SSC-N-647

Configurations for E778

T. Chen and J. Peterson
SSC Central Design Group
June 30, 1989

The polarity configurations of sextupoles are investigated for the June '89 run of E778.

The sixteen sextupoles are set in F and C sectors of the Tevatron. They are powered in pairs by 8 power supplies. Table 1 lists some possible configurations investigated.

Table 1. Configurations

Config. no.	F	C
88	+ - + - + - + -	+ - + - + - + -
890	+ + + + + + + +	- - - - - - - -
891	+ - + - + - + -	- + - + - + - +
892	+ - - + + - - +	- + + - - + + -
893	+ + - - + + - -	- - + + - - + +
894	+ - - + + - - +	+ - - + + - - +
895	+ + + + + + + +	+ + + + + + + +
896	+ + - - + + - -	+ + - - + + - -
897	+ + - - - - + +	- - + + + + - -
898	+ + - - + - + -	- + + - + + - -

The two important resonances in E778 are 1/3 and 2/5. The phase advance between two adjacent sextupoles is 68°. For third order resonance, $3\psi = 204°$, which is not too far from 180°. As a result, if two adjacent sextupoles have the same polarities, the two vectors will almost cancel each other. But if they have opposite polarities, the two vectors will add up, so that a strong 1/3 resonance will be driven.

The phase advance between F and C sector is $9.7 \times 360°$. To consider the fifth order resonance, the fractional part of 5ψ is just about 180°. To drive the 2/5 resonance, the two sextupoles that have the same station number, but in F and C sectors, respectively, should have opposite polarities.

The chromaticity caused by the special sextupoles is proportional to the dispersion function at the sextupole locations. The dispersion function is almost the same in the F sector as in the C sector, but it is not regularly distributed within the sectors. Therefore, to minimize the chromaticity produced, the polarities of the sextupoles with the same station number, but in F and C sectors, respectively, should be opposite.

The features just described for the sextupole configurations considered are shown in Table 2. The resonance excitation is seen in the phase-space tracking results shown in Figure 1, for the Tevatron tuned to 19.41, 19.46.

Table 2

Config. no.	drive 1/3	drive 2/5	chromaticity
88	strong	weak	-5.56/1.57
890	weak		-0.65/0.26
891	strong	strong	0.20/-.04
892	*	*	0.86/-.53
893	weak	strong	0.33/-.04
894	*	*	7.65/-9.2
895	weak	weak	140.1/-46.4
896	*	*	-18.4/5.88
897	Weak	strong	-2.15/0.49
898	**	**	-13.7/3.70

* Q_x increases with amplitude.
** symmetry lacking.

Following are some suggestions for this E778 run.

1. Island experiment:

The configuration 891 drives the 2/5 resonance and provides large islands. It's good for island experiments to measure the capture fraction, island position and width, etc. Since the island is much larger than in the configuration used in the 1988 run, the particle motion inside the island could be observable, and Qi or decoherence in islands might be measurable. From tracking, Qi = 0.0115.

The configuration 897 also drives the 2/5 resonance. Although the island size is not as large as in 891, the islands are distributed almost on a circle and evenly spaced. This is good for comparing measurement results with computing results, for instance, resonance amplitude, island size.

Some configurations drive other resonances. For example, 890 provides large 1/3 resonance islands, and 894 gives seventh order resonance islands. They could be used for other resonance investigations.

2. Mocking up SSC:

The tune shift versus smear curve is chosen as the criterion of mocking up SSC. From tracking, we know that SSC has relatively small tune-shift and large smear. The large smear is attributable to coupling resonances. Fig. 2 shows the 892's tune shift versus smear curve approaches that for the SSC when the basic tunes are moved closer together. Thus, adjusting the horizontal-vertical coupling can provide a tune-shift vs. smear curve similar to that of the SSC.

Most of the configurations have higher tune shift versus smear curve than the SSC. To get a lower curve, a fancy configuration—898 was found. Fig. 3 shows the results.

3. Two-dimensional resonances:

To study what can be observed about 2-D coupling resonances, some 2-D tracking calculations were performed, and betatron phase ψ_y vs. ψ_x plots were displayed.

Figure 4 illustrates the case in which there is resonance in the x plane only. Islands are observed in the x-plane, but not in the y-plane.

Figure 5 shows similar plots for the $Q_x - Q_y$, and $2Q_x - Q_y$ resonances. The bands show that the two phases are correlated. No islands can be observed.

Figure 6 is a special case: $q_x = 0.2$, $q_y = 0.4$, so that the particle is involved in three resonances $5q_x=1$, $5q_y=2$ and $2q_x - q_y = 0$. In ψ_y vs. ψ_x space, there are intermittent bands. And islands can be observed in both planes.

Generally, it is advantageous to observe ψ_y vs. ψ_x space to find the coupling resonances.

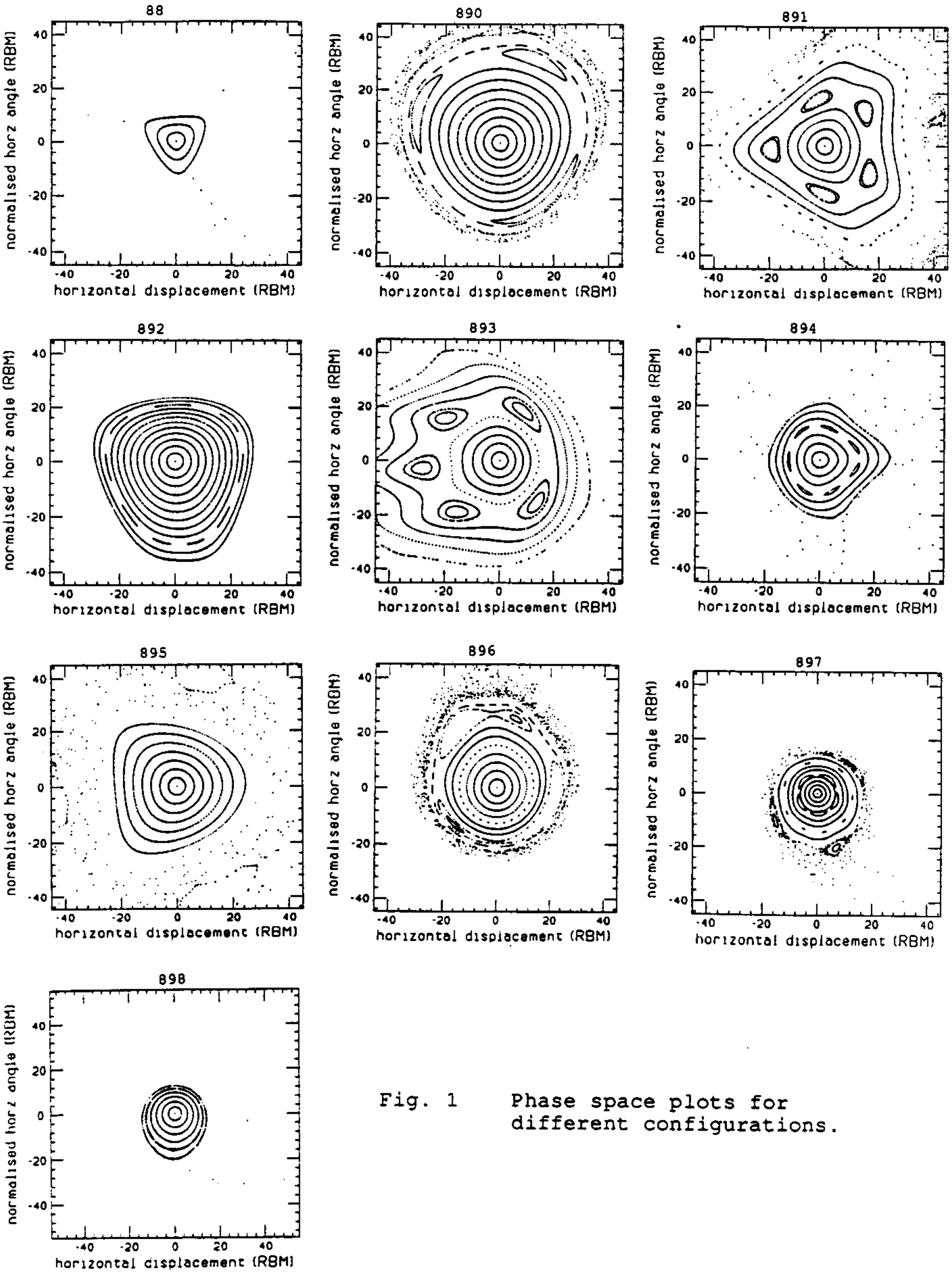

Fig. 1 Phase space plots for different configurations.

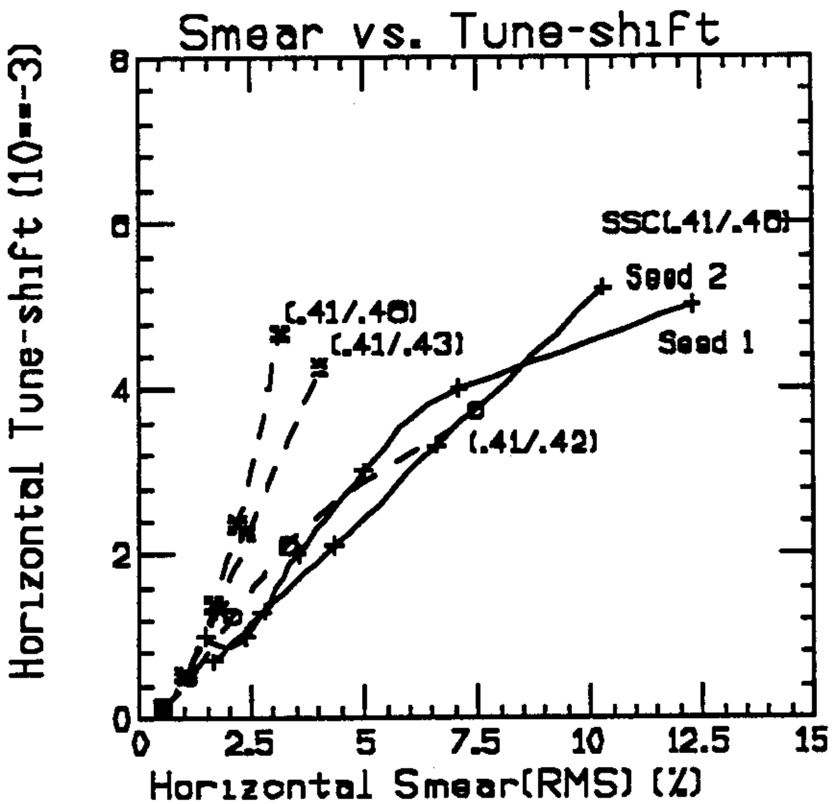

Fig. 2 Tune-shift vs. smear of SSC and 892.

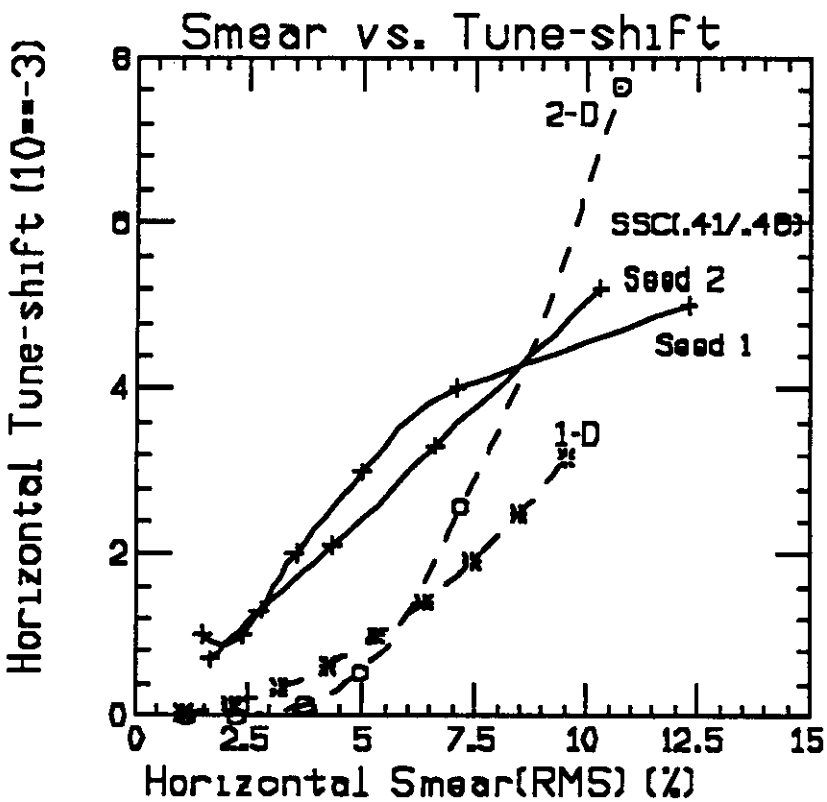

Fig. 3 Tune-shift vs. smear of SSC and 898.

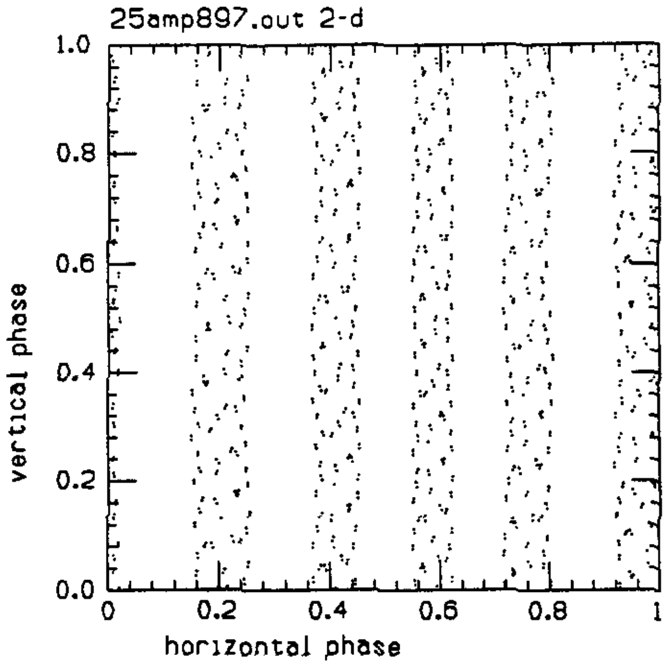

Fig. 4 Betatron phase plot with 1-D resonance only.

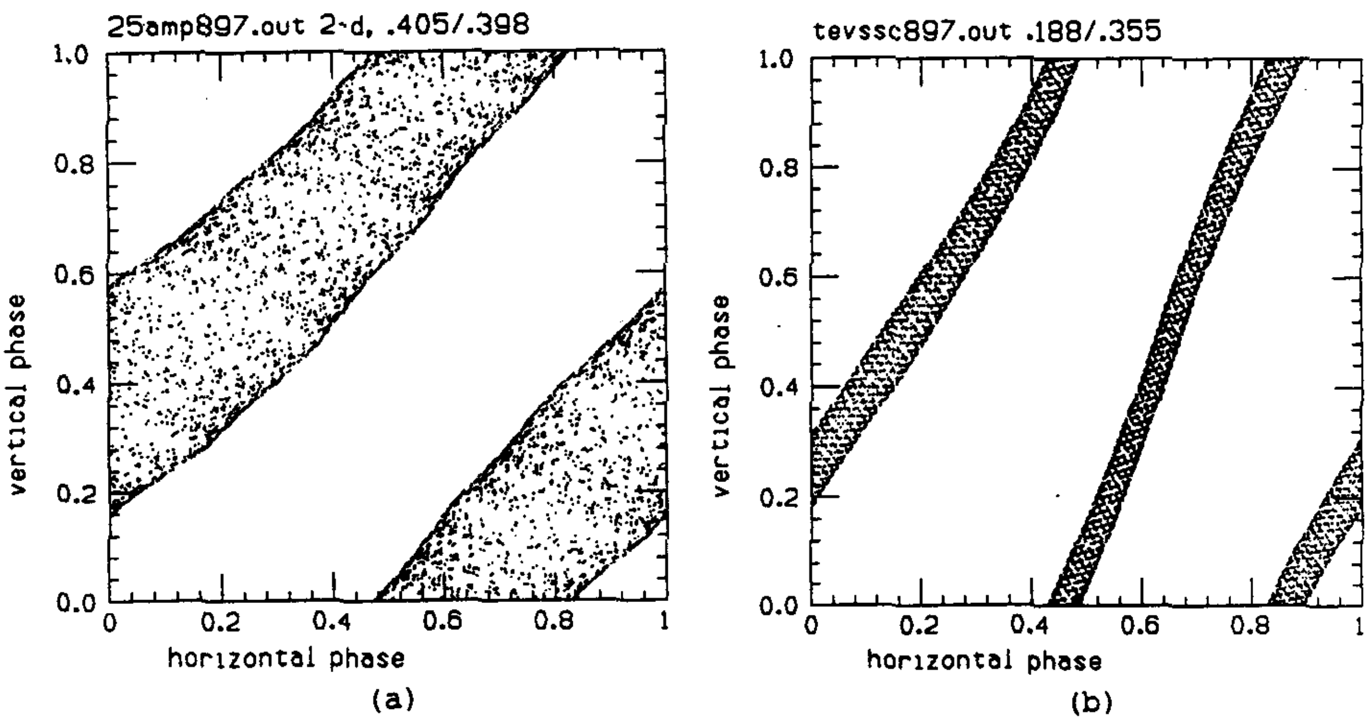

Fig. 5 Betatron phase plot with 2-D coupling resonances.
(a) for Q_x-Q_y , *(b) for* $2Q_x-Q_y$.

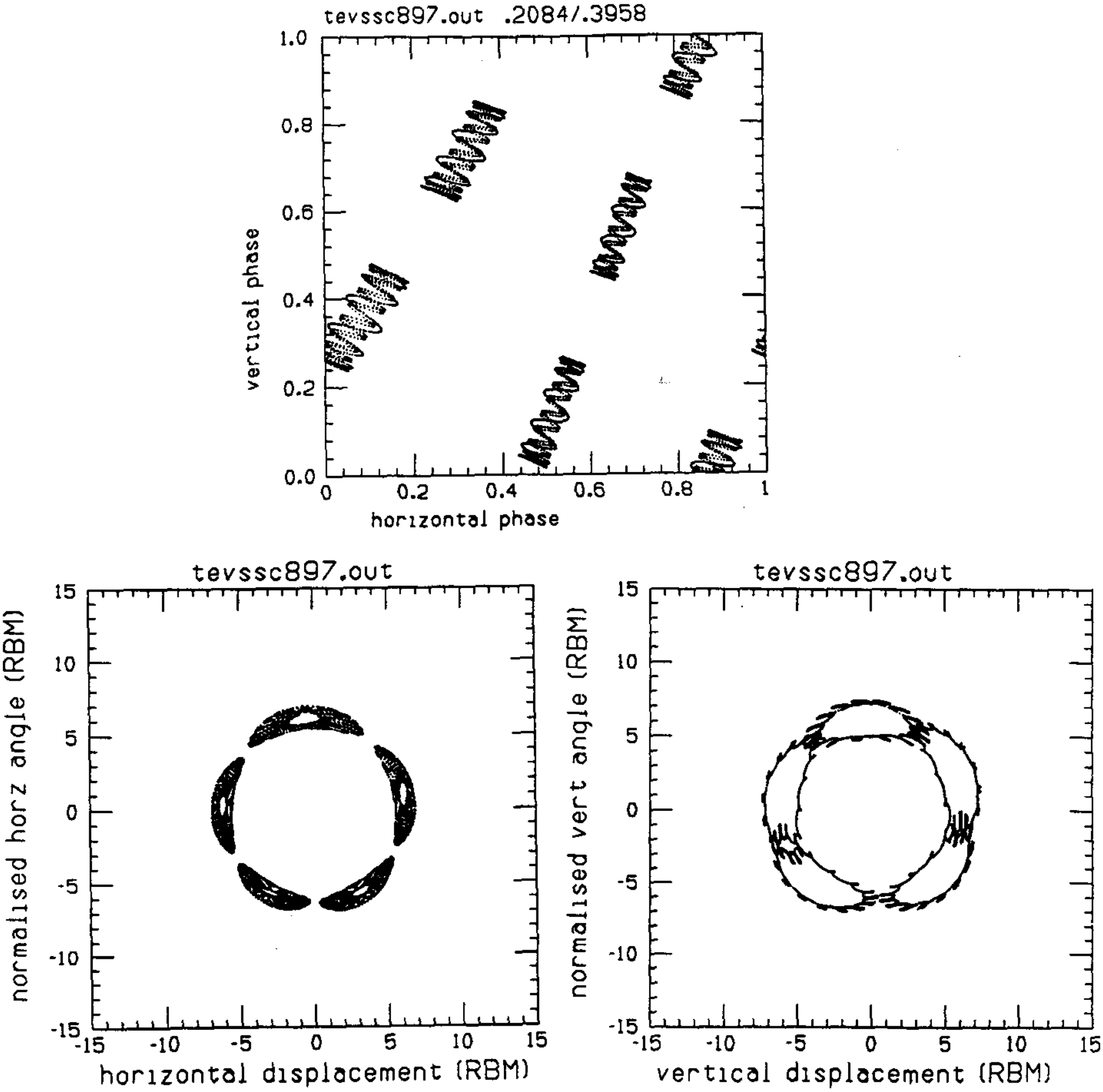

Fig. 6 Betatron phase plot with three resonances: $5q_x=1, 5q_y=2, 2q_x-q_y=0$.