

Longitudinal Impedance Measurements VIII

E. Raka

December 1978

Collider Accelerator Department
Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No.EY-76-C-02-0016 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Date 12/22/78 Time 0000-0600 Experimenters E. Raka, L. Ahrens, E. GillSubject Longitudinal Impedance MeasurementsOBSERVATIONS AND CONCLUSIONProcedure:

As usual a long flat top was set up at ~ 5 GeV and both the frequency synchronization loop and the radial loop controlling the flat top voltage were closed. A new feature was the presence of a third loop that servos the field on the flat top to a fixed Gauss clock setting. This loop is disabled prior to closing the radial loop, however. This did not improve the operation of the frequency loop which still causes beam shake-up on many pulses.

Due to problems with the linac, MG set and the high level rf system plus set-up time, less than half the period was available for measurements.

Observations and Results:

The upper dipole and quadrupole lines at $h = 13, 14$ ($n = 1$) were excited and values of $f_q - 2f_d = -20, -18$ cycles were obtained. These are larger than found on the last two runs at this energy, and since the bunch length was also somewhat longer (~ 35 nsec) the resulting Z/n was $\sim 147 \Omega$. The $V_{ext} = 238$ kV at a setting of 1500 for ten stations and the bunch area was $\sim .69$ eV-sec again larger than for runs 117, 116.

A more detailed measurement of the dipole mode amplitude was made at $h = 14$ as a function of frequency. Observations were made from $(26 f_o + f_d)$ to $(122 f_o + f_d)$. These indicated a spectrum closer to that for sinusoidal modes, but with less of a fall-off at higher frequencies.

An interesting effect was observed when one of the rf stations was locked out (KL) with a high value of its Vernier current present. This shifted the $h = 13$ quadrupole frequency by $+19 \sim$ so that $f_q - 2f_d \approx -1 \sim$. For the $h = 14$ line the shift was only about $+5$ cycles. Also, one noted that the dipole line exhibited some spontaneous growth and the width of the quadrupole lines was increased particularly for the $h = 13$ case. Unfortunately, the Vernier current was not adjusted to a low value to see if the shift reversed its sign. The difference between the lock-out value and the running value of the Vernier current was only 50-60 amps.

Conclusions:

The larger value of Z/n is closer to that obtained on 8/24 where again the bunch length and area were larger than on 11/27 or 10/5,6. Whether this is significant is not yet clear. Also, on 8/24, there was one rf station locked out, but

whether the Vernier current was such as to tune the station above or below $12f_0 = f_{rf}$ is not known.

The effect of the single rf station (KL) in the lock-out mode on the quadrupole frequency is also not understood. Calculations of the effect of tuning below f_{rf} by 2-3% on the $\text{Im } (Z/n)_{\text{eff}}$ show a negligible result. However, the effect on the $\text{Re } (Z/n)_{\text{eff}}$ is considerable and the observation of spontaneous growth at $3.5-4 \times 10^{12}$ confirms this.

Thus one must repeat the measurement with an rf station off and detuned on both sides of f_{rf} probably at some energy above transition. Also a clean way of changing the bunch length to check for its effect on the observed Z/n must be found. Finally, the width of the window for the latching on of the frequency synchronization loop must be narrowed again so as to minimize the phase transients when it closes.