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Longitudinal Impedance Measurements VIII

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Subject Longitudinal Impedance Measurements

OBSERVATIONS AND CONCLUSION

Procedure:

As usual a long flat top was set up at $\approx$ 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 $f_q - 2fd$ = -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 ($\approx$ 35 nsec) the resulting Z/n was $\approx$ 147 Ω. The V_{ext} = 238 kV at a setting of 1500 for ten stations and the bunch area was $\approx$ .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 $f_q - 2f_d \simeq -1 \sim$. 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 $12f_o = f_{rf}$ 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 Im $(Z/n)_{eff.}$ show a negligible result. However, the effect on the Re $(Z/n)_{eff.}$ is considerable and the observation of spontaneous growth at $3.5\text{-}4 \times 10^{12}$ 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.