national accelerator laboratory

EXP-33

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ACCELERATOR EXPERIMENT--Coherent Oscillations in the Booster

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This note summarizes the present state of the observation of coherent oscillations in the booster.

1. Radial. With sextupoles off and radial feedback off, there is a spontaneous, persistent radial coherent oscillation that corresponds to the lowest mode of the resistive-wall instability, of frequency

$$f = (7-\nu_x)\ f_o,$$

where f_o is the revolution frequency.

There is also an induced radial motion with the vertical kick described below, possibly because the vertical kicker may be slightly rotated. This oscillation, which is shown in Fig. 1b, damps rapidly.

2. Vertical. a. With sextupoles on at the usual operating value of 25A, there is a persistent, but not spontaneous coherent vertical motion. It is started by a vertical kick, dies partly away, and starts up again. This is shown in Fig. 1, where the charge detector is the upper trace and the L20 vertical detector is the lower trace. The sweep speed is 2 msec/div. Fig. 1b has the L20 horizontal detector as tht lower trace. Note that the beam is lost at transition energy.

b. With sextupoles off, there is a spontaneous vertical coherent oscillation, shown in Fig. 2 at a sweep speed of 2 msec/div and in Fig. 3 at a sweep speed of 10 μsec/div. The beam is again lost at transition energy. (Perhaps some head-tail effect is present.) The threshold is approximately 12 mA of beam current (measured by Hubbard). The scrapers were used to show that there is vertical beam loss associated with the vertical oscillation.

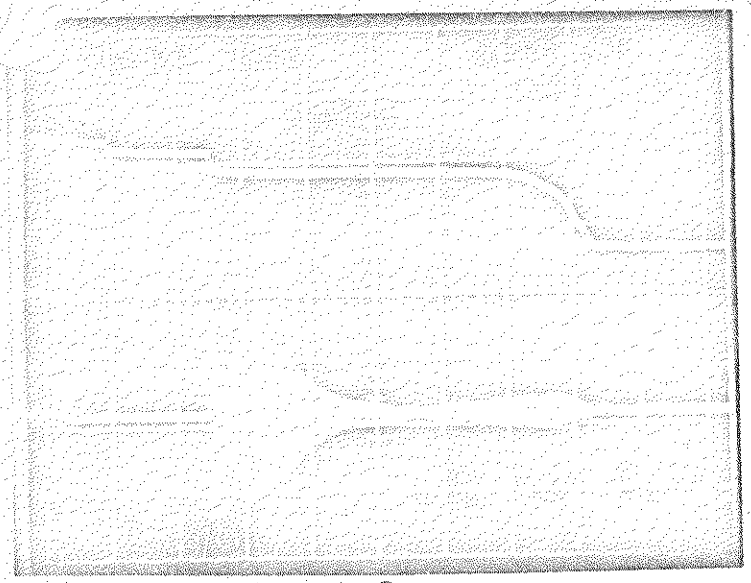
The frequency measured from Fig. 3 (and with a signal generator) is 142 kHz. The value of ν_z calculated from this is 6.766, in good agreement with other measurements.

Many higher modes were observed. These are tabulated below:

n	$(n-\nu_z)f_o$	Measured Frequency
7	147.8 kHz	142 kHz
8	763.9	763
9	1380	1377
10	1996	1993
11	2612	2612
12	3228	3190
13	3844	3851, 3858

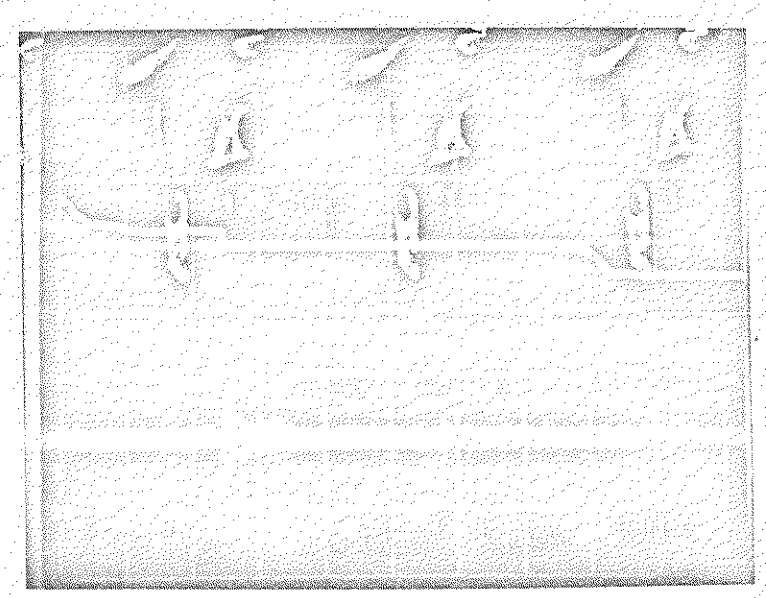
F. T. Cole

With 10KV Vertical Kicker (Notcher)
similar pictures as 0100 can be obtained with any starting time for kick



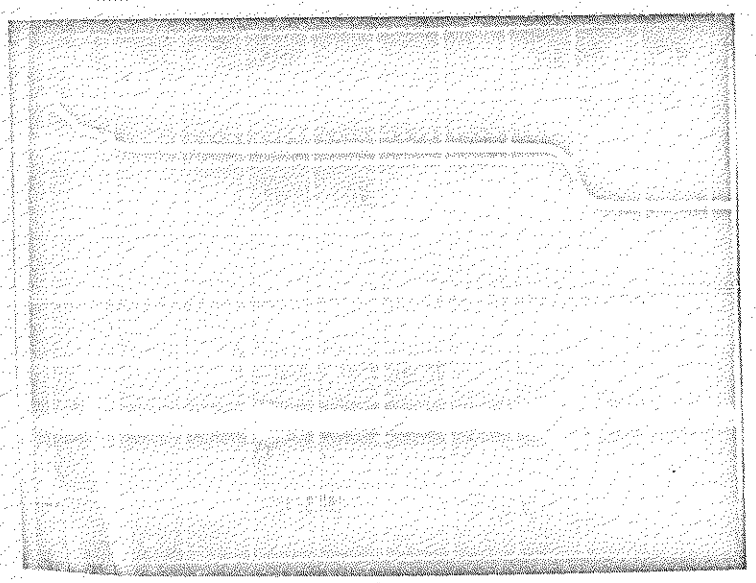
NOTCHER ON

Vert. (1a)



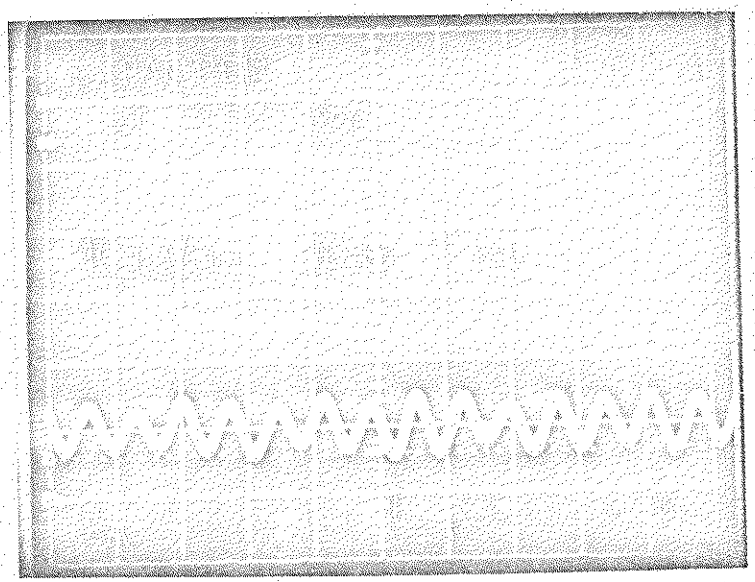
Horiz. (1b)

Spontaneous VERTICAL Osc → VERTICAL LOS



NOTCHER OFF

(2)



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