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Tracking results from a hybrid booster lattice at working points (?x ?y) = (4.83,4.82) and (3.83,3.82)

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DISCLAIMER

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TRACKING RESULTS FROM A HYBRID BOOSTER LATTICE AT WORKING POINTS
(ν_x, ν_y) = (4.83,4.82) AND (3.83,3.82)

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Abstract

Tracking at $\Delta P/P$ = 0.0% of particles having emittances of $\epsilon_x = \epsilon_y = 50\pi$ mm mrad suggests that the operating point (3.83,3.82) is too close to the 3rd order structure resonance $3\nu = 12$. Even without chromaticity correcting sextupoles, the eddy current sextupoles are sufficient to drive this resonance.

Introduction

Tracking of particles with emittances of $\epsilon_x = \epsilon_y = 50\pi$ mm mrad through a hybrid lattice[1] has been performed with PATRICIA. The lattice contains combined function dipoles as well as one focusing and one defocusing quadrupole per superperiod. Sextupoles near these discrete quadrupoles are used to correct the chromaticity.

Three cases have been studied with and without the presence of eddy current multipoles[2]:

1). $\nu_x = 4.83$, $\nu_y = 4.82$ with the chromaticity corrected to zero,
2). $\nu_x = 3.83$, $\nu_y = 3.82$ with the chromaticity corrected to zero,
3). $\nu_x = 3.83$, $\nu_y = 3.82$ with no chromaticity correction.

The results for these three cases are discussed below.

Results

I. $\nu_x = 4.83$, $\nu_y = 4.82$ with chromaticity corrected to zero.

The phase plots are shown in Fig. 1(a) for tracking without eddy current multipoles and in Fig. 1(b) with eddy current multipoles. In both cases the phase plots have a finite radial width that is attributed to coupling. The width increases when eddy current multipoles are present and indicates increased coupling. Although the radial width increases, the basic shape of the phase plots is not changed when eddy current multipoles are present.

II. $\nu_x = 3.83$, $\nu_y = 3.82$ with chromaticity corrected to zero.

Results without eddy current multipoles are shown in Fig. 2(a). The phase plot for the x motion shows six islands indicating the proximity to the resonance $\nu_x = 3.833$. Both x and y plots have radial widths that are essentially unchanged from case-I above. Inclusion of the eddy current multipoles produces phase plots that are triangular in shape, Fig. 2(b). The radial width has increased significantly and indicates coupling of nearly 100%. The shape has become triangular and is consistent with driving the $3\nu = 12$ structure resonance at $\nu = 4$.

III. $\nu_x = 3.83$, $\nu_y = 3.82$ with no chromaticity correction.

It was suggested that the sextupoles required to correct chromaticity might be driving the 3rd order structure resonance[3]. Consequently a run was made for which there was no chromaticity correction. The results in Fig. 3(a) show phase plots having essentially zero radial width and are consistent with zero coupling. Inclusion of the eddy current multipoles Fig. 3(b) again produces triangular shaped phase plots with large coupling. One concludes that the eddy current multipoles by themselves are capable of driving the 3rd order structure resonance.

Conclusions

These preliminary tracking studies at $\Delta P/P = 0.0\%$ indicate that the operating point $(\nu_x, \nu_y) = (4.83, 4.82)$ is preferable to operation at (3.83,3.82).

References

1. J. Claus and S.Y. Lee, private communication.
2. G. Morgan and S. Kahn, Booster Tech Note #4.
3. S.Y. Lee, private communication.

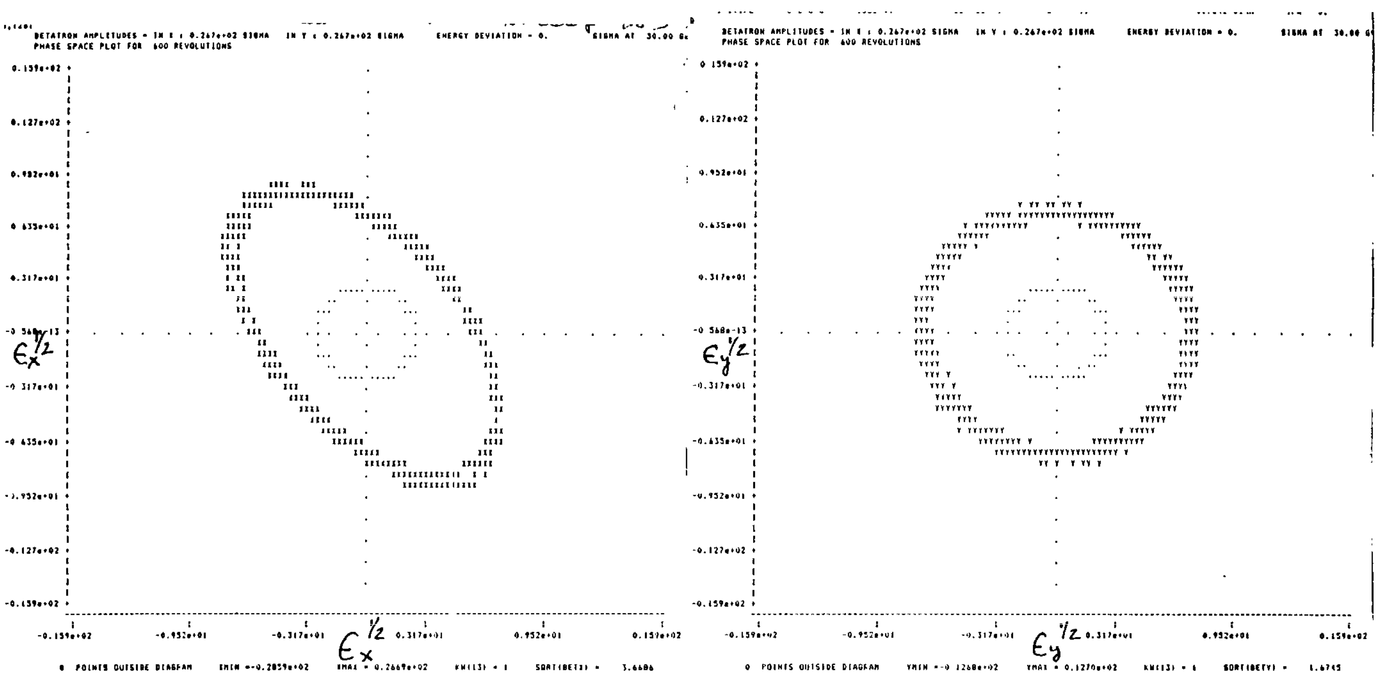

Fig. 1(a) Hybrid lattice, $\nu_x = 4.830$, $\nu_y = 4.820$, No eddy current multipoles. $\Delta P/P = 0.0\%$, Chromaticity = 0 in both planes, $\epsilon_x = \epsilon_y = 50\pi$ mm mrad, 600 Turns.

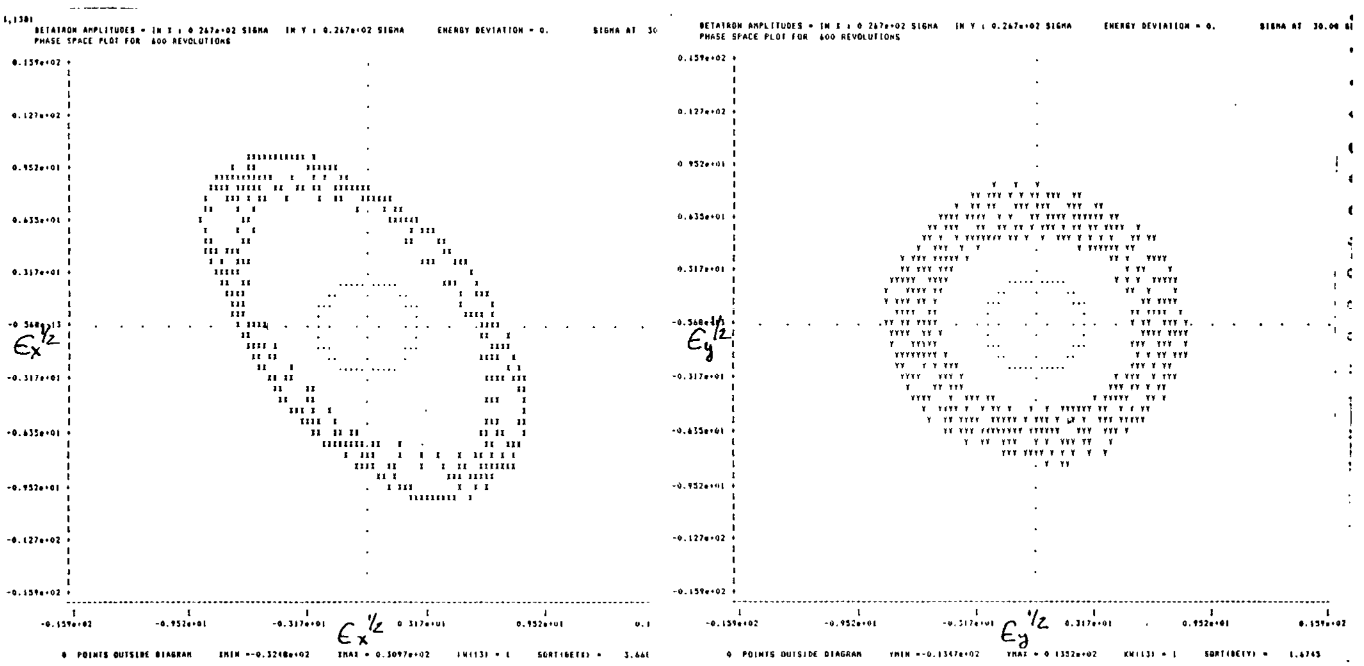

Fig. 1(b) Hybrid lattice, $\nu_x = 4.830$, $\nu_y = 4.820$, With eddy current multipoles. $\Delta P/P = 0.0\%$, Chromaticity = 0 in both planes, $\epsilon_x = \epsilon_y = 50\pi$ mm mrad, 600 Turns.

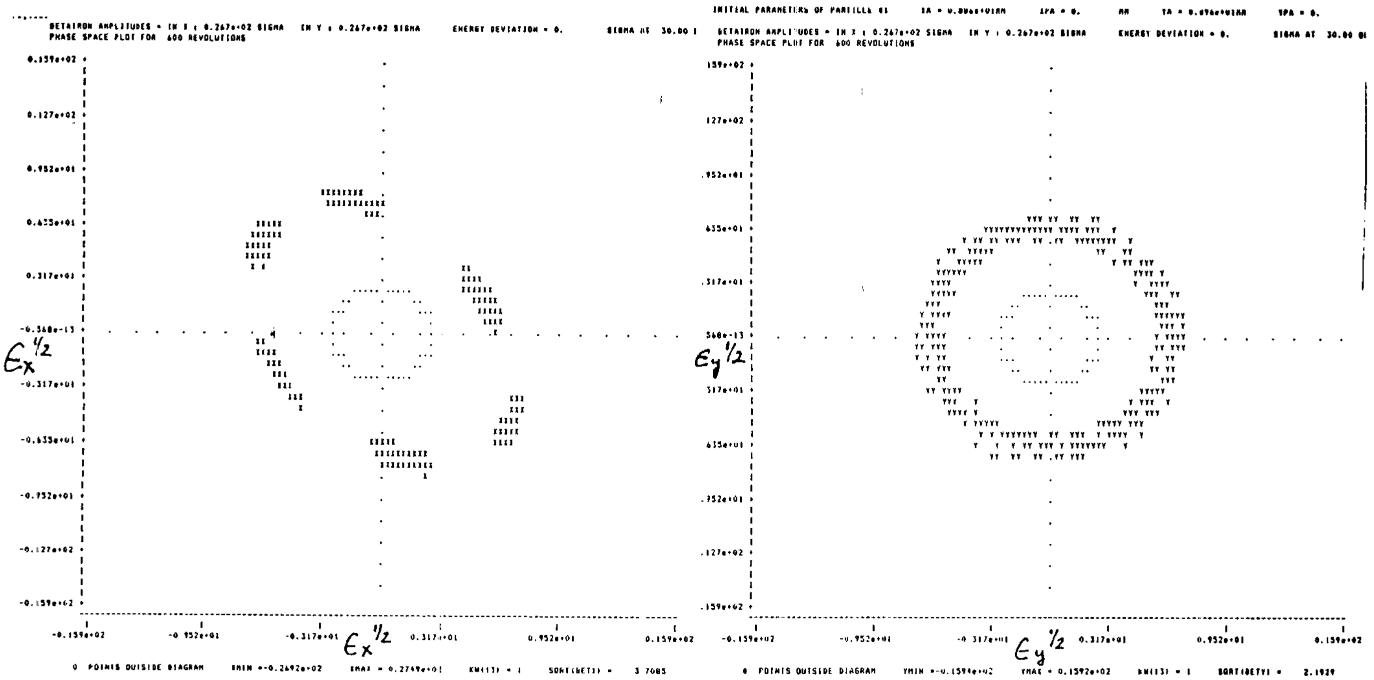

Fig. 2(a) Hybrid lattice, $\nu_x = 3.830$, $\nu_y = 3.820$, No eddy current multipoles. $\Delta P/P = 0.0\%$, Chromaticity = 0 in both planes, $\epsilon_x = \epsilon_y = 50\pi$ mm mrad, 600 Turns.

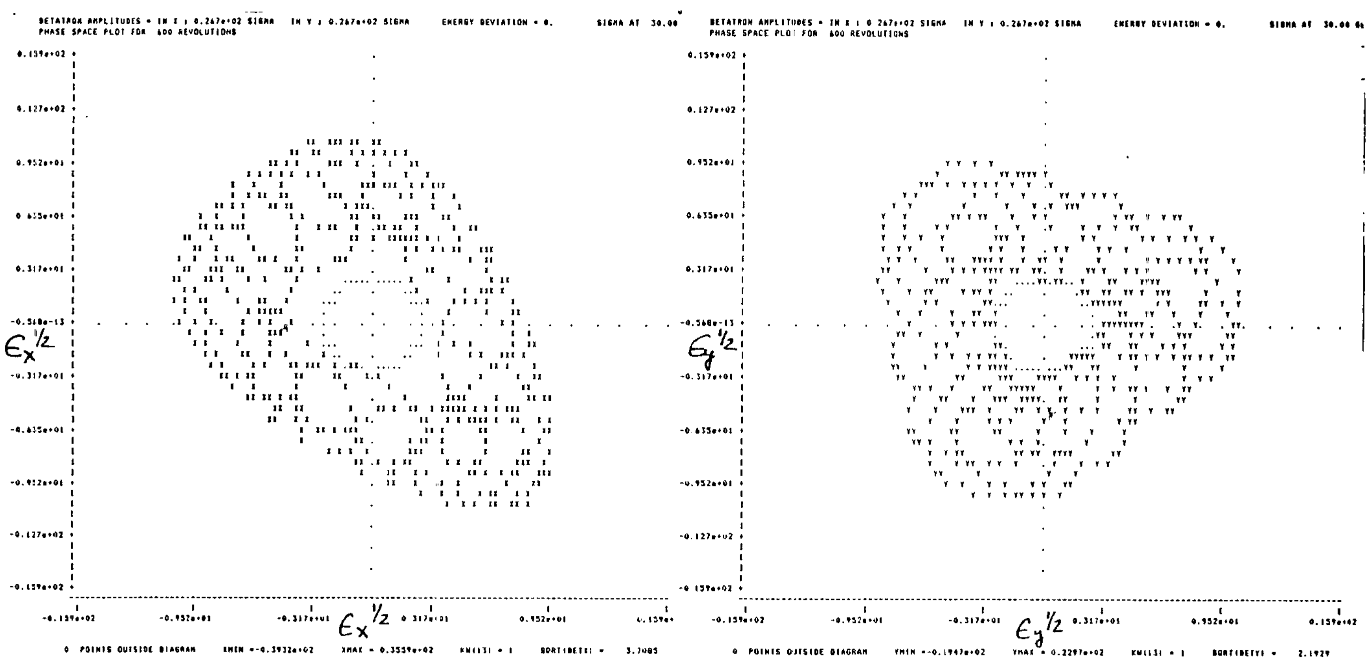

Fig. 2(b) Hybrid lattice, $\nu_x = 3.830$, $\nu_y = 3.820$, With eddy current multipoles. $\Delta P/P = 0.0\%$, Chromaticity = 0 in both planes, $\epsilon_x = \epsilon_y = 50\pi$ mm mrad, 600 Turns.

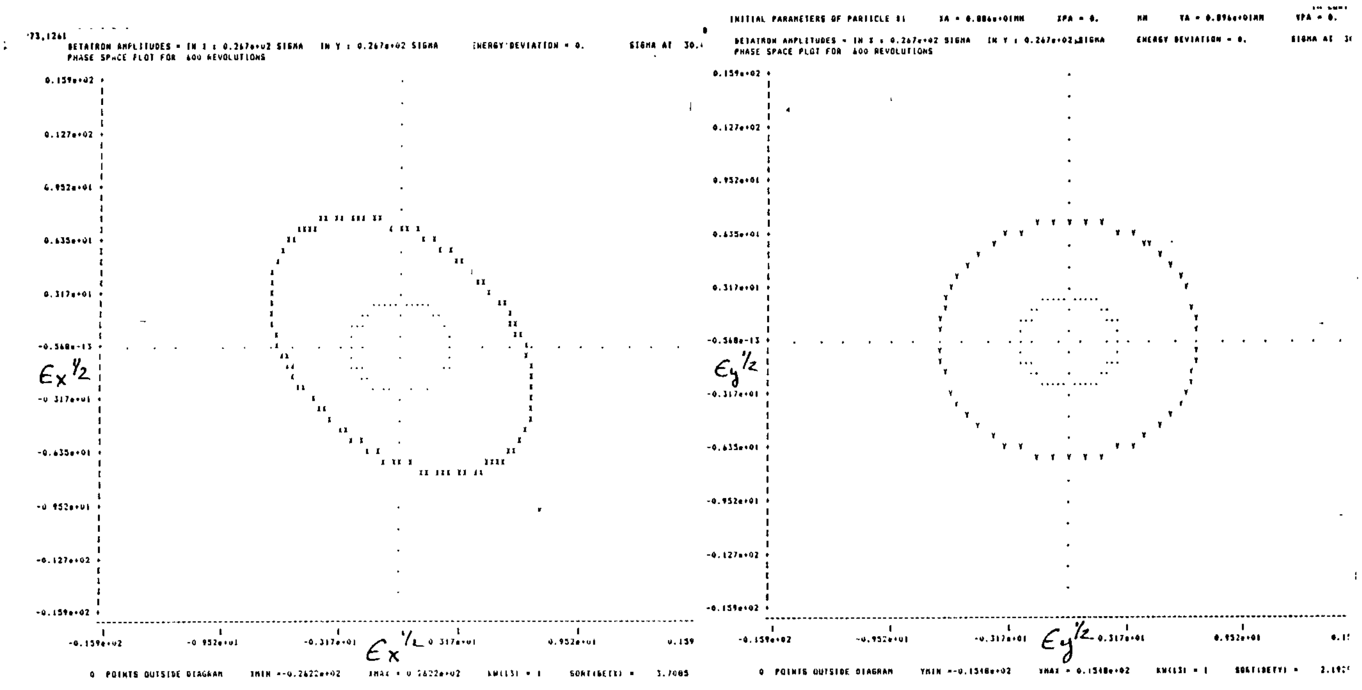

Fig. 3(a) Hybrid lattice, $\nu_x = 3.830$, $\nu_y = 3.820$, No eddy current multipoles. $\Delta P/P = 0.0\%$, No chromaticity correction, $\epsilon_x = \epsilon_y = 50\pi$ mm mrad, 600 Turns.

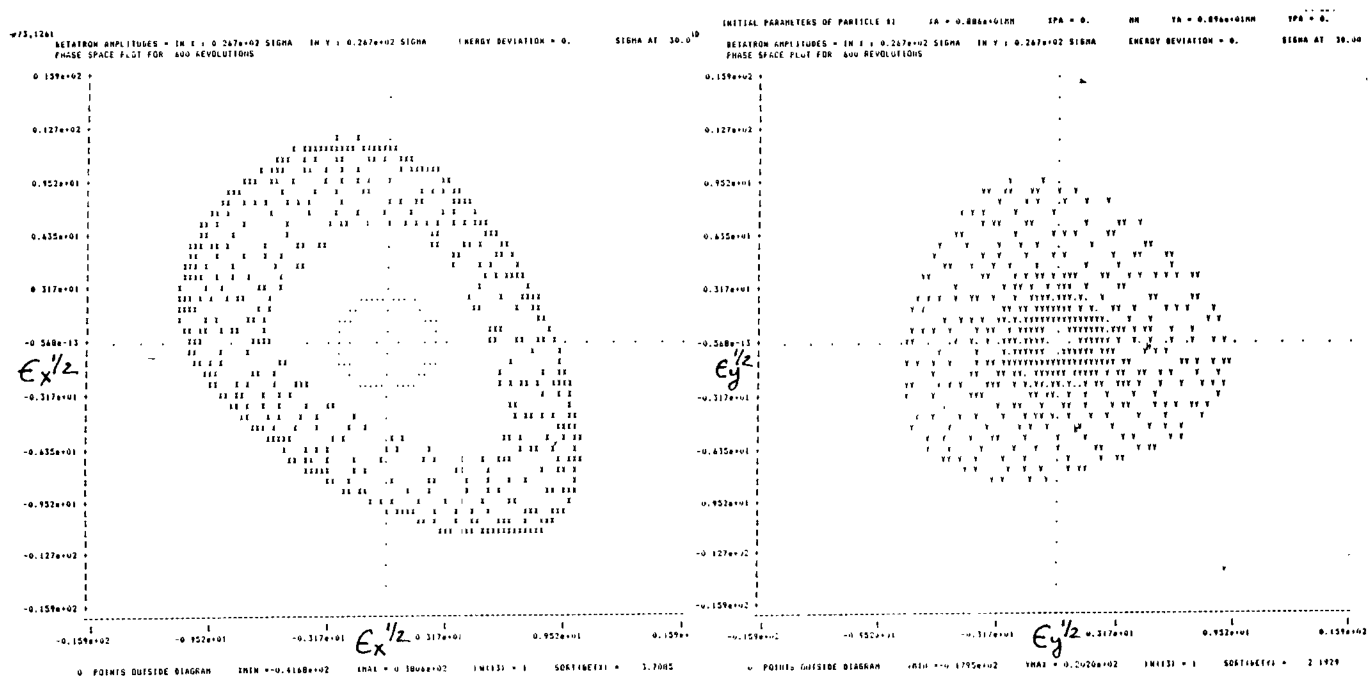

Fig. 3(b) Hybrid lattice, $\nu_x = 3.83$, $\nu_y = 3.82$, With eddy current multipoles. $\Delta P/P = 0.0\%$, No chromaticity correction, $\epsilon_x = \epsilon_y = 50\ \pi$ mm mrad, 600 Turns.