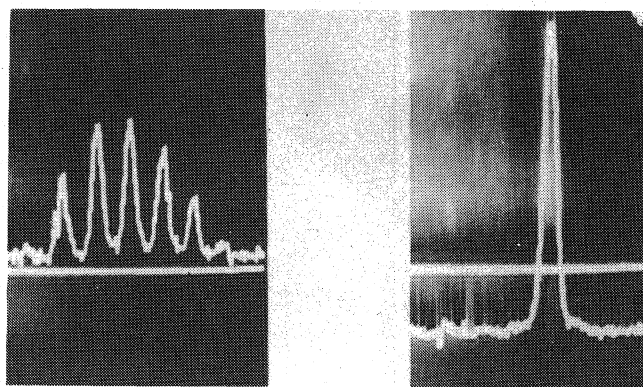


Fig. 1 Timing System



SHB Off SHB ON
Fig. 2 The shape of output beam

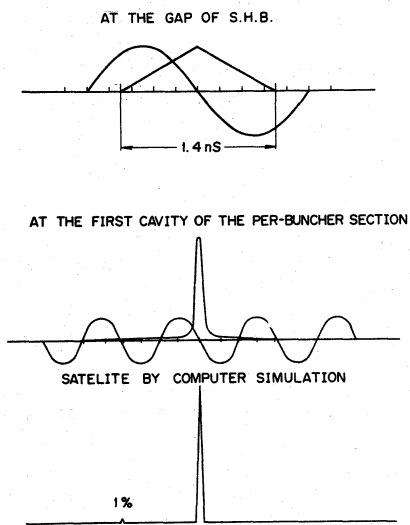


Fig. 3 Satellite (1)

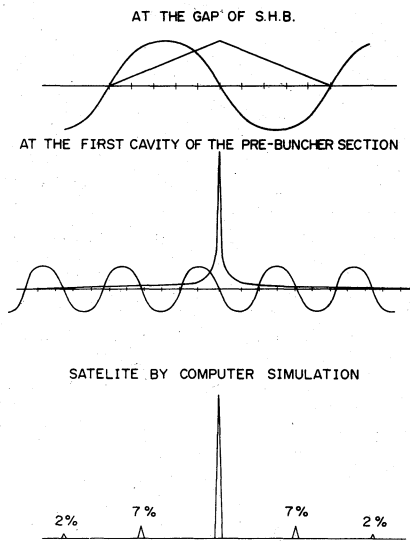


Fig. 4 Satellite (2)

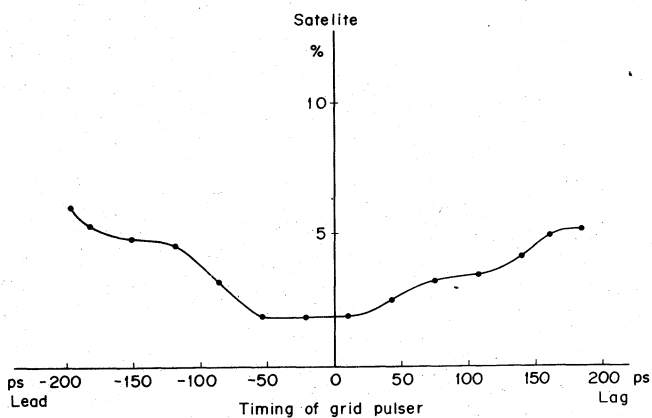


Fig. 5 Satellite and timing of grid pulser