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Analysis of alternate Booster lattices using NONLIN

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ANALYSIS OF ALTERNATE BOOSTER LATTICES USING NONLIN

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No.59

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ABSTRACT

WE HAVE STUDIED THE NONLINEAR EFFECTS OF THE ALTERNATE CONCEPTUAL AGS-BOOSTER LATTICES. WE PRESENT SOME OF OUR RESULTS FOR THESE LATTICES USING PROGRAM "NONLIN" (WHICH WE HAVE DEVELOPED) INCLUDING THE PERTURATION TO TUNE; EMITTANCE GROWTH; HAMILTONIAN RESONANCE STRENGTH; FIXED POINTS; CHIRIKOV CRITERIA; ISLAND WIDTH ETC. WE ALSO INCLUDE THE RESULTS OBTAINED FROM PROGRAM HARMON FOR THESE SAME LATTICES AND GIVE A COMPARISON OF THE RESULTS.

I. INTRODUCTION

In our investigation of the nonlinear effects on the dynamical systems we have developed and implemented a program that calculates and obtains information about nonlinear contributions in accelerators including [1]: the perturbation of tune; emittance growth; Hamiltonian resonance strength; generating function resonance strength; fixed points; Chirikov criteria; Island width etc. Using this program ("NONLIN") we study the structure resonances in the Alternate Booster Lattices due to I) eddy current sextupoles and II) the chromaticity corrcting sextupoles.

We also compare our results obtained from NONLIN with those obtained from HARMON [2] for the same lattices [3].

The following Tables divided into two sections showing the results obtained for the six Alternate Booster Lattices using NONLIN and HARMON respectively. The Tables labled with "[NONLIN]" corresponds to the same Tables labled with "[HARMON]" for a given (Table number) lattice.

II. PROGRAMS' NOTATION:

For clarity, we note the following differences between the notations and magnitudes given in the results from programs HARMON and NONLIN:

The stop bandwidths (given under the heading of "DQ") in the HARMON output is twice as large as the stop bandwidth obtained from NONLIN's output (given under the heading "Stp bnw"), because, the stop bandwith calculated from HARMON is over the full width of the interval whereas NONLIN calculates over half of the interval;

We calculate two different resonance strengths, the Hamiltonian and the generating funcltion resonance strengths. The resonance strengths obtained from HARMON's output which is normalized (under the "MODULUS" heading) when multiplied by Ex**(|nx|/2)*Ey**(|ny|/2), [where Ex and Ey are the transverse beam emittances], corresponds to the Hamiltonian resonance strength obtained from NONLIN's output (under the heading of "Strength" given next to the stop bandwidth column).

Furthermore, the perturbation to tunes in NONLIN (i.e., the Q shift parameters in HARMON) are the same as those calculated by HARMON.

CONCLUSION

In this note, we have presented the results of the program "NONLIN" to calculate the nonlinear effects in the six alternate lattices to the proposed standard Booster lattice. The comparison of our results using NONLIN and the program HARMON for the investigation of nonlinear effects in accelerators is given.

We find that the results between HARMON and NONLIN agrees qualitatively for the six lattices tested (i.e. the strength of resonances may agree qualitatively but not quantitatively).

These programs agree quantitatively, in tune shift parameters and the stop bandwidth calculation for the third order resonances. The differences in the stop bandwidths of the other resonances may be due in part to the difference in the canonical transformations used on the Hamiltonian.

Additionally, we can calculate emittance growth; sixth order resonances; the Chirikov criterion (i.e., to determine when two or more resonances could lead to chaotic behavior), and generating function resonance strength with NONLIN (as was illustrated in the previous section).

References:

1. Z. Parsa, S. Tepikian and E.D. Courant, Second Order Perturbation Theory for Accelerators, (to be published).

2. M. Donald, D. Schofield, a Users Guide to the Harmon program, Lep Note 420 (1982); M. Donald private communication.

3. Z. Parsa, S. Tepikian, Analysis of Resonances in the AGS - Booster, BN - BST/ TN 34, (1986); Z. Parsa, S. Tepikian, Resonance Analysis for standard Booster Lattice with split tunes, BNL - BST/ TN 35, (1986).

RESULT OBTAINED FROM PROGRAM "NONLIN"

TABLE I

1/3 AGS BOOSTER LATTICE [NONLIN]

Circumference = 269.04001 P = 8
vx0 = 6.8200002
vy0 = 6.8299994

Perturbation of tunes

vx = vx0 + 108.3684 * ex + -79.42130 * ey
vy = vy0 + -79.42130 * ex + 238.0322 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),

the perturbed tunes become
vx = 6.821977 vy = 6.840833

The emittance can grow to

exmax = 2.6963916E-04 at the 6 th element and
eymax = 2.5500849E-04 at the 6 th element.

The resonances are numbered as follows:

No.	Resonance	Strength	Stp bndw
7	2vx-2vy = 0	6.8113E-07	3.9891E-02
		Fix pts.	Width Chirikov cr
		1.2448E-03	1.8358E-05 3.4659E-03

The generating function resonance strength
for this resonance is: (at the 6'th element)

No.	Strength
7	6.38614E-07

TABLE II

1/3 AGS BOOSTER LATTICE [NONLIN]

Circumference = 269.04001 P = 8
vx0 = 5.3398924
vy0 = 5.3498421

Perturbation of tunes

vx = vx0 + -150.7028 * ex + -116.8775 * ey
vy = vy0 + -116.8775 * ex + 50.65845 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 5.321617 vy = 5.345319

The emittance can grow to
exmax = 4.6593347E-04 at the 6 th element and
eymax = 3.4503511E-04 at the 6 th element.

The resonances are numbered as follows:

No.	Resonance	Strength Fix pts.	Stp bndw Width	Chirikov cr
5	1 vx +2 vy = 16	5.2152E-07 2.2907E-02	3.8179E-02 ***	 ***
7	2 vx -2 vy = 0	5.1138E-07 6.1779E-03	2.9949E-02 3.0921E-05	 1.5449E-03
8	2 vx +0 vy = 8	1.2576E-06 1.3914E-01	7.3649E-02 4.5675E-05	 2.5720E-03
10	2 vx +4 vy = 32	3.6110E-07 6.7674E-02	1.0574E-01 1.4739E-05	 2.2887E-03
11	3 vx +0 vy = 16	2.3942E-07 3.1549E-02	3.1549E-02 **	 **
14	4 vx +2 vy = 24	8.3452E-07 1.4662E-01	2.4437E-01 7.1520E-06	 5.4500E-03
15	6 vx +0 vy = 24	5.7171E-07 2.0089E-01	3.0134E-01 3.4218E-06	 5.2026E-03

TABLE I (CONTS.)

The generating function resonance strength for each resonance is: (at the 6'th element)

No.	Strength
5	4.20365E-07
7	5.43361E-07
8	3.25832E-06
10	3.21149E-07
11	1.51201E-06
14	1.52807E-07
15	1.55902E-07

TABLE III

1/3 AGS BOOSTER LATTICE [NONLIN]

Circumference = 269.04001 P = 8
vx0 = 5.8198376
vy0 = 5.8300958

Perturbation of tunes

vx = vx0 + 13.28599 * ex + -24.11663 * ey
vy = vy0 + -24.11663 * ex + 101.5044 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 5.819098 vy = 5.835382

The emittance can grow to
exmax = 1.7789334E-04 at the 6 th element and
eymax = 1.7159859E-04 at the 6 th element.

The resonances are numbered as follows:

No.	Resonance	Strength	Stp bndw
7	2 vx -2 vy = 0	2.9111E-07	1.7049E-02
		Fix pts.	Width Chirikov cr
		4.9770E-03	2.1129E-05 1.2871E-03

The generating function resonance strength
for the resonance is: (at the 6'th element)

No.	Strength
7	3.53915E-07

TABLE IV

```
 COMBINED FUNCTION LATTICE   [nonlin]
-------------------------------------------------------

 Circumference = 201.78000   P = 12
          vx0 = 4.8199997
          vy0 = 4.8299999

 Perturbation of tunes
-----------------------
 vx = vx0 +  -0.3738223 * ex +  -23.53927 * ey
 vy = vy0 + -23.53927   * ex +   41.67454 * ey

 Given a beam with emittances
 ex =  6.8300003E-05 ey =  6.8300003E-05 (*pi m-rad),
 the perturbed tunes become
 vx = 4.818366     vy = 4.831238

 The emittance can grow to
 exmax =  1.8585735E-04 at the 15 th element and
 eymax =  1.8246108E-04 at the 14 th element.

 The resonances are numbered as follows:

 No.   Resonance    Strength   Stp bndw
-----------------------------------------------------
 7  2 vx -2 vy = 0  2.4532E-07 1.4367E-02
                    Fix pts.     Width   Chirikov cr
                    1.4246E-02 2.6343E-05 1.1599E-03

 The generating function resonance strength
 for each resonance is: (max of the 14'th and 15'th)

 No.               Strength
----------------------------
  7              2.64501E-07
```

TABLE V

COMBINED FUNCTION LATTICE [NONLIN]

Circumference = 201.78000 P = 12
vx0 = 4.0101190
vy0 = 4.1101117

Perturbation of tunes

vx = vx0 + -1017.564 * ex + -764.1721 * ey
vy = vy0 + -764.1721 * ex + -342.7070 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 3.888426 vy = 4.034512

The emittance can grow to
exmax = 6.4411538E-04 at the 15 th element and
eymax = 2.6812332E-04 at the 14 th element.

The resonances are numbered as follows:

No.	Resonance	Strength Fix pts.	Stp bndw Width	Chirikov cr
5	1 vx +2 vy = 12	3.7710E-06 1.6564E-01	2.7606E-01 **	****
7	2 vx -2 vy = 0	2.5537E-06 1.3927E-02	1.4956E-01 6.1631E-05	5.1609E-03
8	2 vx +0 vy = 0	4.7862E-06 4.2481E-01	2.8031E-01 3.4292E-05	1.7385E-02
10	2 vx +4 vy = 24	2.3230E-06 4.3536E-01	6.8025E-01 1.0328E-05	2.8017E-02
11	3 vx +0 vy = 12	7.4427E-07 9.8073E-02	9.8073E-02 **	****
14	4 vx +2 vy = 24	1.0178E-06 1.7882E-01	2.9803E-01 2.9182E-06	2.1720E-02
15	6 vx +0 vy = 24	1.0670E-06 1.7990E-06	5.6242E-01 2.4625E-02	3.7495E-01

TABLE V (CONTS.)

The generating function resonance strength
for each resonance is: (max of the 14'th and 15'th)

No.	Strength
5	2.01633E-06
7	1.47760E-06
8	5.18304E-06
10	1.32051E-06
11	4.68442E-06
14	5.99426E-07
15	6.35804E-07

TABLE VI

HYBRID LATTICE [NONLIN]

Circumference = 201.78000 P = 12
vx0 = 4.8200002
vy0 = 4.8299999

Perturbation of tunes

vx = vx0 + -11.54457 * ex + -58.06120 * ey
vy = vy0 + -58.06120 * ex + 15.81874 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 4.815246 vy = 4.827115

The emittance can grow to
exmax = 1.5988557E-04 at the 11 th element and
eymax = 1.5675873E-04 at the 9 th element.

The resonances are numbered as follows:

No.	Resonance	Strength	Stp bndw	
7	2 vx -2 vy = 0	2.1780E-07	1.2755E-02	
		Fix pts.	Width	Chirikov cr
		8.3273E-03	2.1266E-05	1.2756E-03

The generating function resonance strength
for each resonance is: (at the 9'th element)

No.	Strength
7	2.00246E-07

TABLE VII

HYBRID LATTICE [NONLIN]

Circumference = 201.78000 P = 12
vx0 = 4.0099969
vy0 = 4.1099973

Perturbation of tunes

vx = vx0 + -1653.976 * ex + -1060.103 * ey
vy = vy0 + -1060.103 * ex + -490.6285 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 3.824625 vy = 4.004083

The emittance can grow to
exmax = 8.9018885E-04 at the 11 th element and
eymax = 3.2113239E-04 at the 11 th element.

The resonances are numbered as follows:

No.	Resonance	Strength Fix pts.	Stp bndw Width	Chirikov cr
5	1 vx +2 vy = 12	4.4097E-06 1.9369E-01	3.2282E-01 **	 **
7	2 vx -2 vy = 0	3.6610E-06 9.8287E-03	2.1441E-01 1.9368E-04	 2.3544E-03
10	2 vx +4 vy = 24	3.1102E-06 5.8289E-01	9.1076E-01 9.9481E-06	 3.8942E-02
11	3 vx +0 vy = 12	9.3942E-07 1.2379E-01	1.2379E-01 **	 **
14	4 vx +2 vy = 24	1.4139E-06 2.4841E-01	4.1402E-01 2.7907E-06	 3.1553E-02
15	6 vx +0 vy = 24	1.7413E-06 6.1188E-01	9.1782E-01 1.8026E-06	 4.0107E-02

TABLE VII (CONTS.)

The generating function resonance strength
for each resonance is: (at the 11'th element)

No.	Strength
5	2.21538E-06
7	1.96125E-06
10	1.55718E-06
11	5.86242E-06
14	7.47274E-07
15	1.00456E-06

TABLE VIII

1/4 AGS 8 PERIODICITY LATTICE [NONLIN]

Circumference = 201.78000 P = 8
vx0 = 4.8200006
vy0 = 5.8299999

Perturbation of tunes

vx = vx0 + 26.87400 * ex + -246.9074 * ey
vy = vy0 + -246.9074 * ex + -173.8848 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 4.804972 vy = 5.801260

The emittance can grow to
exmax = 1.2314046E-04 at the 2 nd element and
eymax = 1.4639224E-04 at the 1 st element.

TABLE IX

1/4 AGS 8 PERIODICITY LATTICE [NONLIN]

Circumference = 201.78000 P = 8
vx0 = 4.6697268
vy0 = 5.6798048

Perturbation of tunes

vx = vx0 + 24.43950 * ex + -6137.145 * ey
vy = vy0 + -6137.145 * ex + -3108.220 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 4.252229 vy = 5.048347

The emittance can grow to
exmax = 1.7267074E-03 at the 2 nd element and
eymax = 3.3265704E-03 at the 1 st element.

The resonances are numbered as follows:

No.	Resonance	Strength	Stp bndw	
		Fix pts.	Width	Chirikov cr
5	1 vx +2 vy = 16	3.8182E-06	2.7952E-01	
		1.6771E-01	0.0000E+00	0.0000E+00
10	2 vx +4 vy = 32	1.2068E-05	3.5339E+00	
		2.2617E+00	9.0354E-06	1.6637E-01

The generating function resonance strength
for each resonance is: (in the first element)

No.	Strength
5	3.00508E-06
10	1.44126E-05

TABLE X

1/4 AGS 8 PERIODICITY BOOSTER LATTICE [NONLIN]

Circumference = 201.78000 P = 8
vx0 = 4.0099120
vy0 = 5.0200787

Perturbation of tunes

vx = vx0 + 1498.838 * ex + 1276.833 * ey
vy = vy0 + 1276.833 * ex + 75.72473 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 4.199491 vy = 5.112458

The emittance can grow to
exmax = 9.4632553E-03 at the 2 nd element and
eymax = 2.0227776E-04 at the 2 nd element.

The resonances are numbered as follows:

No.	Resonance	Strength Fix pts.	Stp bndw Width	Chirikov cr
8	2 vx +0 vy = 8	1.1756E-05	6.8852E-01	
		1.5043E+00	4.4282E-05	3.3068E-02
13	4 vx +0 vy =16	8.8530E-06	2.0739E+00	
		2.4694E+00	9.6068E-06	5.7391E-02

The generating function resonance strength
for each resonance is: (in the second element)

No.	Strength
8	2.03537E-05
13	1.31462E-05

TABLE XI

```
 STANDARD BOOSTER LATTICE SPLIT TUNES I [NONLIN]
-------------------------------------------------------------

 Circumference = 201.78000     P = 6
          vx0 = 4.8199992
           vy0 = 3.8300011

 Perturbation of tunes
------------------------
 vx = vx0 +   9.875389 * ex +  -44.16544 * ey
 vy = vy0 +  -44.16544 * ex +   114.8772 * ey

 Given a beam with emittances
 ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
 the perturbed tunes become
 vx =   4.817657     vy =   3.834831

 The emittance can grow to
 exmax =  9.3103066E-05 at the 6 th element and
 eymax =  8.4061801E-05 at the 10 th element.
```

TABLE XII

STANDARD BOOSTER WITH SPLIT TUNES I [NONLIN]

Circumference = 201.78000 P = 6
vx0 = 4.5008211
vy0 = 3.5109022

Perturbation of tunes

vx = vx0 + 7.144453 * ex + -29.04304 * ey
vy = vy0 + -29.04304 * ex + 111.7539 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 4.499325 vy = 3.516551

The emittance can grow to
exmax = 1.6472676E-04 at the 6 th element and
eymax = 8.6201551E-05 at the 6 th element.

The resonances are numbered as follows:

No.	Resonance	Strength	Stp bndw Fix pts.	Width	Chirikov cr
13	4 vx +0 vy = 18	1.8388E-08	4.3075E-03	1.8913E-03	6.3414E-06 1.8058E-04

The generating function resonance strength
for each resonance is: (in the 6'th element)

No.	Strength
13	3.09927E-08

TABLE XIII

STANDARD BOOSTER WITH SPLIT TUNES I [NONLIN]

Circumference = 201.78000 P = 6
vx0 = 4.0098424
vy0 = 3.0199578

Perturbation of tunes

vx = vx0 + -10.78179 * ex + -57.78951 * ey
vy = vy0 + -57.78951 * ex + 108.0402 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 4.005159 vy = 3.023390

The emittance can grow to
exmax = 1.2154784E-04 at the 10 th element and
eymax = 1.3938885E-04 at the 10 th element.

The resonances are numbered as follows:

No.	Resonance	Strength Fix pts.	Stp bndw Width	Chirikov cr
1	0 vx +2 vy = 6	3.6860E-07 2.3005E-02	2.1587E-02 2.9205E-05	1.5720E-03
2	0 vx +4 vy = 12	1.4516E-07 2.1651E-02	3.4005E-02 4.5818E-06	1.9730E-03
11	3 vx +0 vy = 12	9.1799E-08 1.2096E-02	1.2096E-02 **	** **
15	6 vx +0 vy = 24	1.8274E-08 6.4213E-03	9.6320E-03 2.2872E-06	3.3172E-04

The generating function resonance strength
for each resonance is: (in the 10'th element)

No.	Strength
1	4.31316E-07
2	1.52855E-07
11	5.85155E-07
15	2.06349E-08

TABLE XIV

STANDARD BOOSTER LATTICE WITH SPLIT TUNES I [NONLIN]

Circumference = 201.78000 P = 6
vx0 = 4.6698065
vy0 = 3.6802068

Perturbation of tunes

vx = vx0 + 8.429522 * ex + -161.8193 * ey
vy = vy0 + -161.8193 * ex + 49.56433 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 4.659330 vy = 3.672540

The emittance can grow to
exmax = 1.6464839E-04 at the 6 th element and
eymax = 2.2785737E-04 at the 6 th element.

The resonances are numbered as follows:

No.	Resonance	Strength	Stp bndw	
		Fix pts.	Width	Chirikov cr
5	1 vx +2 vy = 12	5.4943E-07	4.0222E-02	
		2.4133E-02	**	**
10	2 vx +4 vy = 24	3.2169E-07	9.4200E-02	
		6.0288E-02	1.3511E-05	2.9657E-03

The generating function resonance strength
for each resonance is: (in the 6'th element)

No.	Strength
5	5.68550E-07
10	3.68423E-07

TABLE XV

STANDARD BOOSTER LATTICE WITH SPLIT TUNES II [NONLIN]

Circumference = 201.78000 P = 6
vx0 = 3.8199983
vy0 = 4.8299999

Perturbation of tunes

vx = vx0 + 6.983605 * ex + 200.6003 * ey
vy = vy0 + 200.6003 * ex + -66.52982 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 3.834176 vy = 4.839157

The emittance can grow to
exmax = 1.1529480E-04 at the 6 th element and
eymax = 1.4312129E-04 at the 10 th element.

TABLE XVI

STANDARD BOOSTER LATTICE WITH SPLIT TUNES II [NONLIN]

Circumference = 201.78000 P = 6
vx0 = 3.5008779
vy0 = 4.5021882

Perturbation of tunes

vx = vx0 + 7.010273 * ex + 60.17466 * ey
vy = vy0 + 60.17466 * ex + -5.151743 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 3.505466 vy = 4.505946

The emittance can grow to
exmax = 9.1532944E-05 at the 10 th element and
eymax = 2.0699165E-04 at the 10 th element.

The resonances are numbered as follows:

No.	Resonance	Strength	Stp bndw	
2	0 vx +4 vy = 18	6.6026E-08	1.5467E-02	
		Fix pts.	Width	Chirikov cr
		5.0968E-03	1.4151E-05	2.9057E-04

The generating function resonance strength
for this resonance is: (in the 10'th element)

No.	Strength
2	1.26331E-07

TABLE XVII

STANDARD BOOSTER LATTICE WITH SPLIT TUNES II [NONLIN]

Circumference = 201.78000 P = 6
vx0 = 3.0101504
vy0 = 4.0201583

Perturbation of tunes

vx = vx0 + 1069.106 * ex + 109.9859 * ey
vy = vy0 + 109.9859 * ex + 12.57230 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 3.090683 vy = 4.028529

The emittance can grow to
exmax = 3.5498552E-02 at the 10 th element and
eymax = 1.6244168E-04 at the 10 th element.

The resonances are numbered as follows:

No.	Resonance	Strength	Stp bndw	
		Fix pts.	Width	Chirikov cr
8	2 vx +0 vy = 6	6.7624E-05	3.9604E+00	
		8.5169E+00	1.2575E-04	6.6981E-02
13	4 vx +0 vy = 12	5.5942E-05	1.3105E+01	
		1.3810E+01	2.8594E-05	1.2184E-01

The generating function resonance strength
for each resonance is: (in the 10'th element)

No.	Strength
8	2.60064E-07
13	7.29373E-05

TABLE XVIII

STANDARD BOOSTER LATTICE WITH SPLIT TUNES II [NONLIN]

Circumference = 201.78000 P = 6
vx0 = 3.3298202
vy0 = 4.3398085

Perturbation of tunes

vx = vx0 + 7.947122 * ex + -270.0179 * ey
vy = vy0 + -270.0179 * ex + -156.1402 * ey

Given a beam with emittances
ex = 6.8300003E-05 ey = 6.8300003E-05 (*pi m-rad),
the perturbed tunes become
vx = 3.311921 vy = 4.310702

The emittance can grow to
exmax = 4.2574492E-04 at the 10 th element and
eymax = 7.6328992E-04 at the 10 th element.

The resonances are numbered as follows:

No.	Resonance	Strength Fix pts.	Stp bndw Width	Chirikov cr
5	1 vx +2 vy = 12	4.9075E-07	3.5926E-02	
		2.1555E-02	**	**
10	2 vx +4 vy = 24	5.2159E-07	1.5274E-01	
		9.7751E-02	8.7667E-06	7.4107E-03

The generating function resonance strength
for each resonance is: (in the 10'th element)

No.	Strength
5	5.13995E-07
10	9.39615E-07

RESULT OBTAINED FROM PROGRAM "HARMON"

TABLE I

ALTERNATE AGS-BOOSTER LATTICE (1/3 AGS) WITH CHROMATICITY AND EDDY CURRENT SEXTUPOLES
AT OPERATING TUNES (Qx = 6.82, Qy = 6.83) [HARMON]

BOOSTER LATTICE WITH SEP. FUNCTION ELEMENTS
DELTA(P)/P = 0.000000

TOTAL LENGTH	= 269.040000	NSUP	= 8
QX	= 6.820000	QY	= 6.829999
QX'	= 0.000000	QY'	= 0.000000
ALFA	= 0.221530E-01	GAMMA(TR)	= 6.718681
BETAX	= 3.33250E+00	BETAY	= 1.36827E+01
		ETAX	= 6.38422E-01
BETAX(MAX)	= 14.132757	BETAY(MAX)	= 13.682687
DX(MAX)	= 1.937133	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SXV	6.69892E-02
SFCH	3.71406E-01
SDCH	-9.85768E-01

Q SHIFT EFFECTS

G22000		DQXDEX	DQX
5.41842E+01	7.57342E-01	1.08368E+02	7.40156E-03
G00220		DQYDEY	DQY
1.19016E+02	9.16056E-01	2.38032E+02	1.62576E-02
G11110		DQXDEY	DQYDEX
-7.94214E+01	1.22141E+00	-7.94214E+01	-7.94214E+01
		DQX	DQY
		-5.42448E-03	-5.42448E-03

TABLE IIA

ALTERNATE AGS-BOOSTER LATTICE (1/3 AGS) WITH CHROMATICITY
AND EDDY CURRENT SEXTUPOLES [HARMON]
AT TUNES NEAR RESONANCE (Qx = 5.34, Qy = 5.35)

BOOSTER LATTICE WITH SEP. FUNCTION ELEMENTS
DELTA(P)/P = 0.000000

TOTAL LENGTH =	269.040000	NSUP =	8
QX =	5.339892	QY =	5.349842
QX' =	1.749702	QY' =	1.046964
ALFA =	0.364175E-01	BETAX(MAX) =	14.497906
BETAX =	4.89019E+00	BETAY =	1.42118E+01
		ETAX =	1.24746E+00
BETAY(MAX) =	14.211846	GAMMA(TR) =	5.240162
DX(MAX) =	2.219571	DY(MAX) =	0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SXV	6.69892E-02
SFCH	9.83404E-02
SDCH	-8.31124E-01

Q SHIFT EFFECTS

G22000		DQXDEX	DQX
2.53192E+01	1.63113E+00	5.06385E+01	3.45861E-03
G11110		DQXDEY	DQYDEX
-1.16873E+02	2.17484E+00	-1.16873E+02	-1.16873E+02

DQX	DQY
-7.98239E-03	-7.98239E-03

TABLE IIB

ALTERNATE BOOSTER LATTICE (1/3 AGS) WITH [SEP. FUNCTION ELEMENTS] CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P= 0.000000 [EX0 =6.8300E-05 EY0 =6.8300E-05]
[HARMON]

THIRD ORDER EFFECTS OF SEXTUPOLES [RESONANCE EFFECTS]

3Qx = 16

COSINE	SINE	MODULUS	RANDOM	DE(S)
1.5991E-01	-3.9287E-01	4.2417E-01	7.1560E-01	6.3099E-02
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
1.0645E-01	2.1033E-02	3.5484E-02	4.3468E-02	7.3333E-02

Qx+2Qy=16

COSINE	SINE	MODULUS	RANDOM	DE(S)
6.5096E-01	-6.5569E-01	9.2395E-01	4.1137E+00	7.6358E-02
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
3.3997E-01	3.4149E-02	1.5204E-01	7.0574E-02	3.1421E-01

TABLE III

ALTERNATE AGS-BOOSTER LATTICE (1/3 AGS) WITH CHROMATICITY AND EDDY CURRENT SEXTUPOLES [HARMON]
AT ALTERNATE OPERATING TUNES (Qx = 5.82, Qy = 5.83)

BOOSTER LATTICE WITH SEP. FUNCTION ELEMENTS
DELTA(P)/P = 0.000000

TOTAL LENGTH =	269.040000	NSUP = 8	
QX =	5.819837	QY =	5.830096
QX' =	0.000631	QY' =	0.000067
ALFA =	0.307175E-01	GAMMA(TR) =	5.705678
BETAX =	4.29045E+00	BETAY =	1.39083E+01
		ETAX =	1.02027E+00
BETAX(MAX) =	14.173987	BETAY(MAX) =	13.908285
DX(MAX) =	2.015216	DY(MAX) =	0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SXV	6.69892E-02
SFCH	9.83404E-02
SDCH	-8.31124E-01

Q SHIFT EFFECTS

G22000		DQXDEX	DQX
6.63888E+00	1.03313E+00	1.32778E+01	9.06870E-04
G00220		DQYDEY	DQY
5.07415E+01	1.31499E+00	1.01483E+02	6.93129E-03
G11110		DQXDEY	DQYDEX
-2.41117E+01	1.75332E+00	-2.41117E+01	-2.41117E+01
		DQX	DQY
		-1.64683E-03	-1.64683E-03

TABLE IV

ALTERNATE AGS-BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
AT OPERATING TUNE (Qx = 4.82, Qy = 4.83) [HARMON]

BOOSTER LATTICE OF COMBINED FUNCTION ELEMENTS
DELTA(P)/P = 0.000000

TOTAL LENGTH =	201.780000	NSUP =	12
QX =	4.820000	QY =	4.830000
QX' =	0.000000	QY' =	-0.000003
ALFA =	0.509860E-01	GAMMA(TR) =	4.428684
BETAX =	1.15267E+01	BETAY =	1.15697E+01
		ETAX =	1.56754E+00
BETAX(MAX) =	15.591579	BETAY(MAX)=	15.607346
DX(MAX) =	2.239726	DY(MAX) =	0.000000

NORMALIZED STRENGTHS [m^{-2}]

ID	STRENGTH
SFC	-2.76326E-01
SDC	-1.02324E+00
SXV1	4.46595E-02
SXV2	5.58243E-02
SXV3	7.81541E-02
SXV4	3.34946E-02

Q SHIFT EFFECTS [PERTURBATION OF TUNES]

G22000		DQXDEX	DQX
-1.86911E-01	1.60308E+00	-3.73823E-01	-2.55321E-05
G00220		DQYDEY	DQY
2.08373E+01	2.19891E+00	4.16746E+01	2.84637E-03
G11110		DQXDEY	DQYDEX
-2.35393E+01	2.93188E+00	-2.35393E+01	-2.35393E+01
		DQX	DQY
		-1.60773E-03	-1.60773E-03

TABLE VA

ALTERNATE AGS-BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
AT TUNE NEAR RESONANCE (QX = 4.01, QY = 4.11) [HARMON]

BOOSTER LATTICE OF COMBINED FUNCTION ELEMENTS
DELTA(P)/P = 0.000000

TOTAL LENGTH =	201.780000	NSUP =	12
QX =	4.010119	QY =	4.110112
QX'=	0.671394	QY'=	3.951067
ALFA =	0.689755E-01	GAMMA(TR) =	3.807611
BETAX =	1.04933E+01	BETAY =	1.04988E+01
		ETAX =	2.15115E+00
BETAX(MAX) =	14.547907	BETAY(MAX)=	14.295551
DX(MAX) =	2.873679	DY(MAX) =	0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SFC	-2.76326E-01
SDC	-1.02324E+00
SXV1	4.46595E-02
SXV2	5.58243E-02
SXV3	7.81541E-02
SXV4	3.34946E-02

Q SHIFT EFFECTS

G22000		DQXDEX	DQX
-5.08782E+02	1.34757E+00	-1.01756E+03	-6.94996E-02
G00220		DQYDEY	DQY
-1.71354E+02	1.88448E+00	-3.42708E+02	-2.34069E-02
G11110		DQXDEY	DQYDEX
-7.64174E+02	2.51264E+00	-7.64174E+02	-7.64174E+02
		DQX	DQY
		-5.21931E-02	-5.21931E-02

TABLE VB

ALTERNATE BOOSTER LATTICE WITH [COMBINED FUNCTION ELEMENTS]
WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P= 0.00 (EX0=6.8300E-05 EY0=6.8300E-05) [HARMON]
[HARMON]

THIRD ORDER EFFECTS OF SEXTUPOLES [RESONANCE EFFECTS]
3Qx = 12

COSINE	SINE	MODULUS	RANDOM	DE(S)
1.2896E+00	2.7465E-01	1.3185E+00	9.2934E-01	1.9615E-01
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
1.3825E-01	6.5382E-02	4.6083E-02	1.3512E-01	9.5237E-02

Qx+2Qy=12

COSINE	SINE	MODULUS	RANDOM	DE(S)
3.2830E+00	5.8184E+00	6.6807E+00	4.5129E+00	5.5212E-01
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
3.7296E-01	2.4691E-01	1.6679E-01	5.1029E-01	3.4471E-01

TABLE VI

ALTERNATE AGS-BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
AT OPERATING TUNE (Qx = 4.82, Qy = 4.83) [HARMON]

hybrid BOOSTER LATTICE OF COMBINED FUNCTION ELEMENTS
DELTA(P)/P = 0.000000

TOTAL LENGTH	=	201.780000		NSUP	= 12
QX	=	4.820000		QY	= 4.830000
QX'	=	0.000054		QY'	= 0.000031
ALFA	=	0.478141E-01	GAMMA(TR)	=	4.573220
BETAX	=	1.00758E+01	BETAY	=	9.76910E+00
			ETAX	=	1.43651E+00
BETAX(MAX)	=	14.058073	BETAY(MAX)	=	13.935099
DX(MAX)	=	2.306863	DY(MAX)	=	0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SFC	-1.89019E-01
SDC	-9.73867E-01
SXV1	8.34574E-02
SXV2	6.72683E-02
SXV3	3.76814E-02

Q SHIFT EFFECTS

G22000		DQXDEX	DQX
-5.77230E+00	1.39254E+00	-1.15446E+01	-7.88496E-04
G00220		DQYDEY	DQY
7.90935E+00	1.81900E+00	1.58187E+01	1.08042E-03
G11110		DQXDEY	DQYDEX
-5.80613E+01	2.42533E+00	-5.80613E+01	-5.80613E+01

DQX	DQY
-3.96559E-03	-3.96559E-03

TABLE VIIA

ALTERNATE AGS-BOOSTER LATTICE (1/4 AGS) WITH CHROMATICITY AND EDDY CURRENT SEXTUPOLES
AT TUNES NEAR RESONANCE (Qx = 4.01, Qy = 4.11) [HARMON]

hybrid BOOSTER LATTICE OF COMBINED FUNCTION ELEMENTS
DELTA(P)/P = 0.000000

TOTAL LENGTH =	201.780000	NSUP =	12
QX =	4.009997	QY =	4.109997
QX' =	1.290876	QY' =	3.696270
ALFA =	0.665890E-01	GAMMA(TR) =	3.875241
BETAX =	9.90474E+00	BETAY =	9.63097E+00
		ETAX =	2.05177E+00
BETAX(MAX) =	13.715713	BETAY(MAX)=	13.673790
DX(MAX) =	2.937144	DY(MAX)=	0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SFC	-1.89019E-01
SDC	-9.73867E-01
SXV1	8.34574E-02
SXV2	6.72683E-02
SXV3	3.76814E-02

Q SHIFT EFFECTS

G22000		DQXDEX	DQX
-8.26976E+02	1.48420E+00	-1.65395E+03	-1.12965E-01
G00220		DQYDEY	DQY
-2.45315E+02	1.99024E+00	-4.90630E+02	-3.35100E-02
G11110		DQXDEY	DQYDEX
-1.06011E+03	2.65366E+00	-1.06011E+03	-1.06011E+03
		DQX	DQY
		-7.24052E-02	-7.24052E-02

TABLE VIIB

ALTERNATE hybrid BOOSTER LATTICE WITH [COMBINED FUNCTION ELEMENTS] WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P= 0.000000 [EX0 =6.8300E-05 EY0 =6.8300E-05]

THIRD ORDER EFFECTS OF SEXTUPOLES [RESONANCE EFFECTS]

3Qx = 12

COSINE	SINE	MODULUS	RANDOM	DE(S)
1.6394E+00	2.8678E-01	1.6643E+00	7.2788E-01	2.4758E-01
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
1.0828E-01	8.2526E-02	3.6093E-02	1.7055E-01	7.4592E-02

Qx+2Qy=12

COSINE	SINE	MODULUS	RANDOM	DE(S)
5.4062E+00	5.6395E+00	7.8122E+00	4.0555E+00	6.4563E-01
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
3.3516E-01	2.8874E-01	1.4989E-01	5.9672E-01	3.0977E-01

TABLE VIII

ALTERNATE BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS (WITH SHORT AND LONG STRAIGHT SECTS.)
AT OPERATING TUNES (Qx = 4.82, Qy = 5.83) [HARMON]

TOTAL LENGTH = 201.780000 NSUP = 8

QX	= 4.820000	QY	= 5.830000
QX'	= 0.000000	QY'	= 0.000000
ALFA	= 0.434514E-01	GAMMA(TR)	= 4.797314
BETAX = 3.71783E+00		BETAY = 1.26347E+01	
ETAX = 1.22212E+00			
BETAX(MAX) = 14.845045		BETAY(MAX) = 13.056088	
DX(MAX)	= 2.442651	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SF	2.80984E-01
SD	-1.57786E+00
SV	4.46595E-02

FOURTH ORDER EFFECTS OF SEXTUPOLES
Q SHIFT EFFECTS

G22000		DQXDEX	DQX
1.34370E+01	4.43651E-01	2.68740E+01	1.83549E-03
G00220		DQYDEY	DQY
-8.69426E+01	4.40566E-01	-1.73885E+02	-1.18764E-02
G11110		DQXDEY	DQYDEX
-2.46908E+02	5.87421E-01	-2.46908E+02	-2.46908E+02
		DQX	DQY
		-1.68638E-02	-1.68638E-02

TABLE IXA

ALTERNATE BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS (WITH SHORT AND LONG STRAIGHT SECTS.)
AT TUNES NEAR RESONANCE (Qx = 4.67, QY = 5.68)
[HARMON]

TOTAL LENGTH = 201.780000 NSUP = 6

QX	= 4.669727	QY	= 5.679805
QX'	= 0.482878	QY'	= 0.560711
ALFA	= 0.463236E-01	GAMMA(TR)	= 4.646210
BETAX	= 3.93919E+00	BETAY	= 1.25606E+01
ETAX	= 1.29773E+00		
BETAX(MAX)	= 15.138198	BETAY(MAX)	= 12.968586
DX(MAX)	= 2.522402	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SF	2.80984E-01
SD	-1.57786E+00
SV	4.46595E-02

FOURTH ORDER EFFECTS OF SEXTUPOLES
Q SHIFT EFFECTS

G22000		DQXDEX	DQX
1.22198E+01	4.71219E-01	2.44396E+01	1.66922E-03
G00220		DQYDEY	DQY
-1.55413E+03	4.64310E-01	-3.10827E+03	-2.12295E-01
G11110		DQXDEY	DQYDEX
-6.13724E+03	6.19081E-01	-6.13724E+03	-6.13724E+03

DQX	DQY
-4.19174E-01	-4.19174E-01

TABLE IXB

ALTERNATE BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS (WITH SHORT AND LONG STRAIGHT SECTS.)
DELTA(P)/P = 0.000000 [EX0 = 6.8300E-05 EY0 = 6.8300E-05]
[HARMON]

THIRD ORDER EFFECTS OF SEXTUPOLES [RESONANCE EFFECTS]
FOURIER ANALYSIS. ORDER OF RESONANCE = 3

Qx+2Qy=16.

COSINE	SINE	MODULUS	RANDOM	DE(S)
-6.7492E+00	-4.5363E-01	6.7644E+00	4.2806E+00	5.5904E-01
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
3.5376E-01	2.5001E-01	1.5821E-01	5.1669E-01	3.2696E-01

TABLE XA

ALTERNATE BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS (WITH SHORT AND LONG STRAIGHT SECTS.)
AT TUNES NEAR RESONANCE (Qx = 4.01, QY = 5.02)
[HARMON]

TOTAL LENGTH = 201.780000 NSUP = 8

QX	= 4.009912	QY	= 5.020079
QX'	=-13.657917	QY'	= 3.139946
ALFA	= 0.615457E-01	GAMMA(TR)	= 4.030893
BETAX	= 3.85585E+01	BETAY	= 1.24667E+01
ETAX	= 1.70938E+00		
BETAX(MAX)	=158.546396	BETAY(MAX)	= 12.822298
DX(MAX)	= 2.987292	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SF	2.80984E-01
SD	-1.57786E+00
SV	4.46595E-02

FOURTH ORDER EFFECTS OF SEXTUPOLES
Q SHIFT EFFECTS

G22000		DQXDEX	DQX
7.49421E+02	1.71222E+02	1.49884E+03	1.02371E-01
G00220		DQYDEY	DQY
3.78625E+01	2.98517E+00	7.57249E+01	5.17201E-03
G11110		DQXDEY	DQYDEX
1.27683E+03	3.98023E+00	1.27683E+03	1.27683E+03

DQX	DQY
8.72077E-02	8.72077E-02

TABLE XB

ALTERNATE BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS (WITH SHORT AND LONG STRAIGHT SECTS.)
DELTA(P)/P = 0.000000 [EX0 = 6.8300E-05 EY0 = 6.8300E-05]
[HARMON]

FOURIER ANALYSIS. ORDER OF RESONANCE = 2

2Qx = 8.

COSINE	SINE	MODULUS	RANDOM	DE(S)
-1.7393E+00	-1.6306E+00	2.3842E+00	1.3676E+01	9.5366E+00
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
5.4704E+01	4.7683E+00	2.7352E+01	4.7683E+00	2.7352E+01

FOURIER ANALYSIS. ORDER OF RESONANCE = 4

4Qx = 16.

COSINE	SINE	MODULUS	RANDOM	DE(S)
4.9350E+00	-4.8135E+00	6.8937E+00	1.1397E+01	1.8187E-02
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
3.0069E-02	4.5469E-03	7.5171E-03	6.5781E-03	1.0875E-02

TABLE XI

AGS BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS
AT OPERATING TUNES (Qx = 4.82, Qy = 3.83) [HARMON]

TOTAL LENGTH = 201.780000 NSUP = 6

QX	= 4.819999	QY	= 3.830001
QX'	= -0.000004	QY'	= -0.000008
ALFA	= 0.416074E-01	GAMMA(TR)	= 4.902470
BETAX	= 3.80934E+00	BETAY	= 1.51943E+01
ETAX	= 5.71156E-01		
BETAX(MAX)	= 13.284572	BETAY(MAX)	= 15.364436
DX(MAX)	= 2.757794	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS [m^{-2}]

ID	STRENGTH
SXF	5.15764E-02
SXD	-7.48396E-01
SXV	1.35000E-01

Q SHIFT EFFECTS [PERTURBATION OF TUNES]

G22000		DQXDEX	DQX
4.93770E+00	3.69541E-16	9.87540E+00	6.74490E-04
G00220		DQYDEY	DQY
5.74386E+01	2.06207E-15	1.14877E+02	7.84612E-03
G11110		DQXDEY	DQYDEX
-4.41655E+01	5.48864E-15	-4.41655E+01	-4.41655E+01
		DQX	DQY
		-3.01650E-03	-3.01650E-03

TABLE XIIA

AGS BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS [HARMON]
AT TUNES NEAR RESONANCE (Qx = 4.501, Qy = 3.511)

SEPARATED FUCTION AGS-BOOSTER LATTICE NSUP = 6
DELTA(P)/P = 0.000000

TOTAL LENGTH = 201.780000

QX	= 4.500821	QY	= 3.510902
QX'	= 1.568697	QY'	= -0.213745
ALFA	= 0.487108E-01	GAMMA(TR)	= 4.530929
BETAX	= 4.21684E+00	BETAY	= 1.56740E+01
ETAX	= 8.66694E-01		
BETAX(MAX)	=13.363965	BETAY(MAX)	= 15.936994
DX(MAX)	= 2.785418	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS [m^{-2}]

ID	STRENGTH
SXF	5.15764E-02
SXD	-7.48396E-01
SXV	1.35000E-01

Q SHIFT EFFECTS [PERTURBATION OF TUNES]

G22000		DQXDEX	DQX
3.57222E+00	3.98153E-16	7.14443E+00	4.87965E-04
G00220		DQYDEY	DQY
5.58769E+01	1.04727E-15	1.11754E+02	7.63278E-03
G11110		DQXDEY	DQYDEX
-2.90430E+01	-4.11767E-15	-2.90430E+01	-2.90430E+01

DQX	DQY
-1.98364E-03	-1.98364E-03

TABLE XIIB

STANDARD AGS - BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P = 0.000000 [EX0 = 6.8300E-05 EY0 = 6.8300E-05]
[HARMON]

FOURTH ORDER EFFECTS OF SETUPOLES [RESONANCE EFFECTS]

4Qx = 18

COSINE	SINE	MODULUS	RANDOM	DE(S)
-1.1265E-01	7.3267E-02	1.3438E-01	1.9692E-01	3.5452E-04

DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
5.1953E-04	8.8630E-05	1.2988E-04	1.2822E-04	1.8790E-04

TABLE XIIIA

AGS BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS [HARMON]
AT TUNES NEAR RESONANCE (Qx = 4.01, Qy = 3.02)

SEPARATED FUCTION AGS-BOOSTER LATTICE NSUP = 6
DELTA(P)/P = 0.000000

TOTAL LENGTH = 201.780000

QX	= 4.009842	QY	= 3.019958
QX'	= 3.970762	QY'	= -0.259775
ALFA	= 0.621845E-01	GAMMA(TR)	= 4.010134
BETAX = 4.94361E+00		BETAY	= 1.44310E+01
ETAX = 1.34289E+00			
BETAX(MAX)	= 13.819729	BETAY(MAX)	= 20.627309
DX(MAX)	= 3.045880	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS [m^{-2}]

ID	STRENGTH
SXF	5.15764E-02
SXD	-7.48396E-01
SXV	1.35000E-01

Q SHIFT EFFECTS [FOURTH ORDER EFFECTS OF SEXTUPOLES]

G22000		DQXDEX	DQX
-5.39073E+00	2.39243E-15	-1.07815E+01	-7.36374E-04
G00220		DQYDEY	DQY
5.40201E+01	-9.14974E-16	1.08040E+02	7.37915E-03
G11110		DQXDEY	DQYDEX
-5.77895E+01	4.13282E-16	-5.77895E+01	-5.77895E+01
		DQX	DQY
		-3.94702E-03	-3.94702E-03

TABLE XIIIB

STANDARD AGS - BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P = 0.000000 [EX0 = 6.8300E-05 EY0 = 6.8300E-05]
[HARMON]

SECOND ORDER EFFECTS OF SEXTUPOLES [RESONANCE EFFECTS]
2Qy = 6

COSINE	SINE	MODULUS	RANDOM	DE(S)
3.7943E+00	-2.2381E+00	4.4052E+00	3.5156E+00	1.7621E+01
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
1.4062E+01	8.8105E+00	7.0311E+00	8.8105E+00	7.0311E+00

FOURIER ANALYSIS. ORDER OF RESONANCE =3

3Qx = 12

COSINE	SINE	MODULUS	RANDOM	DE(S)
1.4996E-01	-6.2946E-02	1.6263E-01	6.6932E-01	2.4193E-02
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
9.9568E-02	8.0643E-03	3.3189E-02	1.6666E-02	6.8591E-02

FOURIER ANALYSIS. ORDER OF RESONANCE = 4

4Qy = 12

COSINE	SINE	MODULUS	RANDOM	DE(S)
-3.4003E-01	-1.8945E-01	3.8924E-01	1.2352E+00	1.0269E-03
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
3.2587E-03	2.5673E-04	8.1468E-04	3.7142E-04	1.1786E-03

TABLE XIVA

AGS BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS [HARMON]
AT TUNES NEAR RESONANCE (Qx = 4.67, QY = 3.68)

SEPARATED FUCTION AGS-BOOSTER LATTICE NSUP = 6
DELTA(P)/P = 0.000000

TOTAL LENGTH	= 201.780000		
QX	= 4.669806	QY	= 3.680207
QX'	= 0.750768	QY'	= -0.135290
ALFA	= 0.448424E-01	GAMMA(TR)	= 4.722324
BETAX	= 3.99415E+00	BETAY	= 1.54051E+01
ETAX	= 7.12403E-01		
BETAX(MAX)	= 13.302322	BETAY(MAX)	= 15.607883
DX(MAX)	= 2.754428	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SXF	5.15764E-02
SXD	-7.48396E-01
SXV	1.35000E-01

Q SHIFT EFFECTS [FOURTH ORDER EFFECTS OF SEXTUPOLES]

G22000		DQXDEX	DQX
4.21477E+00	4.39129E-16	8.42954E+00	5.75737E-04
G00220		DQYDEY	DQY
2.47824E+01	1.68949E-14	4.95648E+01	3.38528E-03
G11110		DQXDEY	DQYDEX
-1.61819E+02	7.21102E-14	-1.61819E+02	-1.61819E+02
		DQX	DQY
		-1.10522E-02	-1.10522E-02

TABLE XIVB

STANDARD AGS - BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P = 0.000000 [EX0 = 6.8300E-05 EY0 = 6.8300E-05]
[HARMON]

FOURIER ANALYSIS. ORDER OF RESONANCE = 3

Qx+2Qy=12

COSINE	SINE	MODULUS	RANDOM	DE(S)
9.7275E-01	-3.4598E-02	9.7337E-01	3.3420E+00	8.0443E-02
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
2.7619E-01	3.5975E-02	1.2352E-01	7.4349E-02	2.5527E-01

TABLE XV

AGS BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS [HARMON]
AT OPERATING TUNES (Qx = 3.82, Qy = 4.83)

TOTAL LENGTH = 201.780000 NSUP = 6

QX	= 3.819998	QY	= 4.830000
QX'	= -0.000004	QY'	= -0.000006
ALFA	= 0.707480E-01	GAMMA(TR)	= 3.759611
BETAX	= 4.62031E+00	BETAY	= 1.28928E+01
ETAX	= 1.49867E+00		
BETAX(MAX)	= 16.047983	BETAY(MAX)	= 12.940117
DX(MAX)	= 3.459309	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS [m^{-2}]

ID	STRENGTH
SXF	-1.93739E-01
SXD	-6.82097E-01
SXV	1.35000E-01

FOURTH ORDER EFFECTS OF SEXTUPOLES
Q SHIFT EFFECTS [PERTURBATION OF TUNES]

G22000		DQXDEX	DQX
3.49180E+00	2.22445E-16	6.98360E+00	4.76980E-04
G00220	DQYDEY	DQY	
-3.32647E+01	1.15672E-15	-6.65294E+01	-4.54396E-03
G11110		DQXDEY	DQYDEX
2.00599E+02	5.90557E-15	2.00599E+02	2.00599E+02
		DQX	DQY
		1.37009E-02	1.37009E-02

TABLE XVIA

AGS BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS [HARMON]
AT TUNES NEAR RESONANCE (Qx = 3.501, QY = 4.502)

TOTAL LENGTH = 201.780000 NSUP = 6

QX	= 3.500878	QY	= 4.502188
QX'	= 0.965781	QY'	= 0.934611
ALFA	= 0.841653E-01	GAMMA(TR)	= 3.446939
BRTAX	= 4.96124E+00	BETAY	= 1.29891E+01
ETAX	= 1.90161E+00		
BETAX(MAX)	= 17.195597	BETAY(MAX)	= 13.041884
DX(MAX)	= 3.854957	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS [m^{-2}]

ID	STRENGTH
SXF	-1.93739E-01
SXD	-6.82097E-01
SXV	1.35000E-01

FOURTH ORDER EFFECTS OF SEXTUPOLES
Q SHIFT EFFECTS [PERTURBATION OF TUNES]

G22000		DQXDEX	DQX
3.50514E+00	2.86906E-16	7.01028E+00	4.78802E-04
G00220		DQYDEY	DQY
-2.57585E+00	1.71454E-15	-5.15171E+00	-3.51862E-04
G11110		DQXDEY	DQYDEX
6.01745E+01	7.35472E-15	6.01745E+01	6.01745E+01

DQX	DQY
4.10992E-03	4.10992E-03

TABLE XVIB

STANDARD AGS - BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P = 0.000000 [EX0 = 6.8300E-05 EY0 = 6.8300E-05]
[HARMON]

FOURTH ORDER EFFECTS OF SEXTUPOLES [RESONANCE EFFECTS]
4Qy=18

COSINE	SINE	MODULUS	RANDOM	DE(S)
4.7689E-01	4.0294E-01	6.2432E-01	5.5601E-01	1.6471E-03
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
1.4669E-03	4.1178E-04	3.6672E-04	5.9574E-04	5.3055E-04

TABLE XVIIA

AGS BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS
AT TUNES NEAR RESONANCE (Qx = 3.01, QY = 4.02)
[HARMON]

TOTAL LENGTH = 201.780000 NSUP = 6

QX	= 3.010151	QY	= 4.020158
QX'	= 6.037958	QY'	= 2.576143
ALFA	= 0.109313E+00	GAMMA(TR)	= 3.024576
BETAX	= 1.22766E+00	BETAY	= 1.33334E+01
ETAX	= 2.64756E+00		
BETAX(MAX)	=211.310990	BETAY(MAX)	= 13.401659
DX(MAX)	= 4.656692	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SXF	-1.93739E-01
SXD	-6.82097E-01
SXV	1.35000E-01

FOURTH ORDER EFFECTS OF SEXTUPOLES
Q SHIFT EFFECTS

G22000		DQXDEX	DQX
5.34555E+02	4.37152E-13	1.06911E+03	7.30202E-02
G00220		DQYDEY	DQY
6.28613E+00	-3.62599E-15	1.25723E+01	8.58686E-04
G11110		DQXDEY	DQYDEX
1.09986E+02	-4.07215E-14	1.09986E+02	1.09986E+02
		DQX	DQY
		7.51201E-03	7.51201E-03

TABLE XVIIB

STANDARD AGS - BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P = 0.000000 [EX0 = 6.8300E-05 EY0 = 6.8300E-05]
[HARMON]

FOURIER ANALYSIS. ORDER OF RESONANCE = 2

2QX = 6

COSINE	SINE	MODULUS	RANDOM	DE(S)
1.2479E+00	7.7481E-01	1.4689E+00	1.7635E+01	5.8755E+00
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
7.0539E+01	2.9378E+00	3.5269E+01	2.9378E+00	3.5269E+01

FOURIER ANALYSIS. ORDER OF RESONANCE = 4

4QX = 12

COSINE	SINE	MODULUS	RANDOM	DE(S)
-1.8352E+01	-1.0566E+01	2.1176E+01	4.3150E+01	5.5869E-02
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
1.1384E-01	1.3967E-02	2.8460E-02	2.0207E-02	4.1175E-02

TABLE XVIIIA

AGS BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES
AND EDDY CURRENTS
AT TUNES NEAR RESONANCE (Qx = 3.33, QY = 4.34)
[HARMON]

TOTAL LENGTH = 201.780000 NSUP = 6

QX	= 3.329820	QY	= 4.339808
QX'	= 1.489621	QY'	= 1.496112
ALFA	= 0.928495E-01	GAMMA(TR)	= 3.281786
BETAX	= 4.94754E+00	BETAY	= 1.30637E+01
ETAX	= 2.15777E+00		
BETAX(MAX)	= 18.772303	BETAY(MAX)	= 13.119966
DX(MAX)	= 4.128330	DY(MAX)	= 0.000000

NORMALIZED STRENGTHS

ID	STRENGTH
SXF	-1.93739E-01
SXD	-6.82097E-01
SXV	1.35000E-01

FOURTH ORDER EFFECTS OF SEXTUPOLES
Q SHIFT EFFECTS

G22000		DQXDEX	DQX
3.97356E+00	2.43621E-16	7.94712E+00	5.42788E-04
G00220		DQYDEY	DQY
-7.80774E+01	8.18510E-14	-1.56155E+02	-1.06654E-02
G11110		DQXDEY	DQYDEX
-2.70047E+02	3.26858E-13	-2.70047E+02	-2.70047E+02

DQX	DQY
-1.84442E-02	-1.84442E-02

TABLE XVIIIB

STANDARD AGS - BOOSTER LATTICE WITH CHROMATICITY SEXTUPOLES AND EDDY CURRENTS
DELTA(P)/P = 0.000000 [EX0 = 6.8300E-05 EY0 = 6.8300E-05]
[HARMON]

THIRD ORDER EFFECTS OF SEXTUPOLES [RESONANCE EFFECTS]
FOURIER ANALYSIS. ORDER OF RESONANCE = 3

QX+2QY=12

COSINE	SINE	MODULUS	RANDOM	DE(S)
8.5277E-01	1.6930E-01	8.6941E-01	3.2858E+00	7.1851E-02
DE(R)	DQ(S)	DQ(R)	DQ20(S)	DQ20(R)
2.7155E-01	3.2133E-02	1.2144E-01	6.6408E-02	2.5098E-01