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Longitudinal Coupling Impedance Measurements

E. Raka

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Collider Accelerator Department

Brookhaven National Laboratory

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OBSERVATIONS AND CONCLUSION

Introduction:

The first run was made at ≃ 10.2 BeV and the second at 4.08 BeV. For both runs excitation at h = 13 and 14 was used. At the higher energy, the spontaneous growth threshold was around 2.7×10^{12} while at the lower energy it was below 2.5×10^{12}.

Results:

At 10.2 GeV we found $f_q - 2f_d = -3$ ~ for a $V_{ext} = 285$ kV and a bunch area of .76 eV sec. The Legendre mode Z/n is then j18.5 Ω since we are above the transition energy here. At 4.08 BeV, $f_q - 2f_d = -17$ ~ and $V_{ext} = 288$ kV. This gives a Z/n of -j137 Ω for Legendre modes and a bunch area of .48 eV sec.

Discussion:

The 10.2 GeV result can be used with the early 27.4 GeV data to fit the expression for $I_m(Z/n) = j[\Omega_o L - g_o Z_o/2\beta\gamma^2]$. One can determine L and ε where $g_o = 1 + 2\ln b/a = 1 + 2\ln b - 2\ln \sqrt{\varepsilon\bar{\beta}/\beta\gamma}$ with ε the normalized emittance, $\bar{\beta} = R/Q = 14.6$ meters, and b the average radius of the vacuum chamber. Assuming the measured Z/n given by Legendre modes results in an $\Omega_o L \cong 30\,\Omega$ but an $\varepsilon = 2.5\pi$ μrad-m. This is much too small a value for ε since it is about 30π μrad-m in the AGS at 4×10^{12}. If one assumes sinusoidal modes, then all of the previous quoted values of Z/n should be multiplied by $(27/4\pi^2) = .684$. Then the two parameter fit yields an $\Omega_o L \cong 20\,\Omega$ and an $\varepsilon = 22\pi$ μrad-m. The impedance at 6.6 GeV then becomes j3.8 Ω and it also falls on the resulting curve.

However, the 5 GeV points as well as the 4.08 GeV value lies far above the lower branch of the resulting Z/n plot. The reason for this is not yet understood. A more detailed discussion of all the runs to date is contained in BNL-25782; "A Measurement of the Longitudinal Coupling Impedance in the Brookhaven AGS", by F. Pedersen and E. Raka. This paper was submitted to the 1979 Particle Accelerator Conference at San Francisco and will appear in the Proceedings.