MEASUREMENT OF PICOSECOND PULSES OF 35MeV TODAI-LINAC (II)

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To perform the pulse radiolysis study with high time resolution using picosecond pulses,it is necessary to characterize the profile and the width of pulses.Several methods to determine the pulse width have been tried.Characteristics of the detection methods have been compared each other and the results are mentioned.

Detection methods of picosecond electron pulses are divided into two groups(Table 1).One is direct method and the other is indirect one.Assuming that the intensity of Cérenkov radiation which is emitted from electron(>21MeV) travelling in air is proportional to electron density,the electron pulses can be detected by optical detecters such as streak camera,photodiode and photomutiplier. On the other hand,electron itself or induced current around beam is used as electrical methods including co-axial line target and core moniters.

when sampling technique with high time resolution is employed, a syncronous trigger having small jitter and high stability of linac system are required. It must be noticed that time resolutin of detection is strongly dependent on the length of the signal transfer cable. Attenuation of the cable is also dependent on the frequency of signal.

Width of single pulse can be calculated from the energy dispersion,indirectly. From the output of cavities connected with core moniter or co-axial line target,amplitude of higher order harmonics of microwave frequency(2856MHz) are obtined. The pulse shape can be reformed and analized based on Fourier analysis.

Measuring system of pulses is shown in Fig.1. A trigger accurately syncronized with electron pulse is easily obtained from the pulse generator(PG-10P), before electron beam arrives to the detecter head . In Fig.2, it is clearly seen that a 10ns macro pulse contains a number of fine pulses with 350ps separation. Fine structures of 2ns pulse detected by streak camera, co-axial line target and core moniter are shown in Fig.3. It is found that the larger the signal transfer cable, the poorer the time resolution. At present, it is believed that a streak camera has the highest time resolution among our detecters. In addition, it has an advantage that the profile of electron beam can be measured more quickly than other optical detecters such as photodiode combined with sampling scope. Bunch width of electron beam was obtained to be 18ps by comparing the width with the separation of fine pulses,350ps,in Fig.4. Considering both poor focusing of Cérenkov radiation and resolution of streakcamera, the value of 18ps may be larger than true one. However, true pulse width is expected to be ~10ps from theoretical calculation.

TABLE 1 Detection methods of picosecond electron pulses

- Direct method
  - Optical...Cerenkov radiation
    streak camera, photodiode
  - Electrical...electron itself
    or induced current
    core moniter, coaxial line
    target
- Indirect method
  energy spectrum
  Fourier analysis → pulse width

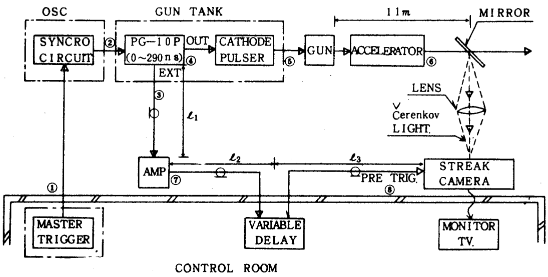


Fig.1 Measuring system of Todai-Linac.

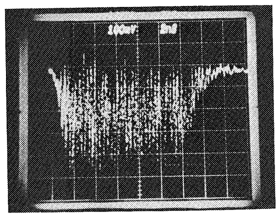
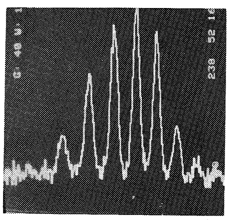


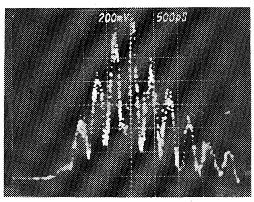
Fig.2
10ns pulse measured by co-axial type Faraday cup.

Fig.3

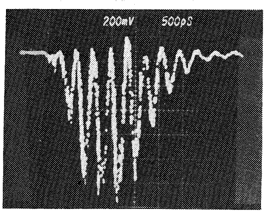
Fine structure of 2ns pulse measured by streak camera(a) and sampling scope with core moniter(b), and co-axial line target(c),(d).



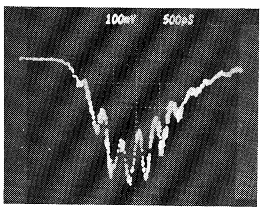
(a)



(b) 15m 10D-2V

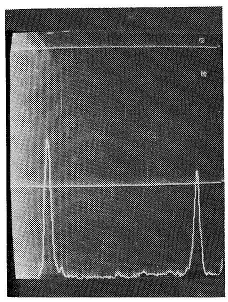


(c) 7.5m 10D-2V



(d) 30m 10D-2V

Fig. 4
Fihe structure of 10ns pulse measured by streak camera.



|← 350ps →|