Nonlinear chromaticity correction for 2008 pp run

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(Feb.14, 2008 RHIC weekly meeting)

1. What MADX says

Yellow ring

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```
2-FAM CORRECTION:

Variable                    Final Value        Lower Limit        Upper Limit
--------------------------------------------------------------------------------
sf0                          3.19594287E-01    -1.00000000E+20     1.00000000E+20
sd0                         -5.98033305E-01    -1.00000000E+20     1.00000000E+20

* NAME                     ORDER1     ORDER2     ORDER3     ORDER4            VALUE
 "Q1"                           0          0          0          0        0.694989969
 "Q2"                           0          0          0          0       0.6849901818
 "DQ1"                          1          0          0          0        1.848885218
 "DQ2"                          1          0          0          0        1.929785464
 "DQ1"                          2          0          0          0        -3781.66364
 "DQ2"                          2          0          0          0        4505.457794
 "DQ1"                          3          0          0          0       -289557.4453
 "DQ2"                          3          0          0          0         2221316.18
```

```
8-FAMILY CORRECTION:

Variable                    Final Value        Lower Limit        Upper Limit
--------------------------------------------------------------------------------
sfmi->k2                     2.33900854E-01    -1.00000000E+20     1.00000000E+20
sfpi->k2                     4.13259256E-01    -1.00000000E+20     1.00000000E+20
sfmo->k2                     3.19379069E-01    -1.00000000E+20     1.00000000E+20
sfpo->k2                     3.18658279E-01    -1.00000000E+20     1.00000000E+20
sdmi->k2                    -5.94152472E-01    -1.00000000E+20     1.00000000E+20
sdpi->k2                    -6.00676412E-01    -1.00000000E+20     1.00000000E+20
sdmo->k2                    -6.93292872E-01    -1.00000000E+20     1.00000000E+20
sdpo->k2                    -5.05876787E-01    -1.00000000E+20     1.00000000E+20

* NAME                     ORDER1     ORDER2     ORDER3     ORDER4            VALUE
 "Q1"                           0          0          0          0        0.694989969
 "Q2"                           0          0          0          0       0.6849901818
 "DQ1"                          1          0          0          0        1.849244762
 "DQ2"                          1          0          0          0        1.929387683
 "DQ1"                          2          0          0          0        -520.5769514
 "DQ2"                          2          0          0          0        492.0890842
 "DQ1"                          3          0          0          0        59493.25207
 "DQ2"                          3          0          0          0        1962409.168
```

--:** temp (Fundamental)--L23--C50--All----

Blue ring

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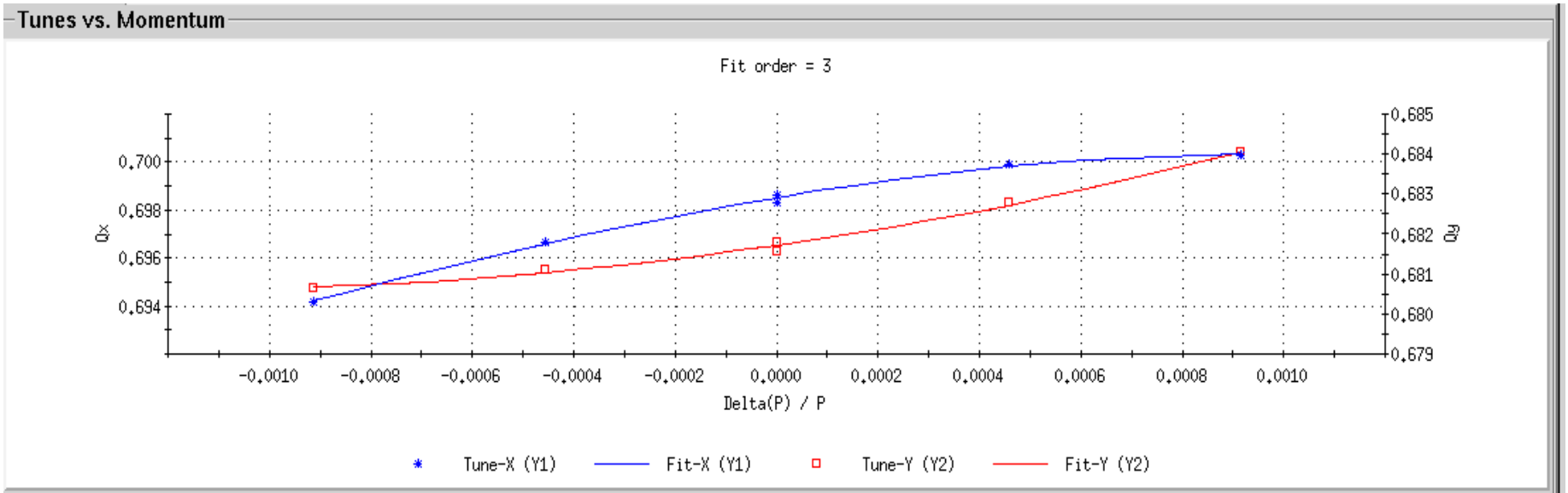
```
2-FAMILY CORRECTION:

Variable                    Final Value        Lower Limit        Upper Limit
-----------------------------------------------------------------------------
sf0                        3.08341161E-01    -1.00000000E+20     1.00000000E+20
sd0                       -5.77840593E-01    -1.00000000E+20     1.00000000E+20

* NAME                   ORDER1     ORDER2     ORDER3     ORDER4          VALUE
 "Q1"                         0          0          0          0     0.6949907261
 "Q2"                         0          0          0          0      0.684991053
 "DQ1"                        1          0          0          0      1.853634348
 "DQ2"                        1          0          0          0      1.926981927
 "DQ1"                        2          0          0          0       398.348265
 "DQ2"                        2          0          0          0      4206.421212
 "DQ1"                        3          0          0          0      1564162.749
 "DQ2"                        3          0          0          0      123561.4375
```

```
8-FAMILY CORRECTION

Variable                    Final Value        Lower Limit        Upper Limit
-----------------------------------------------------------------------------
sfmi->k2                   2.94215963E-01    -1.00000000E+20     1.00000000E+20
sfpi->k2                   3.18705214E-01    -1.00000000E+20     1.00000000E+20
sfmo->k2                   3.26017453E-01    -1.00000000E+20     1.00000000E+20
sfpo->k2                   2.95997047E-01    -1.00000000E+20     1.00000000E+20
sdmi->k2                  -5.81308794E-01    -1.00000000E+20     1.00000000E+20
sdpi->k2                  -5.90116485E-01    -1.00000000E+20     1.00000000E+20
sdmo->k2                  -7.42183718E-01    -1.00000000E+20     1.00000000E+20
sdpo->k2                  -4.14862951E-01    -1.00000000E+20     1.00000000E+20

* NAME                   ORDER1     ORDER2     ORDER3     ORDER4          VALUE
 "Q1"                         0          0          0          0     0.6949907261
 "Q2"                         0          0          0          0      0.684991053
 "DQ1"                        1          0          0          0      1.853627974
 "DQ2"                        1          0          0          0      1.926596059
 "DQ1"                        2          0          0          0      449.6103615
 "DQ2"                        2          0          0          0      492.5315026
 "DQ1"                        3          0          0          0      1608557.232
 "DQ2"                        3          0          0          0      350955.4924
```

--:** madx-says (Fundamental)--L35--C1--All----

2. what machine tells

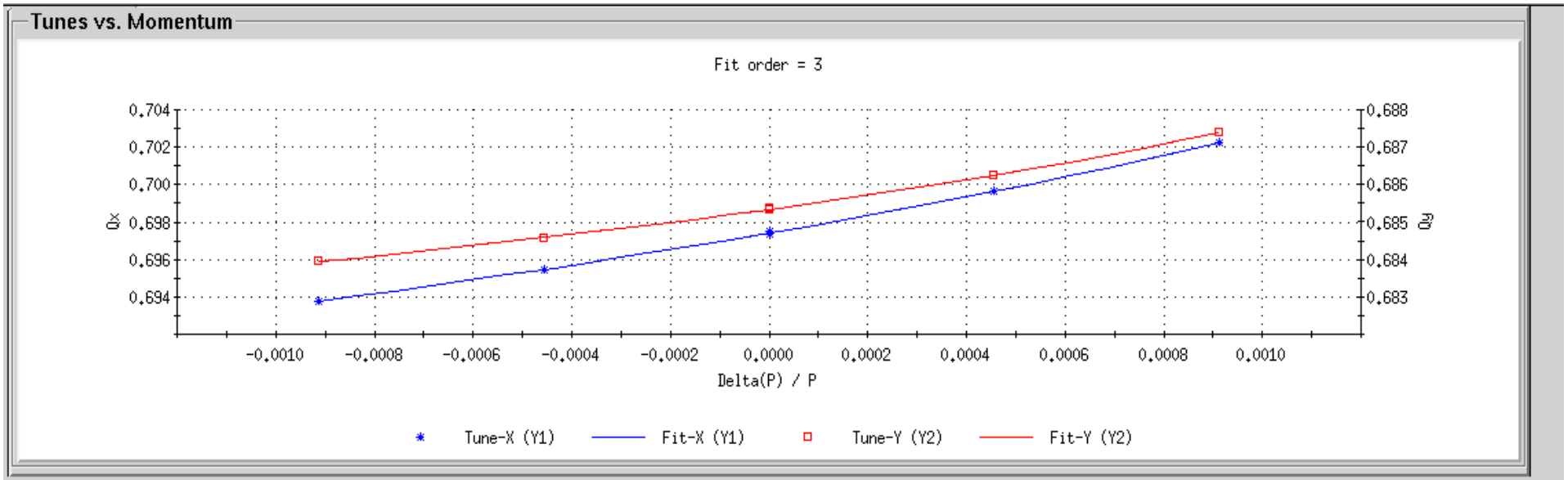
Yellow ring



Row	Delta(p)/p	Skew q1	BBQ X	Tune X #1	Tune X #2	Select	Skew q2	BBQ Y	Tune Y #1	Tune Y #2	Select
1	-0.000913718	-0.000410186	0.694187	0.694336	0.68457	BBQ	0.000726759	0.680655	0.680664	0.709961	BBQ
2	-0.000456401	-5.37851e-05	0.696669	0.697266	0.733398	BBQ	0.000125309	0.681097	0.680664	0.694336	BBQ
3	0	0.0010112	0.698323	0.699219	0.77832	BBQ	0.000380553	0.681558	-999	-999	BBQ
4	0	0.00100655	0.698627	0.698242	0.708984	BBQ	-0.000589897	0.68178	0.681641	0.729492	BBQ
5	0.000457316	0.000633463	0.699878	0.700195	0.786133	BBQ	-0.00196815	0.682789	0.681641	0.689453	BBQ
6	0.000914632	0.000633431	0.700297	0.699219	0.761719	BBQ	-0.00331172	0.684039	0.682617	0.791016	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ

	Corr	Tune	+-Sigma	Chrom[1]	+-Sigma	Chrom[2]	+-Sigma	Chrom[3]	+-Sigma
Horizontal	0.998831	0.698524	7.06036e-05	3.56965	0.119659	-1515.75	198.806	-271271	4772
Vertical	0.997506	0.681717	5.63531e-05	1.85052	0.0955075	771.963	158.679	-22.1868	3809
Skew-q1	0.905927	0.000780266	0.000158589	0.812425	0.268778	-891.194	446.556	-288102	1.07201e+
Skew-q2	0.966801	-0.000344391	0.000258641	-2.31838	0.438345	-1228.86	728.281	132502	1.74832e+

Blue ring

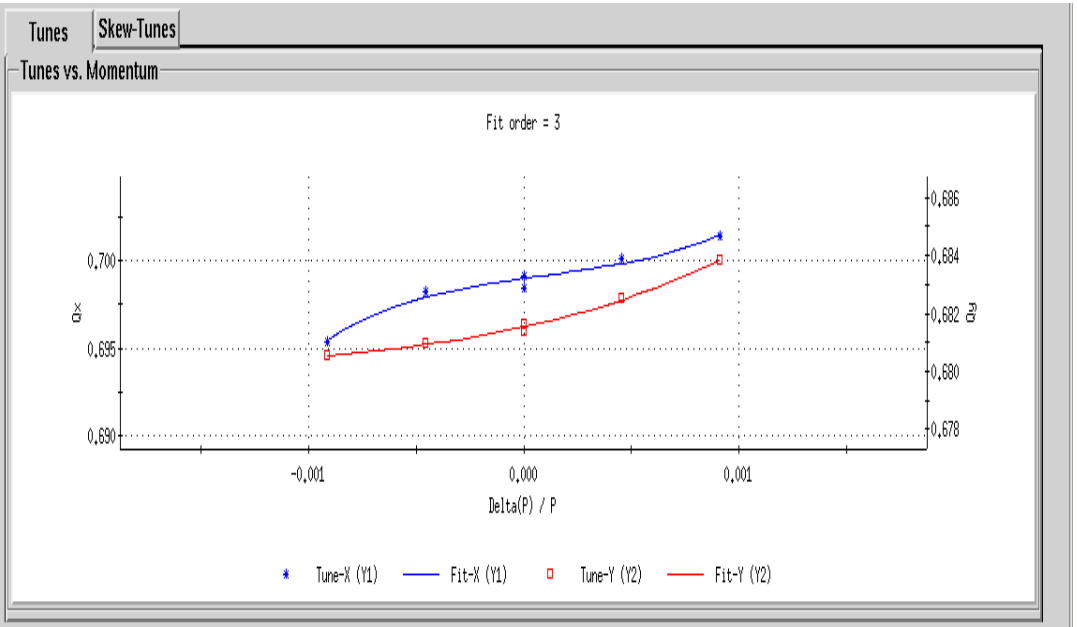


Row	Delta(p)/p	Skew q1	BBQ X	Tune X #1	Tune X #2	Select	Skew q2	BBQ Y	Tune Y #1	Tune Y #2	Select
1	-0.000911751	-0.000509821	0.693776	0.675781	0.760742	BBQ	0.00135293	0.683936	0.6875	0.750977	BBQ
2	-0.000455419	0.000254597	0.695455	0.760742	0.694336	BBQ	0.000363632	0.684567	0.688477	0.767578	BBQ
3	0	0.00193195	0.697466	0.695312	0.760742	BBQ	-0.000823818	0.685376	0.689453	0.660156	BBQ
4	0	0.00121378	0.697376	0.760742	0.693359	BBQ	-0.000717792	0.68533	0.689453	0.658203	BBQ
5	0.000456332	0.00267395	0.699618	0.676758	0.760742	BBQ	-0.00211039	0.686231	0.689453	0.698242	BBQ
6	0.000912664	0.00314614	0.702224	0.676758	0.761719	BBQ	-0.00327156	0.687399	0.692383	0.706055	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ

	Corr	Tune	+-Sigma	Chrom[1]	+-Sigma	Chrom[2]	+-Sigma	Chrom[3]	+-Sigma
Horizontal	0.999942	0.697407	2.0733e-05	4.54332	0.0352141	704.106	58.6322	104260	141057
Vertical	0.99984	0.685337	1.41487e-05	1.79918	0.024031	389.415	40.012	118307	96260.8
Skew-q1	0.986801	0.00155165	0.000147331	2.86996	0.250236	-289.232	416.648	-1.04045e+06	1.00237e+06
Skew-q2	0.999664	-0.000795984	2.78118e-05	-2.77289	0.0472373	-205.231	78.6509	286380	189218

3. What we got

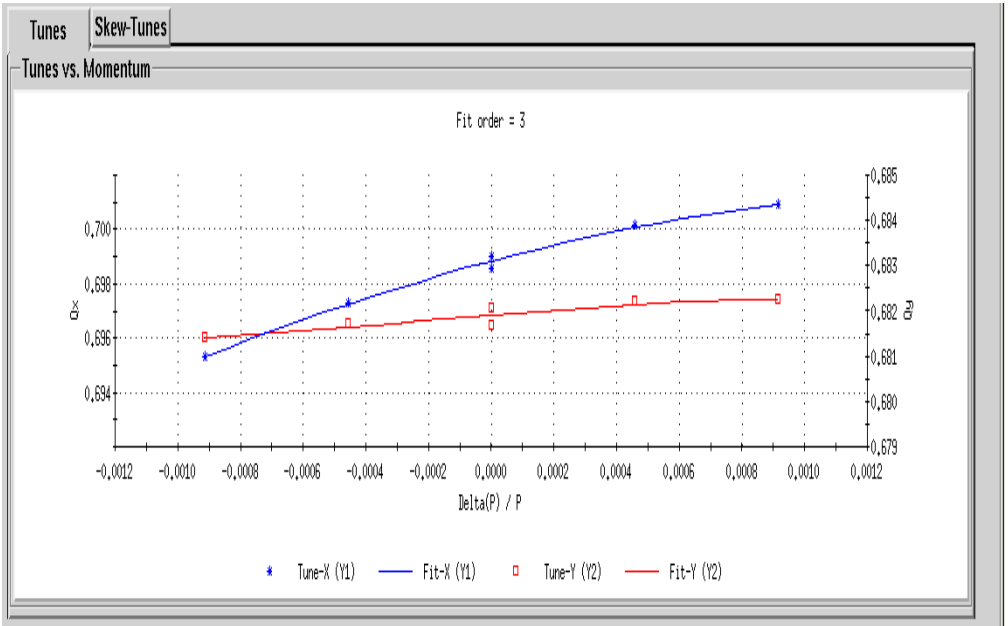
Yellow ring



Row	Delta(p)/p	Skew q1	BBQ X	Tune X #1	Tune X #2	Select	Skew q2	BBQ Y	Tune Y #1	Tune Y #2	Select
1	-0.000913718	-0.00018599	0.695405	0.691406	0.697266	BBQ	0.000105435	0.680519	0.680664	0.636719	BBQ
2	-0.000456401	5.84216e-05	0.698203	0.698242	0.685547	BBQ	0.000428721	0.680967	0.680664	0.722656	BBQ
3	0	0.00117893	0.698485	0.699219	0.634766	BBQ	-0.00175216	0.68139	0.680664	0.705078	BBQ
4	0	-6.70031e-05	0.69913	0.699219	0.685547	BBQ	-0.000826881	0.681622	0.680664	0.674805	BBQ
5	0.000457316	3.89989e-05	0.700138	0.700195	0.602539	BBQ	-0.00141484	0.682504	0.681641	0.607422	BBQ
6	0.000914632	-0.000374658	0.701428	0.701172	0.69043	BBQ	-0.00300485	0.683839	0.683594	0.689453	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ

	Corr	Tune	+-Sigma	Chrom[1]	+-Sigma	Chrom[2]	+-Sigma	Chrom[3]	+-Sigma
Horizontal	0.988673	0.69902	0.00019756	1.72716	0.334826	-640.882	556.291	1.87629e+06	1.33544e+06
Vertical	0.997812	0.681534	5.11718e-05	1.63696	0.0867263	781.999	144.09	213251	345905
Skew-q1	0.64119	0.000418219	0.000271683	0.00628821	0.46045	-890.554	765.007	-129995	1.83649e+06

First try: Q''x reduced by 900.

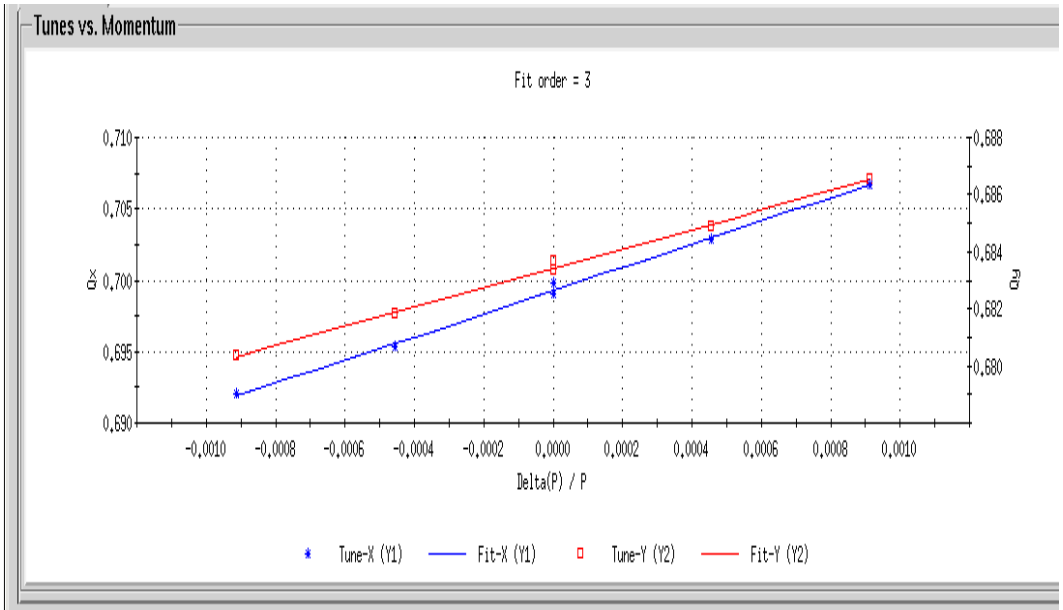


Row	Delta(p)/p	Skew q1	BBQ X	Tune X #1	Tune X #2	Select	Skew q2	BBQ Y	Tune Y #1	Tune Y #2	Select
1	-0.000913718	-1.99944e-05	0.695297	0.692383	0.698242	BBQ	-0.000528289	0.681404	0.680664	0.632812	BBQ
2	-0.000456401	0.000426269	0.697318	0.698242	0.661133	BBQ	-0.000522412	0.681702	0.681641	0.686523	BBQ
3	0	-0.000179534	0.698547	0.701172	0.738281	BBQ	-0.00205585	0.681661	0.681641	0.732422	BBQ
4	0	-0.000535423	0.699004	0.699219	0.791016	BBQ	-0.000553764	0.682058	0.681641	0.630859	BBQ
5	0.000457316	0.000693581	0.700153	0.701172	0.691406	BBQ	-0.000414099	0.682205	0.681641	0.673828	BBQ
6	0.000914632	0.00034853	0.7009	0.701172	0.723633	BBQ	-0.00258848	0.682246	0.681641	0.615234	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ

	Corr	Tune	+-Sigma	Chrom[1]	+-Sigma	Chrom[2]	+-Sigma	Chrom[3]	+-Sigma
Horizontal	0.996935	0.698835	0.000101993	3.11668	0.172859	-859.135	287.194	-61747.8	689442
Vertical	0.917351	0.681907	8.72561e-05	0.580589	0.147882	-79.2842	245.696	-144000	589822
Skew-q1	0.431073	5.81121e-06	0.000262279	0.323976	0.444512	334.336	738.528	-146924	1.77292e+06

Second try: Q''y reduced by 700.

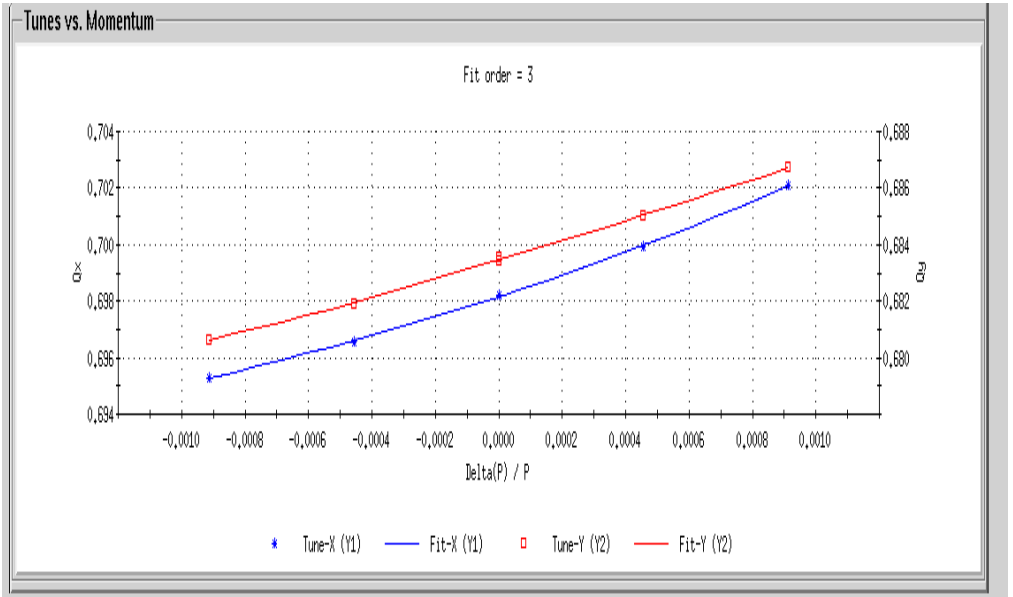
Blue ring



Row	Delta(p)/p	Skew q1	BBQ X	Tune X #1	Tune X #2	Select	Skew q2	BBQ Y	Tune Y #1	Tune Y #2	Selec
1	-0.000911751	-0.000840265	0.692014	0.760742	0.674805	BBQ	0.00146974	0.680338	0.68457	0.726562	BBQ
2	-0.000455419	-0.000176205	0.695388	0.675781	0.760742	BBQ	0.00141864	0.681821	0.686523	0.696289	BBQ
3	0	0.00194922	0.699754	0.760742	0.675781	BBQ	-6.35888e-05	0.683638	0.6875	0.664062	BBQ
4	0	0.00183119	0.699013	0.760742	0.675781	BBQ	0.00015888	0.683338	0.689453	0.767578	BBQ
5	0.000456332	0.00418326	0.702844	0.671875	0.768555	BBQ	-0.00161137	0.684901	0.688477	0.739258	BBQ
6	0.000912664	0.00543665	0.706685	0.676758	0.761719	BBQ	-0.00149588	0.68653	0.691406	0.724609	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ

	Corr	Tune	+-Sigma	Chrom[1]	+-Sigma	Chrom[2]	+-Sigma	Chrom[3]	+-Si
Horizontal	0.998677	0.699263	0.000172943	8.22232	0.293737	51.3758	489.076	-217288	1.176
Vertical	0.998723	0.683435	7.13983e-05	3.37238	0.121267	-24.71	201.912	25843.8	
Skew-q1	0.99988	0.00189465	2.42884e-05	5.22737	0.0412529	[illegible]	68.6868	-2.14788e+06	

With 8 families



Row	Delta(p)/p	Skew q1	BBQ X	Tune X #1	Tune X #2	Select	Skew q2	BBQ Y	Tune Y #1	Tune Y #2	Select
1	-0.000911751	-0.00392527	0.695287	0.675781	0.695312	BBQ	0.00477623	0.680638	0.685547	0.695312	BBQ
2	-0.000455419	-0.0023328	0.696556	0.760742	0.675781	BBQ	0.00264845	0.681912	0.686523	0.711914	BBQ
3	0	0.000401996	0.6982	0.760742	0.675781	BBQ	-0.000197411	0.683555	0.688477	0.705078	BBQ
4	0	4.17707e-05	0.698202	0.760742	0.675781	BBQ	-0.000462771	0.683413	0.6875	0.704102	BBQ
5	0.000456332	0.00206815	0.699933	0.760742	0.675781	BBQ	-0.00305071	0.685008	0.689453	0.766602	BBQ
6	0.000912664	0.00305036	0.702088	0.761719	0.669922	BBQ	-0.00427695	0.686729	0.691406	0.739258	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ
0	0	0	0	0	0	BBQ	0	0	0	0	BBQ

	Corr	Tune	+-Sigma	Chrom[1]	+-Sigma	Chrom[2]	+-Sigma	Chrom[3]	+-Sigma
Horizontal	0.999867	0.698164	2.54394e-05	3.69477	0.0432078	611.994	71.9417	38666	173077
Vertical	0.999634	0.683449	3.77677e-05	3.41541	0.064147	265.58	106.806	-92492.3	256953
Skew-q1	0.998406	0.000133572	9.57072e-05	5.16127	0.162555	-722.135	270.657	-1.60686e+06	651145

After Q' adjustings

4. Summary

1) just did some quick tests, dedicated time needed.
2) seems Q'' are not as big as predicated by MADX.
3) put WP of the ring with smaller Q''x above diagonal

one fact: BB tune shift: 1.0e11--> 0.01