BUNCH MONITOR OF LINEAR ACCELERATOR

M.Washio, S.Tagawa, Y.Katsumura, T.Ueda, Y.tabata

*J.Tanaka, *I.Sato, and *S.Fukuda

Nucear Engneering Research Lab.,Univ. of Tokyo

*National Laboratory For High Energy Physics

In the studies of accelerating mechanism of particles and in the operation of linac, monitoring of the bunched beam is important. To detect the bunched beam, the very wide-band monitors are required. (For ex. up to 20 GHz, for electron linac)

In addition, it is necessary to consider the frequency characteristics of the transmission line and the synchronization of trigger pulse respect to the bunched beam. New bunch monitors and detection systems were recently developed and the preliminary test was performed at the Tokyo Univ. (the Todai linac) and KEK.

Furthermore, the measurements of the harmonics generated by the bunched beam were carried out and these results were analized by " Fourier Transformation " method.

Measurement of Bunched Beam by Sampling Scope

Fig.1 shows a one-turn core monitor which is one of the monitors we have developed.

Usually it has been believed that a core monitor is unsuitable to detect a very fast signal, however, this recently developed monitor is confirmed to have a very fast time resolution. Fig.2 shows a monitoring system of bunched beam in long pulses (4.5 μs) of the Todai linac.

The experimental results obtained with this system are shown in Fig.3 .

A train of bunched beam of 350 picoseconds interval was successfully observed. The shape of a single bunched beam was also measured using the same monitor.

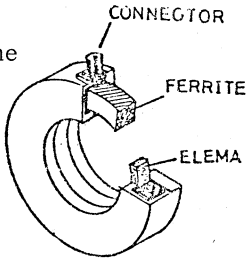

Fig.1 One-turn Core Monitor

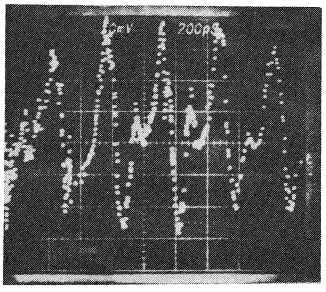

Fig.3 A train of bunched beam of 350 ps interval

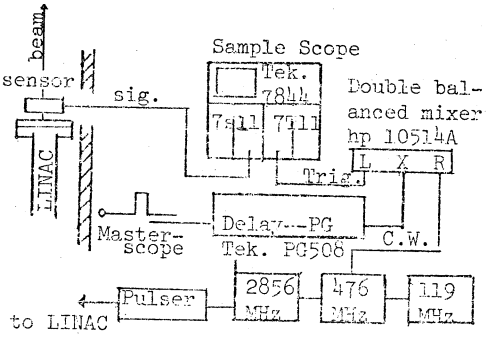

Fig.2 Monitoring system of bunched beam

Fourier Analysis

As the bunched beam of a linac has components of its fundamental frequency (f_0) and higher harmonics (nf_0, n=2,3,···), it is possible to reproduce the bunch shape by summing up these higher components. Reproduction of the bunched beam is possible by using this principle.

It was found that the loop monitor (Fig.4) is capable to pick up the higher harmonic components of bunched beam.

The pick up signal is transmitted from the loop monitor to the band-pass filter (variable coaxial cavity) and the amplitude of each component of higher harmonics is measured.

Then the shape of the bunched beam can be reformed by composing of each harmonic. The harmonics up to the fifth component were measured, and the shape on the sampling scope was compared with the shape composed of these harmonics.

Fig.5 shows bunched beam of KEK proton linac. The similar method is also applied to the analizing of bunched beam of Todai linac.

As mentioned above, Fourier Analysis is powerful for the measurement of bunched beam.

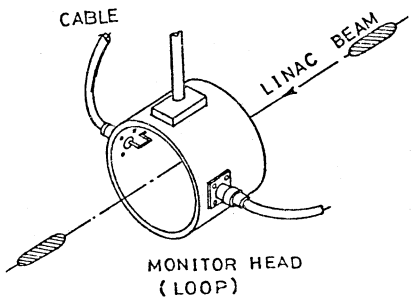

Fig.4 Loop monitor

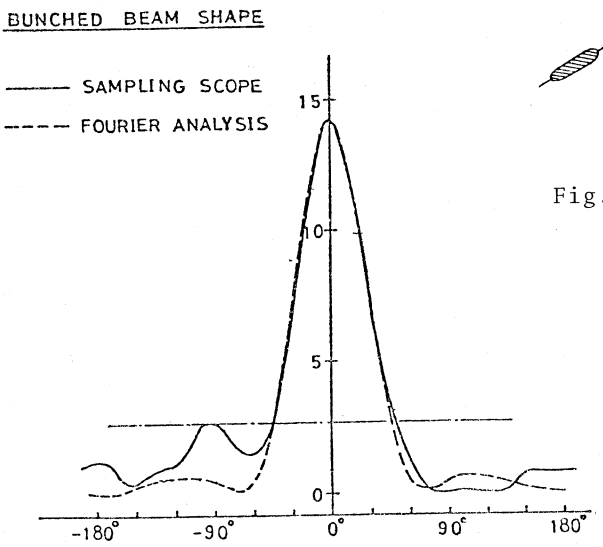

Fig.5 Bunched beam of KEK proton linac