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To Study problems associated with maintaining circulating beam on a 1 GeV flattop, in particular to construct such a flattop, accelerate beam across it, and measure tunes and chromaticities if possible.

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AGS Studies Report

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Reported by L. Ahrens

Purpose To study problems associated with maintaining circulating beam on a 1 GeV flattop, in particular to construct such a flattop, accelerate beam across it, and measure tunes and chromaticities if possible

Observations and Conclusion

A one-second flattop was added to the AGS magnet cycle at a Gauss clock value of 3200 ± 100 counts/sec. The momentum measured from the rf frequency during the study was 1.7 GeV/c or 1 GeV K.E. The flattop in fact had a slope varying over ± 100 counts/sec during the study period. Ripple measured downstream of the main magnet power supply ripple filter was less than 100 volts peak to peak at 720 and 360 Hz and less than 25 volts at 60 Hz. These numbers can be transformed into currents in the 0.75 Henry ring magnet since $I_f = V_f \left(\frac{1}{L\ 2\pi f}\right)$.

I (720) < 29 mA
I (360) < 58 mA
I (60) < 88 mA

The current in the magnet is approximately 300 amps, so the fractional variation in current or field is less than $8.8 \times 10^{-2}/300 = 3.0 \times 10^{-4}$. The corresponding radial motion at fixed momentum is

$$\frac{\Delta r}{R} = \gamma_{tr}\ 2\ \frac{\Delta B}{B} \text{ or } \Delta r = (170\text{ cm})\ (3.0 \times 10^{-4}) = 0.05\text{ cm},$$

a very small number in this situation.

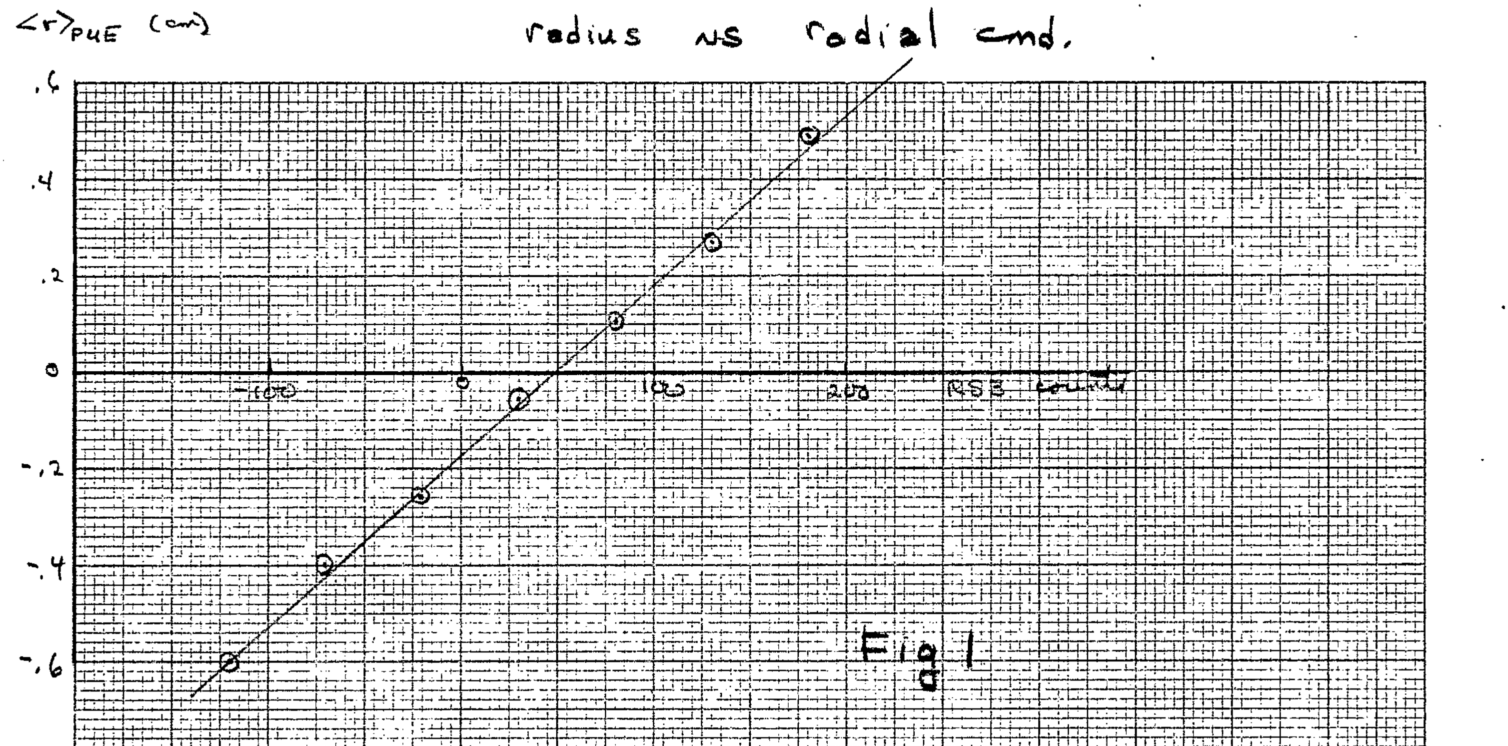
The beam accelerated across this flattop without any significant tuning effort.

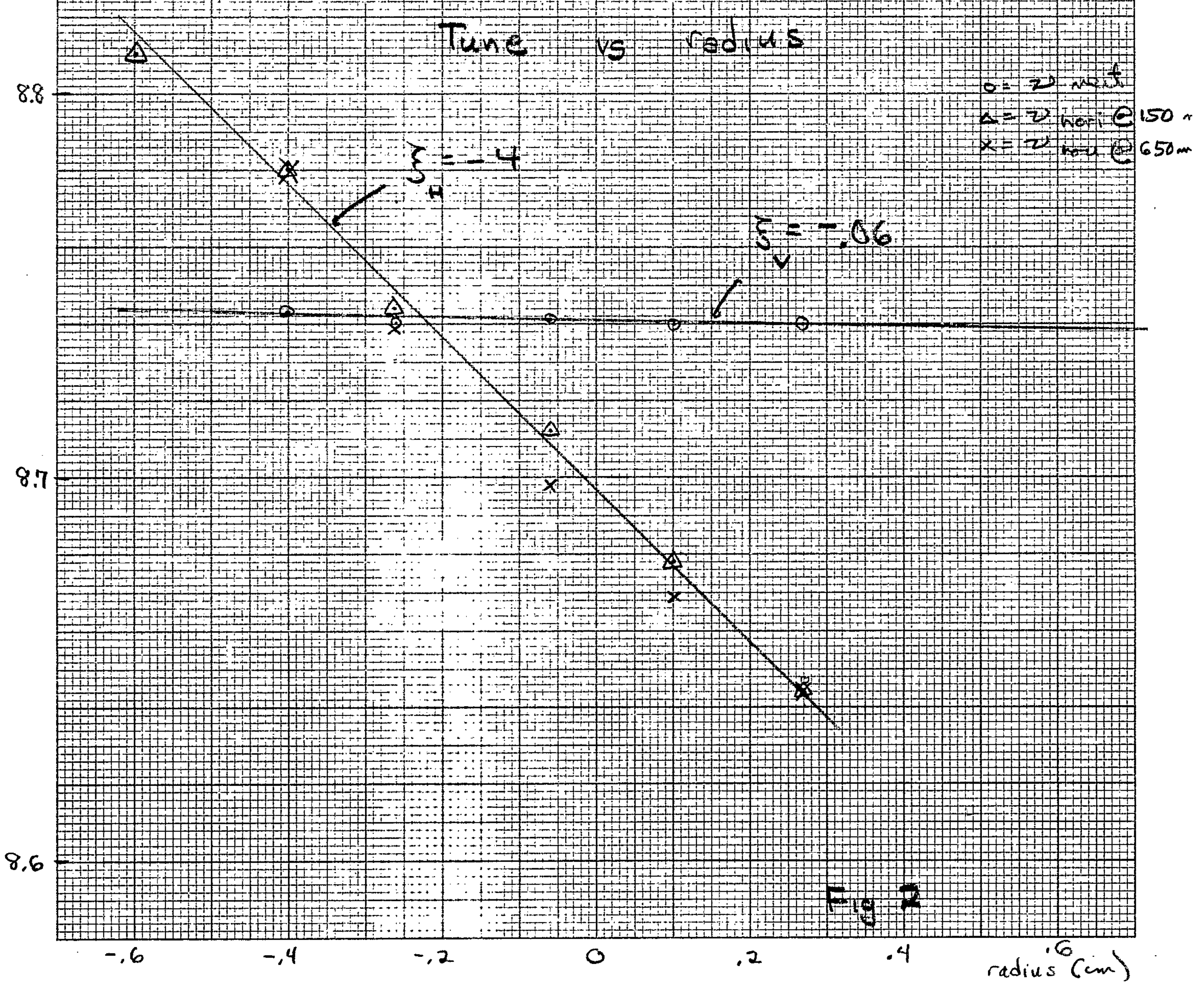
The remainder of the period was spent measuring tunes and radii in order to deduce the horizontal and vertical chromaticities. Tunes were measured using the kickers in the tune meter. The frequencies of the resulting coherent oscillations were measured using a gated frequency counter and PUE signals filtered in the MCR. The effect of coupling between horizontal and vertical planes was observed to significantly affect the measured frequencies.

For the results given below, the coupling was minimized by tuning the low field "zero theta" skew quadrupole strings until a kick in one transverse plane did not show up in the other plane. The command for these skew quad strings was set to 1200 counts (a wide null), 400 counts above their normal setting.

The radius was measured using the equilibrium orbit PUE system. Figure 1 shows the PUE average vs. radial commands. Finally, Figure 2 gives the tune variation with radius. The implied vertical chromaticity is essentially zero. The horizontal is nearly -4. The newly refurbished BEAM program (see C. Gardner note, January 24, 1986) agrees with the vertical result but wants $\xi_{Horizontal} = -2$. Since a linear machine has $\xi_V \approx \xi_H \approx 1$ and adding sextupole uniformly depresses one and raises the other approximately equally, the BEAM result seems reasonable. On the other hand, a sextupole distribution giving ξ_H of -4 is not impossible. More work.

mvh


radius vs radial cmd.
<r>PUE (cm)
.6
.4
.2
0
-.2
-.4
-.6
-100
0
100
200
RSB counts
Fig 1


Tune vs radius
o = ν vert
Δ = ν hori @ 150 m
x = ν hori @ 650 m
$\xi_H = -4$
$\xi_V = -.06$
8.8
8.7
8.6
-.6
-.4
-.2
0
.2
.4
.6
radius (cm)
Fig 2