Follow up of Thin and Thick lens models with errors:

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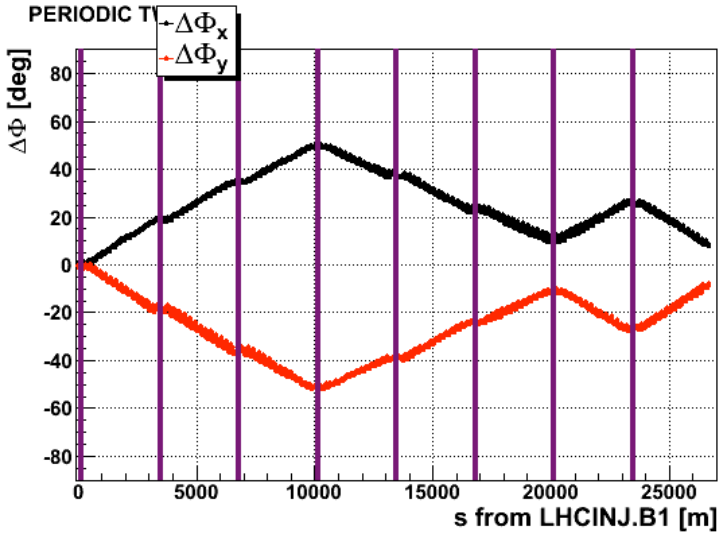
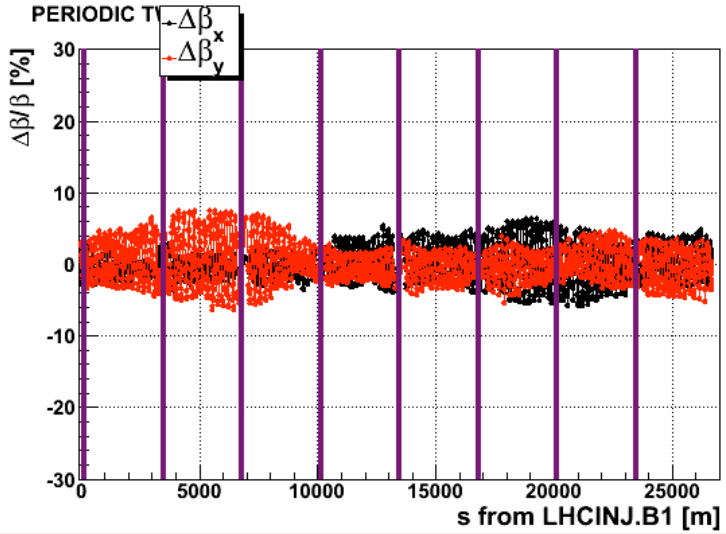
thanks to S.Fartoukh, M.Giovannozzi, T.Risselada, F. Schmidt

Last plots two weeks ago

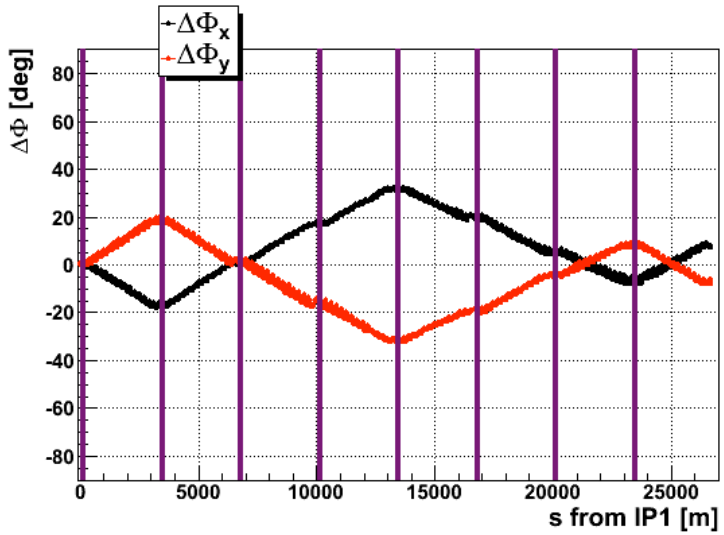
PTC optics with b2 errors in MBs

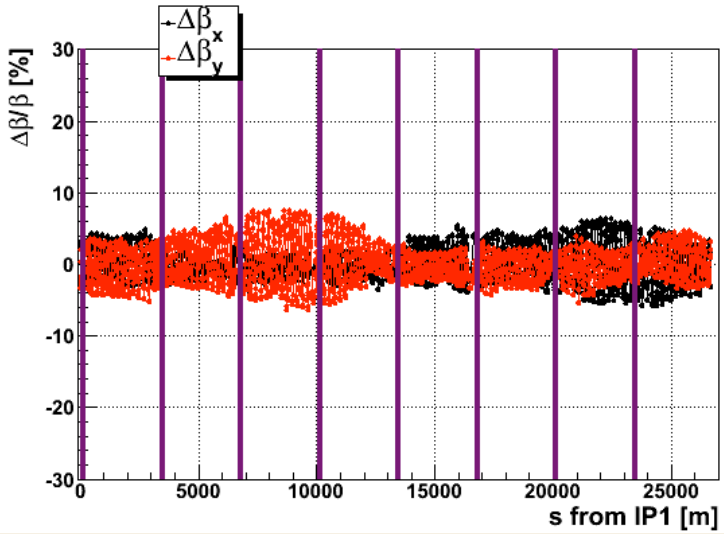
Twiss with initial parameters matched at LHC injection





Periodic TWISS with usual LHC sequence





To do's from two weeks ago

- Next:

--check w.r.t. thin lens with errors ← Until today: done this only

--check w.r.t. declaring k1 in madx dipole definition

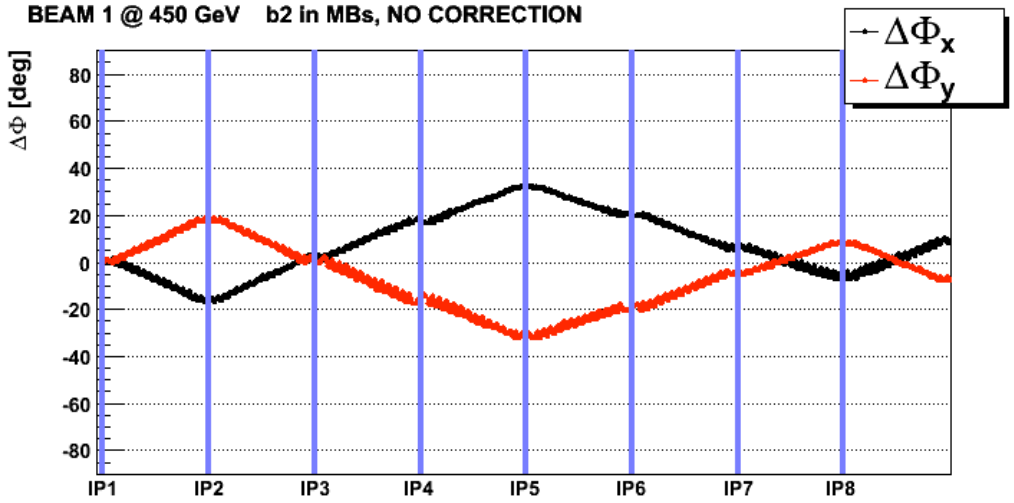
--check resulting tune variations

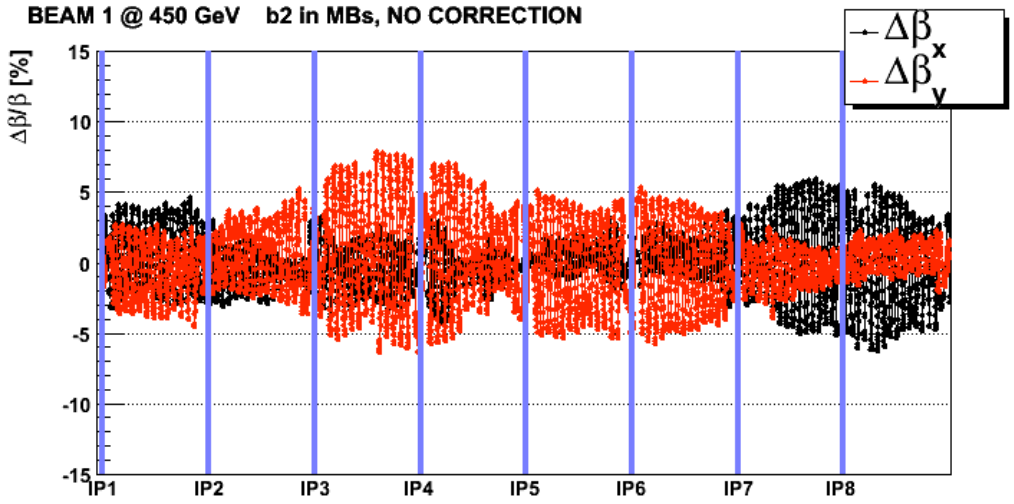
--expand model including all errors, corrections, tune and chromaticity matching etc...

--integration into MADX OM

MB b2 errors, NO correction --- BEAM 1

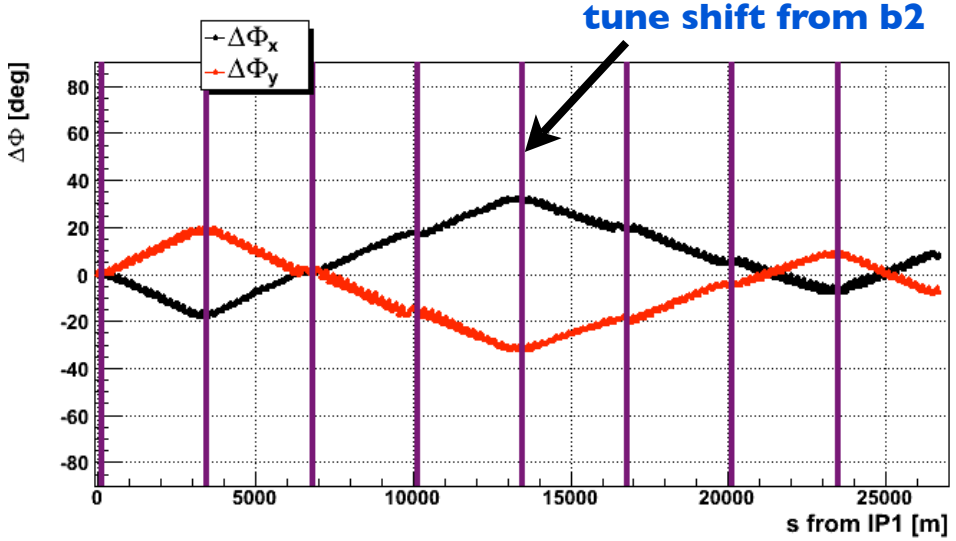
MADX THIN

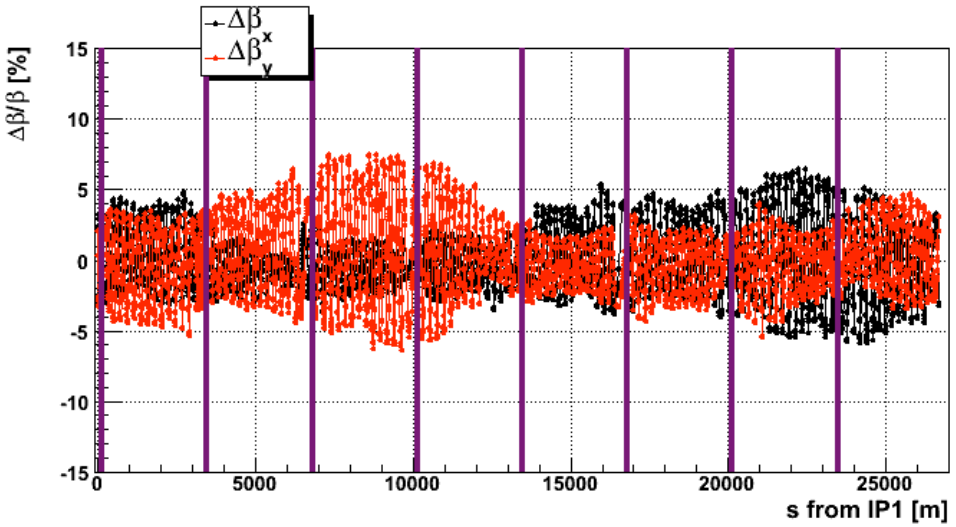




PTC

Maximum phase shift of ~38 deg is in agreement with prediction from total tune shift from b2





Thick lens model with errors - follow up

Frank prepared a new version of PTC with errors that

- now writes TFS tables with thick error values

- tables can be read wit read by READMYTABLE

I started to test it but I’ve no new results yet.

Thin lens + Errors - V6.503

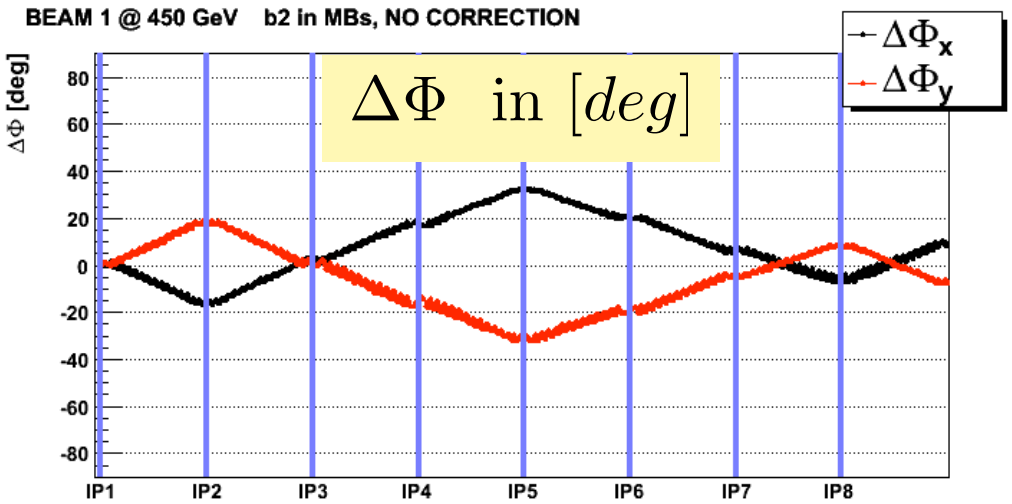
All following plots are produced after running MADX thin lens model:

-including errors (b2 and/or a2) in MBs

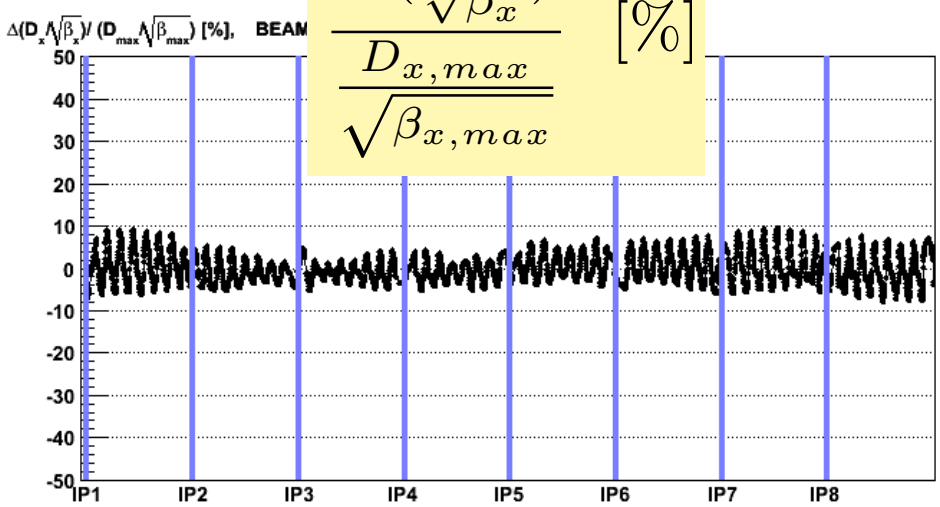
-using Stephane's new correction routine for V6.503

B2 errors in MB, no correction - BEAM 1

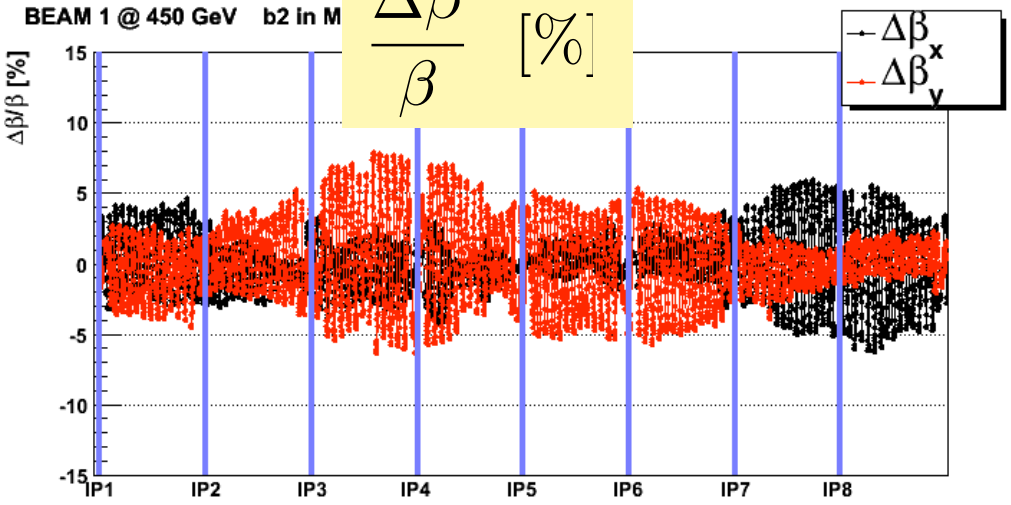
MADX THIN : difference w.r.t. nominal



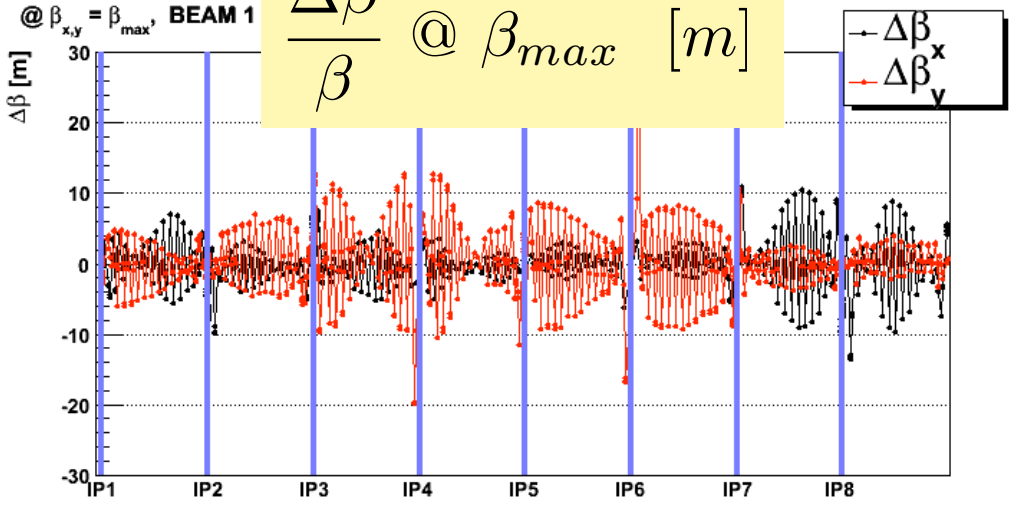
$\Delta\Phi$ in $[deg]$



$$\frac{\Delta\left(\frac{D_x}{\sqrt{\beta_x}}\right)}{\frac{D_{x,max}}{\sqrt{\beta_{x,max}}}} \quad [\%]$$



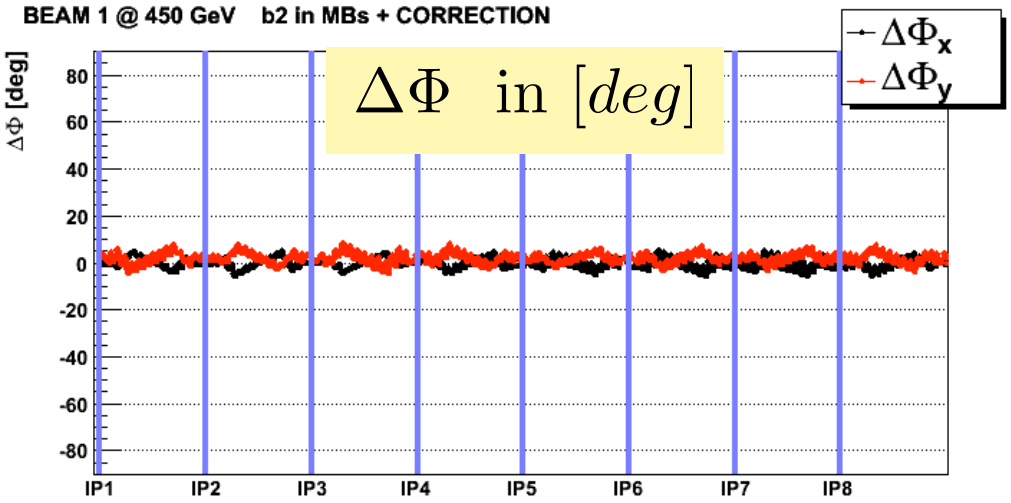
$\frac{\Delta\beta}{\beta}$ $[\%]$



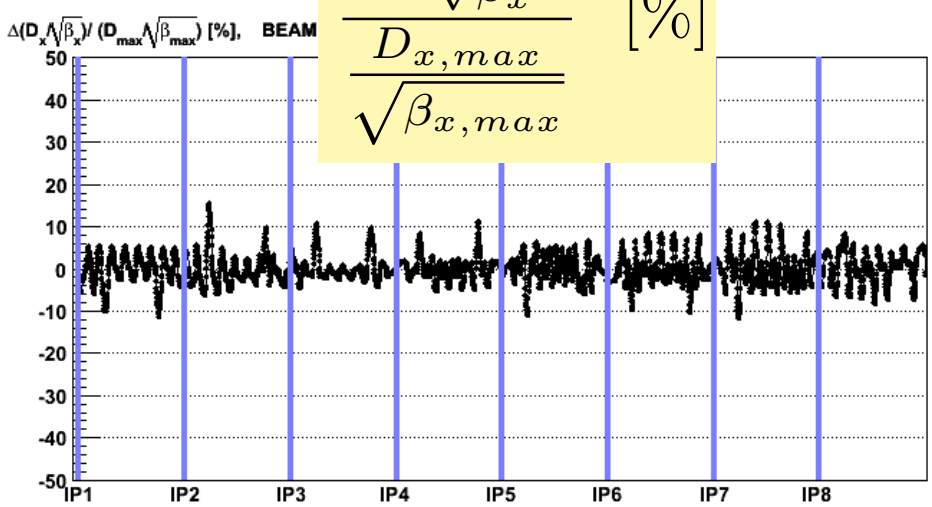
$\frac{\Delta\beta}{\beta}$ @ β_{max} $[m]$

B2 errors in MB, + correction using MQTs - BEAM 1

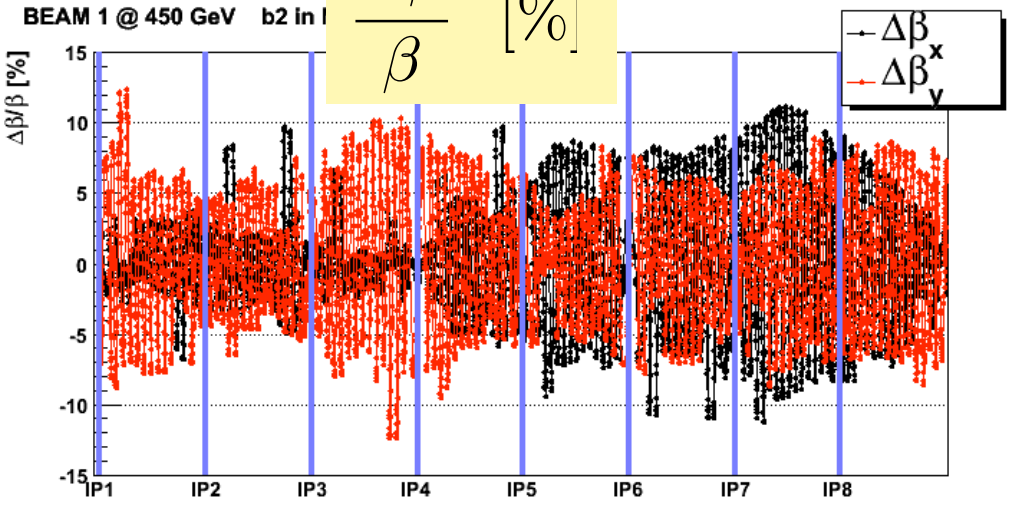
MADX THIN : difference w.r.t. nominal



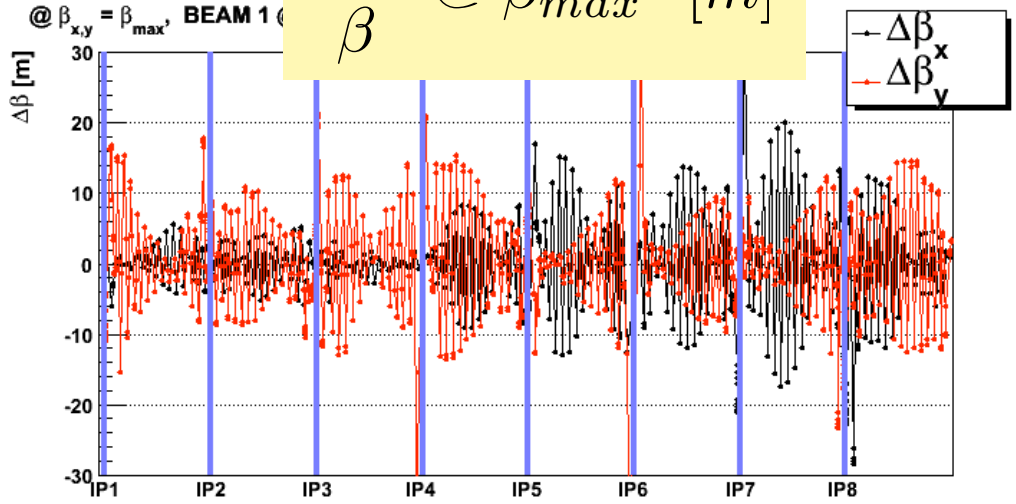
$\Delta\Phi$ in $[deg]$



$$\frac{\Delta\left(\frac{D_x}{\sqrt{\beta_x}}\right)}{\frac{D_{x,max}}{\sqrt{\beta_{x,max}}}} \quad [\%]$$



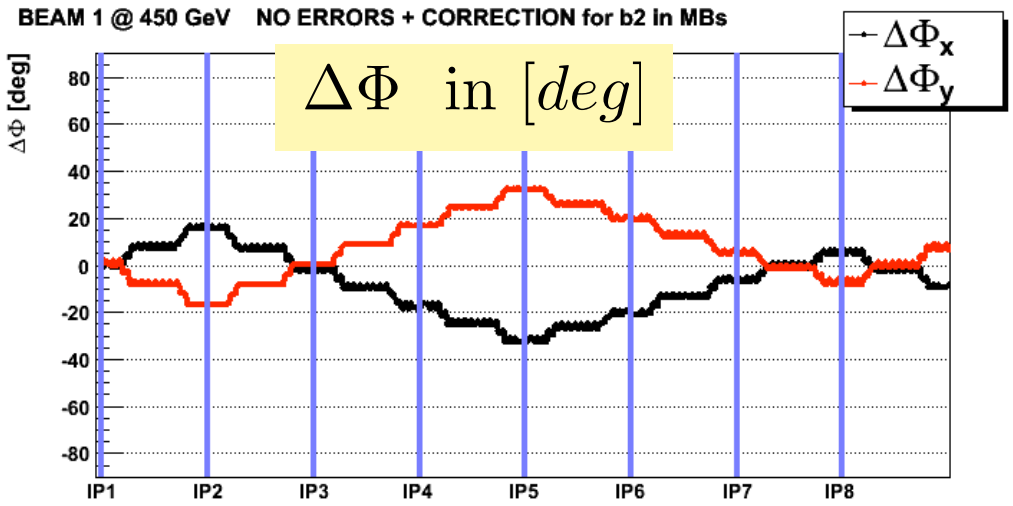
$$\frac{\Delta\beta}{\beta} \quad [\%]$$



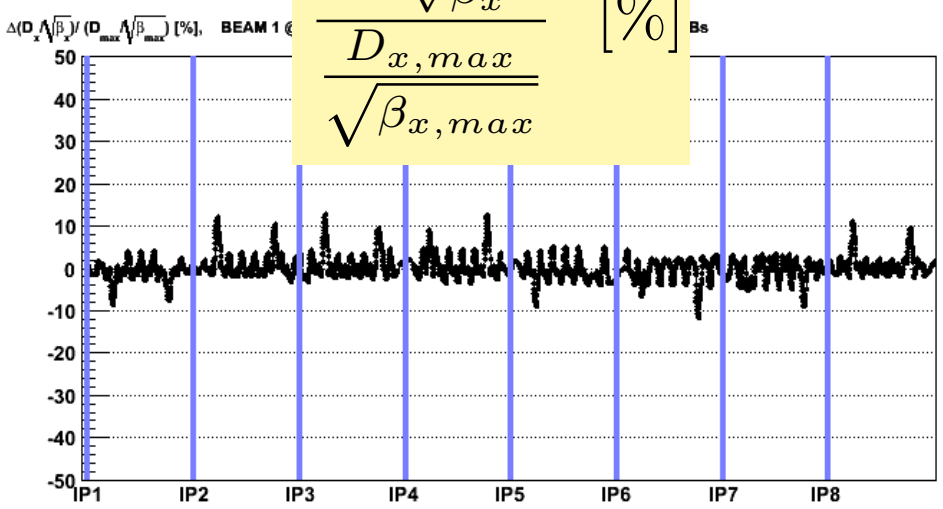
$$\frac{\Delta\beta}{\beta} \;@\; \beta_{max} \quad [m]$$

NO errors in MB, + correction (over compensation) - BEAM 1

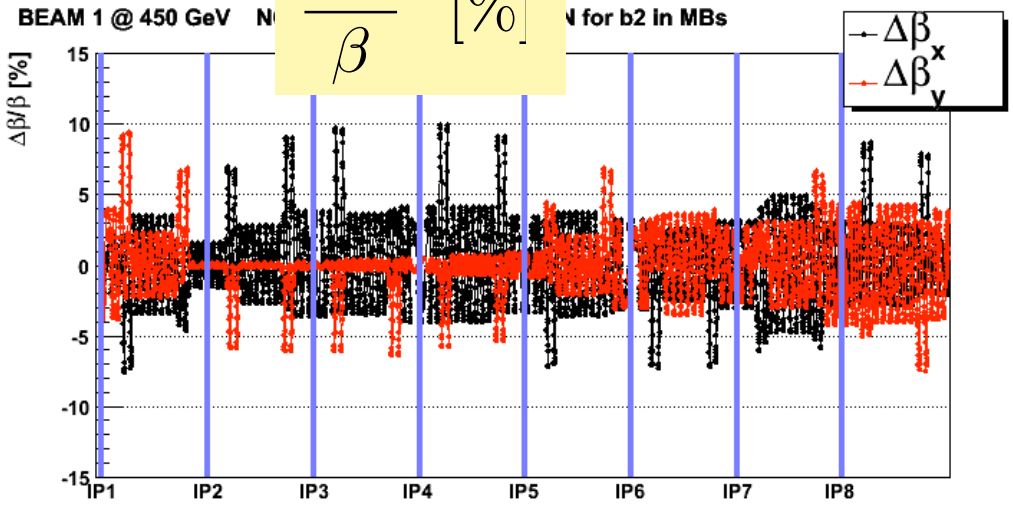
MADX THIN : difference w.r.t. nominal



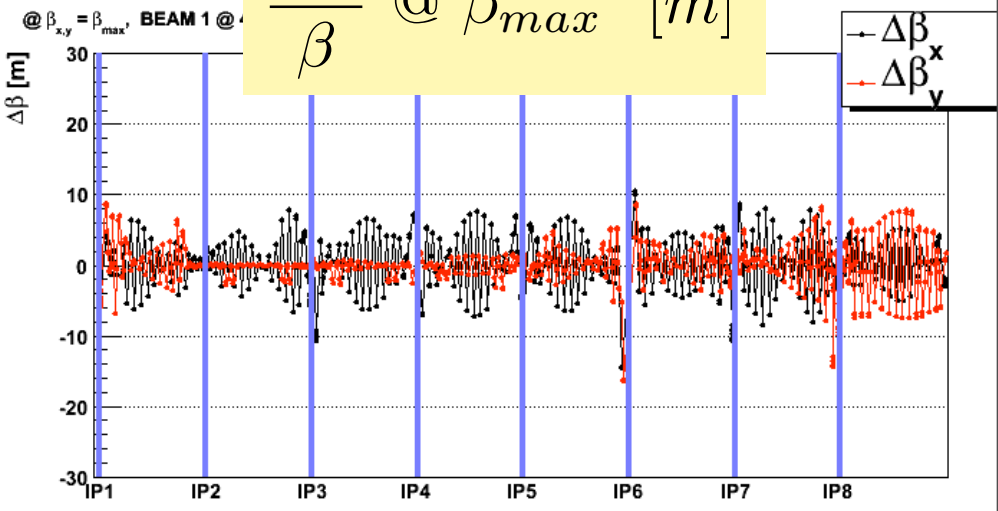
$\Delta\Phi$ in $[deg]$



$$\frac{\Delta\left(\frac{D_x}{\sqrt{\beta_x}}\right)}{\frac{D_{x,max}}{\sqrt{\beta_{x,max}}}} \quad [\%]$$



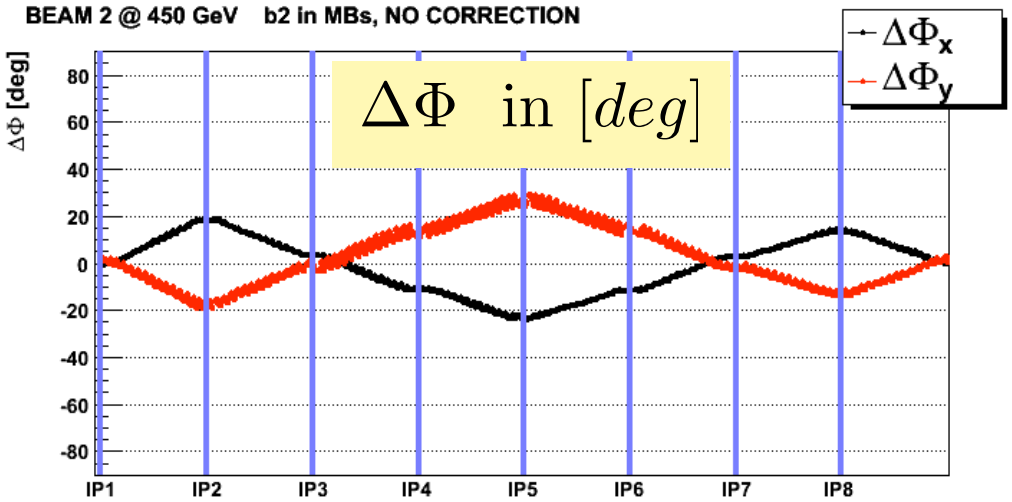
$\frac{\Delta\beta}{\beta}$ $[\%]$



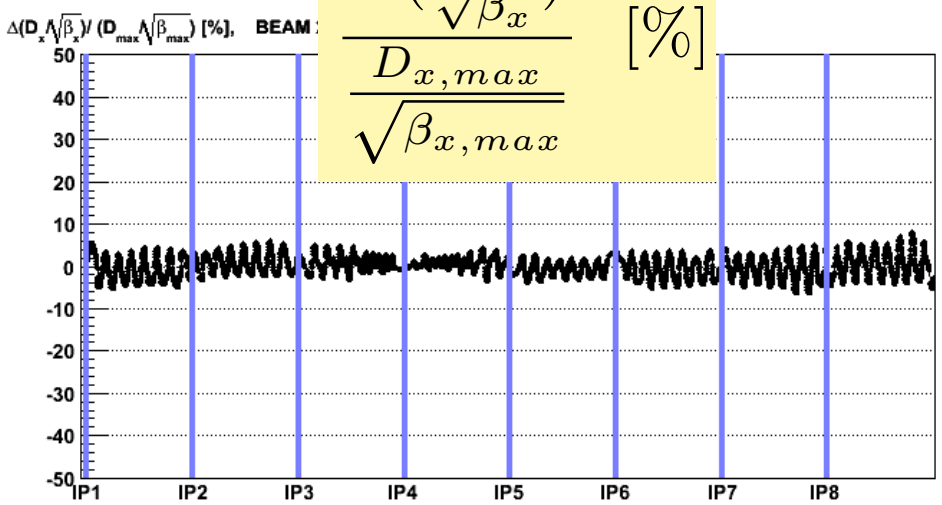
$\frac{\Delta\beta}{\beta}$ @ β_{max} $[m]$

B2 errors in MB, no correction - BEAM 2

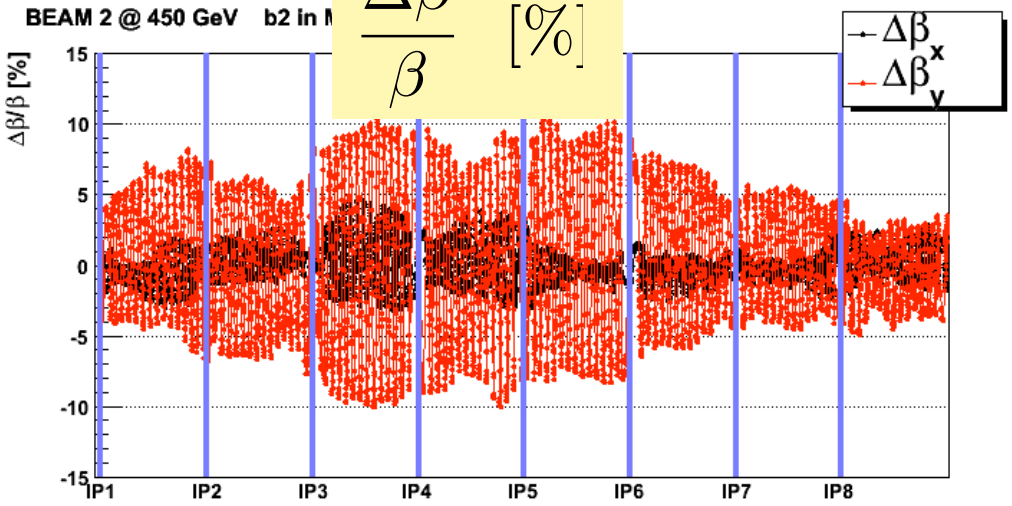
MADX THIN : difference w.r.t. nominal



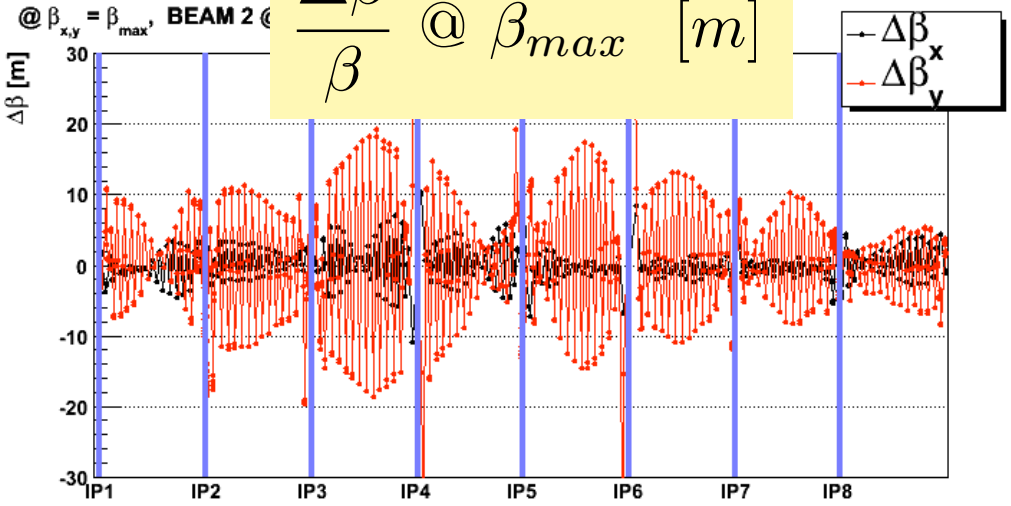
$\Delta\Phi$ in $[deg]$



$$\frac{\Delta\left(\frac{D_x}{\sqrt{\beta_x}}\right)}{\frac{D_{x,max}}{\sqrt{\beta_{x,max}}}} \quad [\%]$$



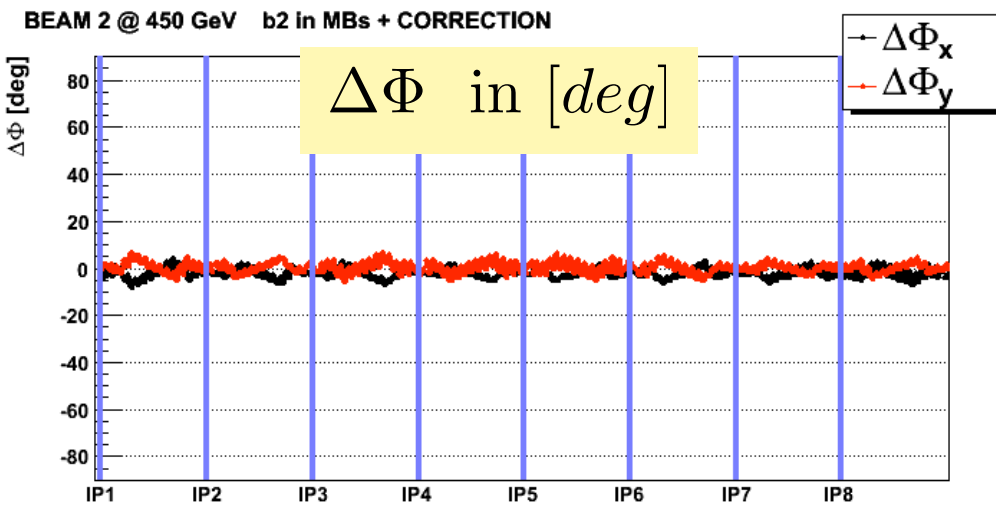
$\frac{\Delta\beta}{\beta}$ $[\%]$



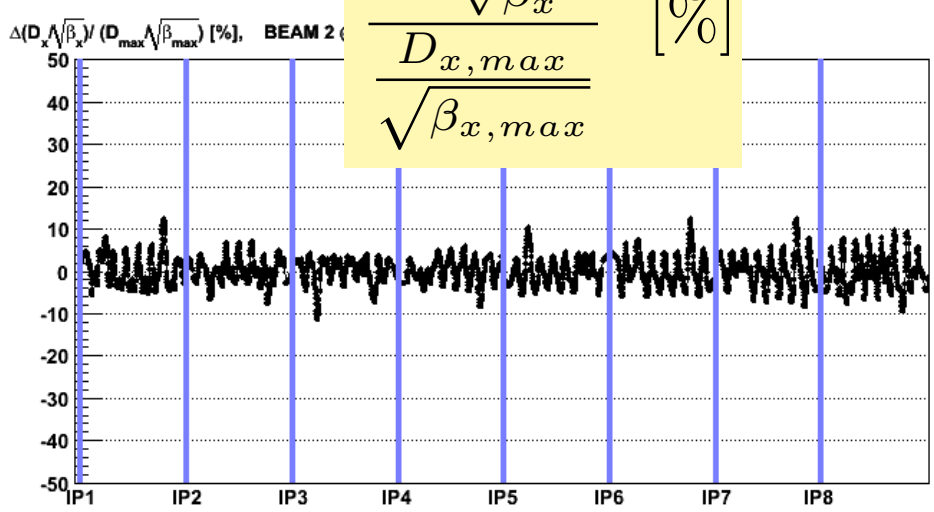
$\frac{\Delta\beta}{\beta}$ @ β_{max} $[m]$

B2 errors in MB, + correction using MQTs - BEAM 2

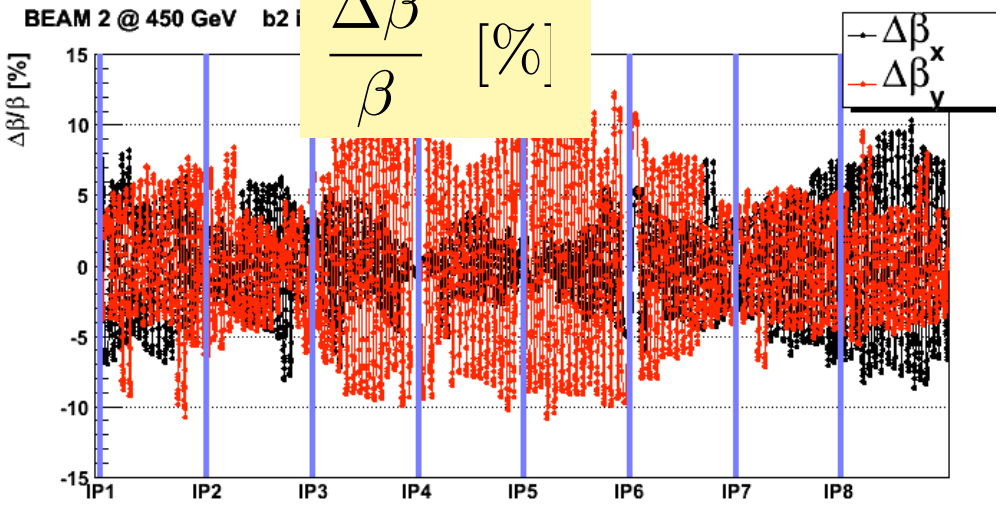
MADX THIN : difference w.r.t. nominal



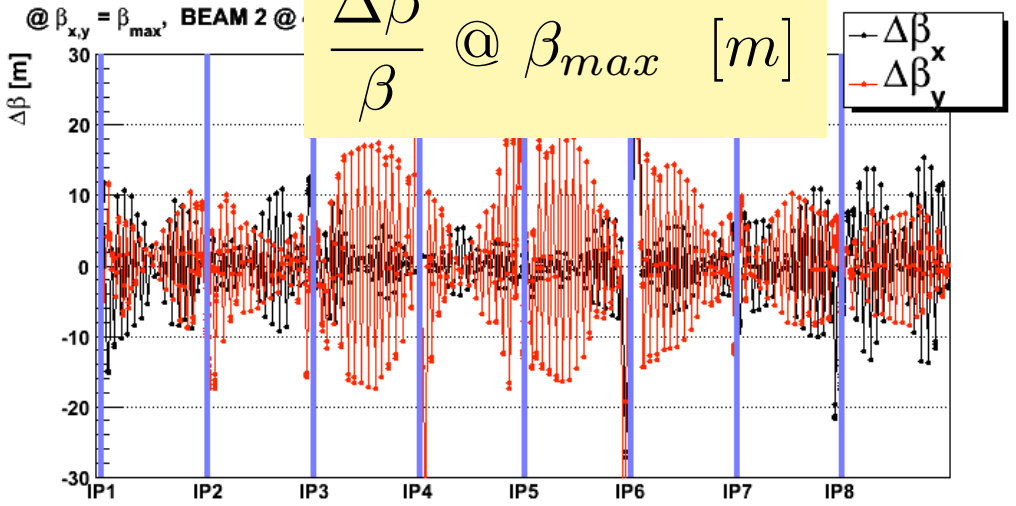
$\Delta\Phi$ in $[deg]$



$$\frac{\Delta\left(\frac{D_x}{\sqrt{\beta_x}}\right)}{\frac{D_{x,max}}{\sqrt{\beta_{x,max}}}} \quad [\%]$$



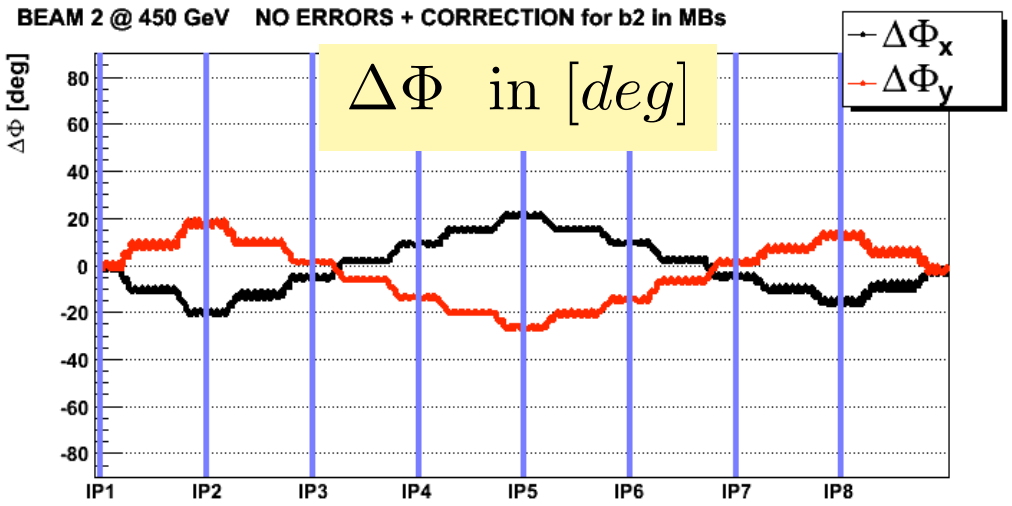
$\frac{\Delta\beta}{\beta}$ $[\%]$



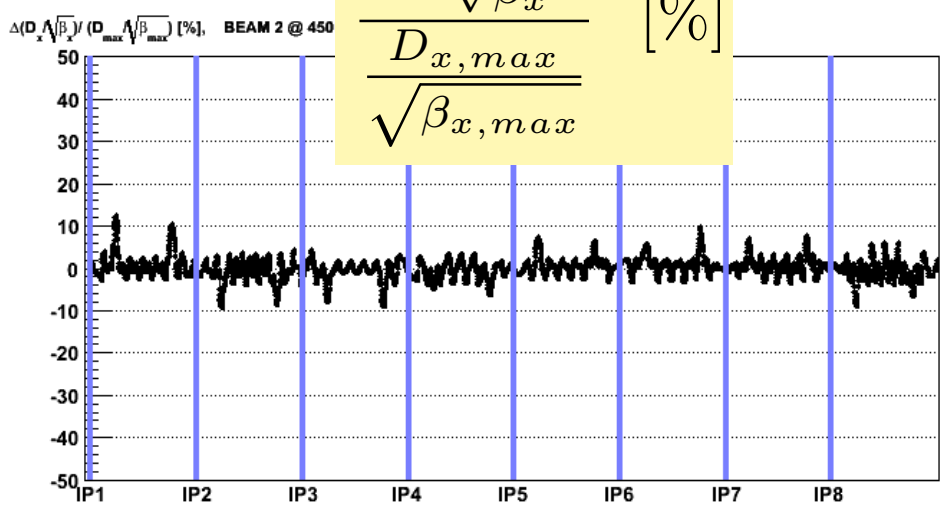
$\frac{\Delta\beta}{\beta}$ @ β_{max} $[m]$

NO errors in MB, + correction (over compensation) - BEAM 2

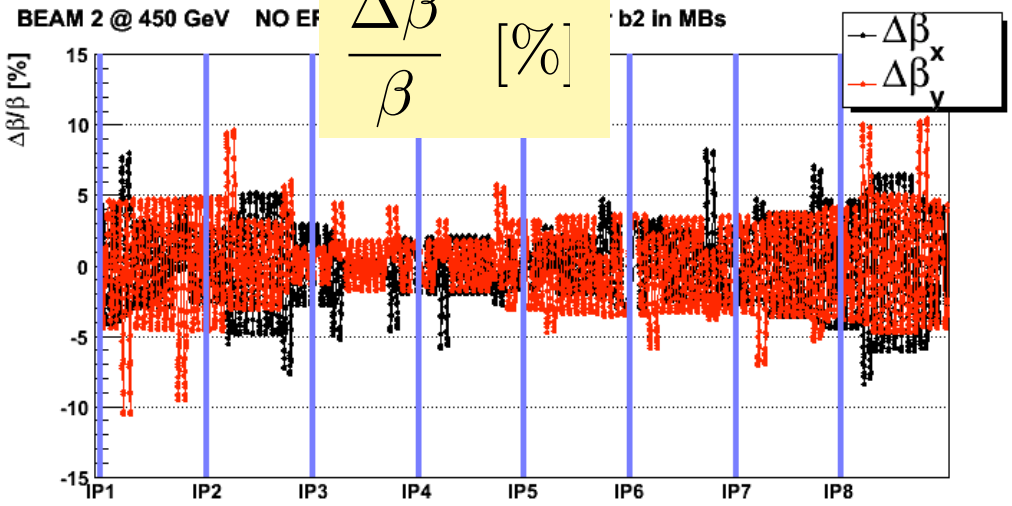
MADX THIN : difference w.r.t. nominal



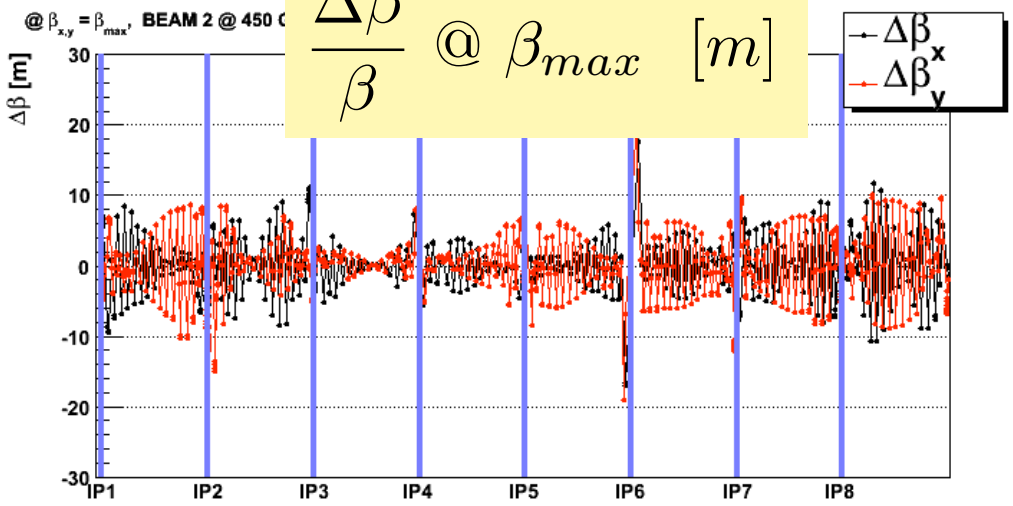
$\Delta\Phi$ in $[deg]$



$$\frac{\Delta\left(\frac{D_x}{\sqrt{\beta_x}}\right)}{\frac{D_{x,max}}{\sqrt{\beta_{x,max}}}} \quad [\%]$$



$\frac{\Delta\beta}{\beta}$ $[\%]$



$\frac{\Delta\beta}{\beta}$ @ β_{max} $[m]$

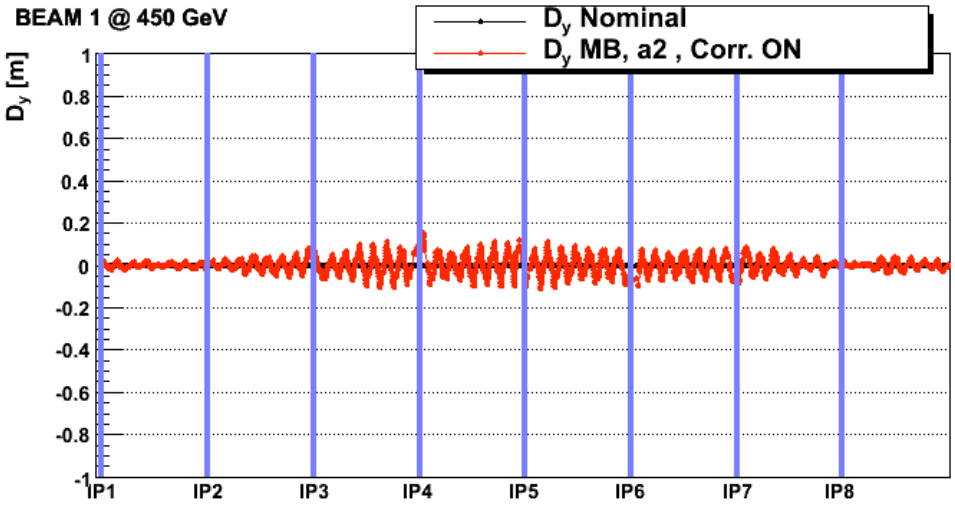
MQT values for correction

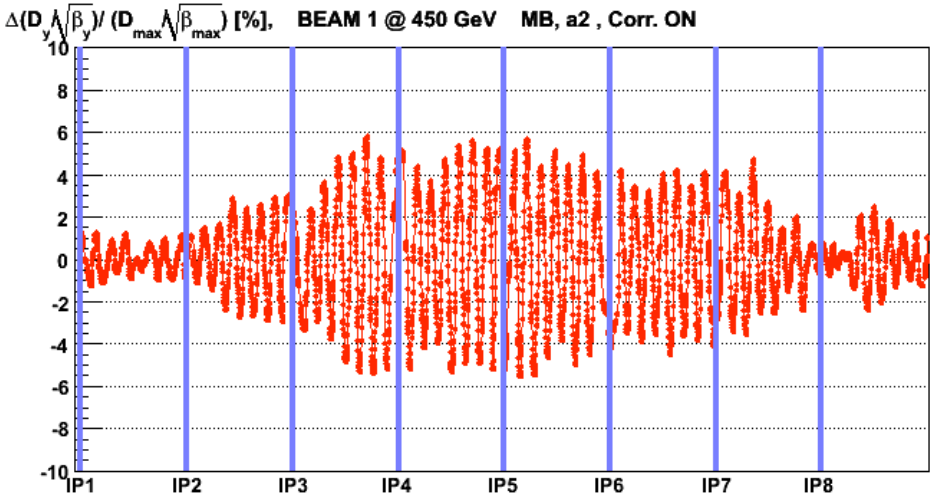
```
!!! b2-correction for beam 1
KQTF.a12B1  := 0.34725125E-03    /l.MQT ;
KQTD.a12B1  := 0.36848764E-03    /l.MQT ;
KQTF.a23B1  := -.38445141E-03    /l.MQT ;
KQTD.a23B1  := -.35134346E-03    /l.MQT ;
KQTF.a34B1  := -.33242673E-03    /l.MQT ;
KQTD.a34B1  := -.34907943E-03    /l.MQT ;
KQTF.a45B1  := -.31314754E-03    /l.MQT ;
KQTD.a45B1  := -.31758572E-03    /l.MQT ;
KQTF.a56B1  := 0.24979243E-03    /l.MQT ;
KQTD.a56B1  := 0.25463035E-03    /l.MQT ;
KQTF.a67B1  := 0.30463845E-03    /l.MQT ;
KQTD.a67B1  := 0.30052694E-03    /l.MQT ;
KQTF.a78B1  := 0.24659201E-03    /l.MQT ;
KQTD.a78B1  := 0.26523168E-03    /l.MQT ;
KQTF.a81B1  := -.31370851E-03    /l.MQT ;
KQTD.a81B1  := -.31432560E-03    /l.MQT ;
```

```
!!! b2-correction for beam 2
KQTF.a12B2  := -.40867351E-03    /l.MQT ;
KQTD.a12B2  := -.37645257E-03    /l.MQT ;
KQTF.a23B2  := 0.31296420E-03    /l.MQT ;
KQTD.a23B2  := 0.34405357E-03    /l.MQT ;
KQTF.a34B2  := 0.30754489E-03    /l.MQT ;
KQTD.a34B2  := 0.31046592E-03    /l.MQT ;
KQTF.a45B2  := 0.26050740E-03    /l.MQT ;
KQTD.a45B2  := 0.26898287E-03    /l.MQT ;
KQTF.a56B2  := -.25158933E-03    /l.MQT ;
KQTD.a56B2  := -.25275204E-03    /l.MQT ;
KQTF.a67B2  := -.29989198E-03    /l.MQT ;
KQTD.a67B2  := -.33807757E-03    /l.MQT ;
KQTF.a78B2  := -.23020558E-03    /l.MQT ;
KQTD.a78B2  := -.23628986E-03    /l.MQT ;
KQTF.a81B2  := 0.27500774E-03    /l.MQT ;
KQTD.a81B2  := 0.30390550E-03    /l.MQT ;
```

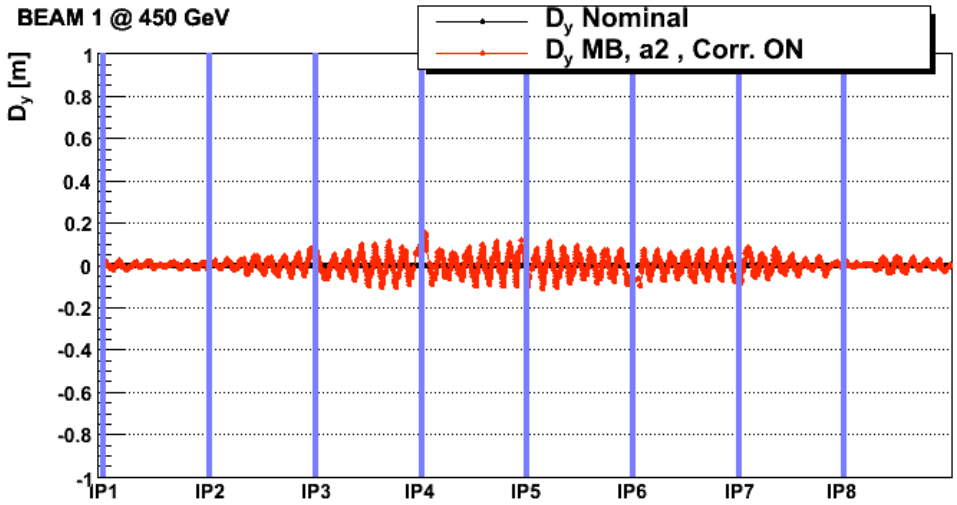
a2 errors in MB, correct with all QS except MQS.23R3 and MQS.27R3 - BEAM 1

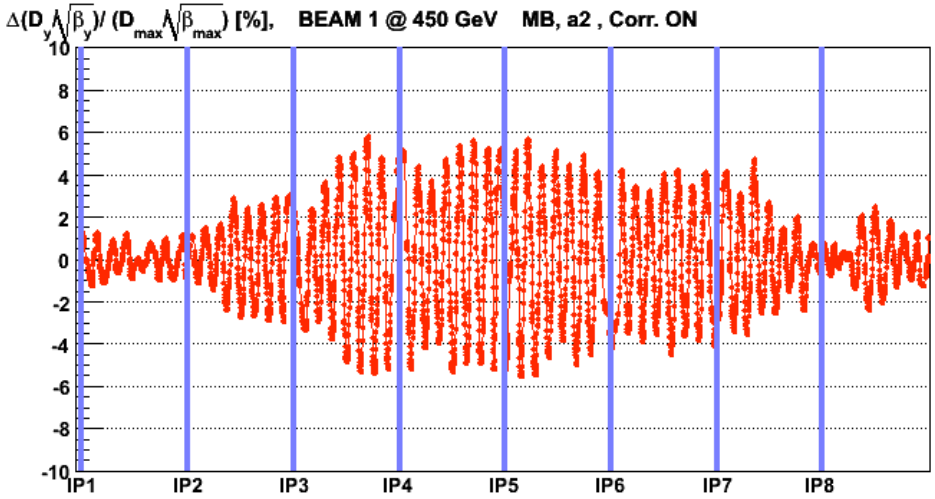
ALL MQS





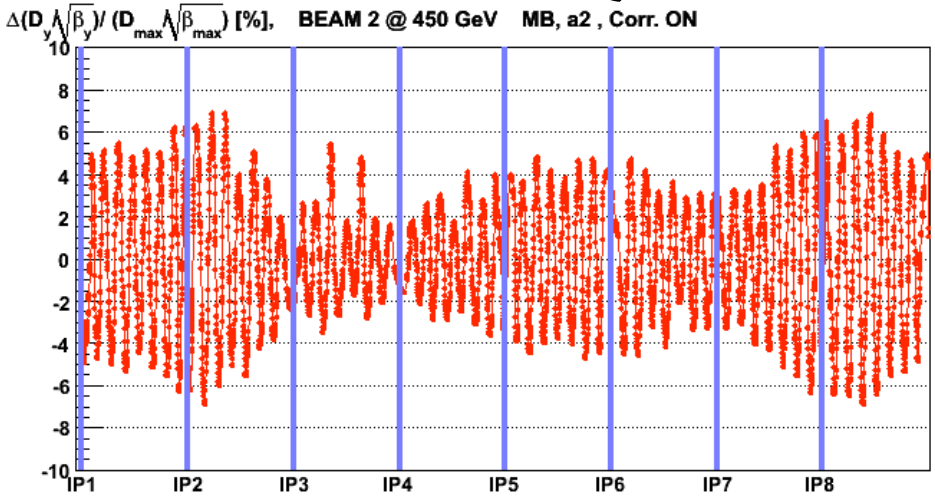
NO MQS 23-27 R3

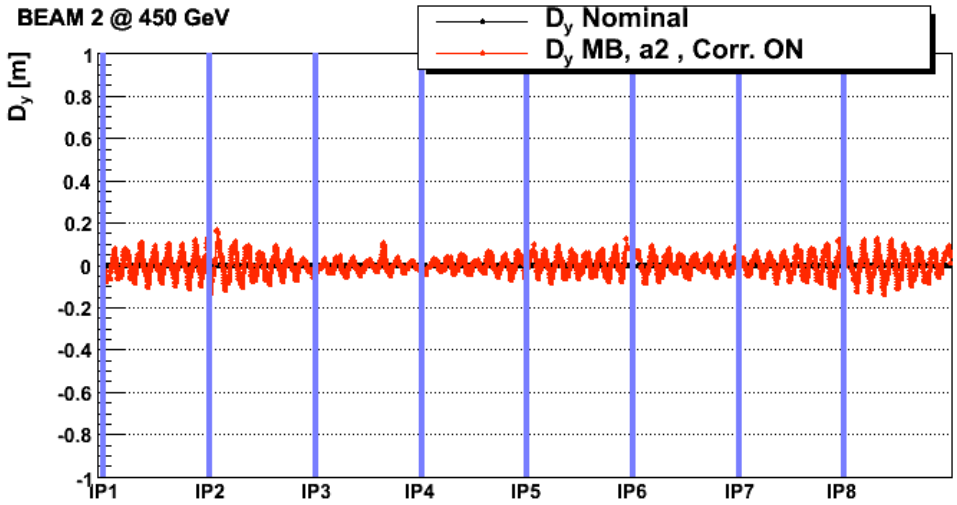




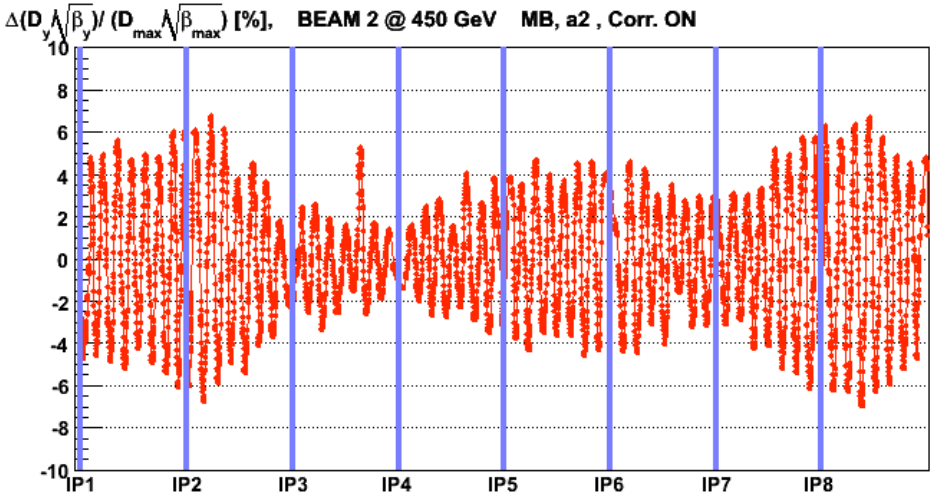
a2 errors in MB, correct with all QS except MQS.23R3 and MQS.27R3 - BEAM 2

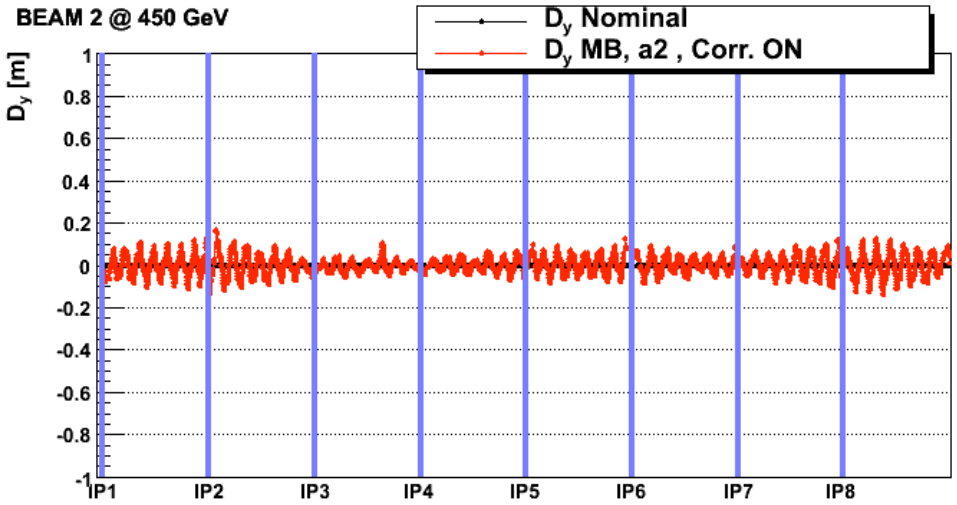
ALL MQS





NO MQS 23-27 R3

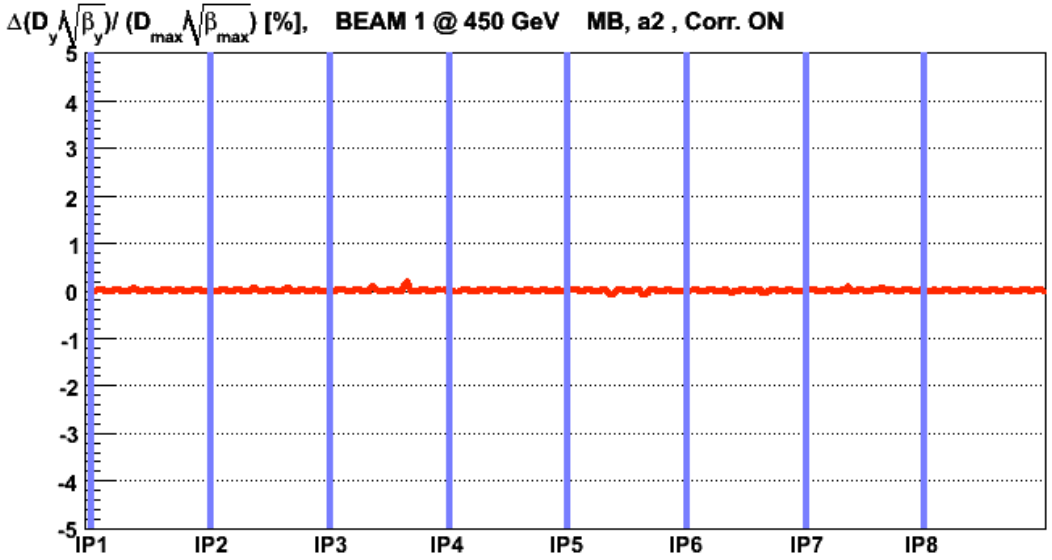




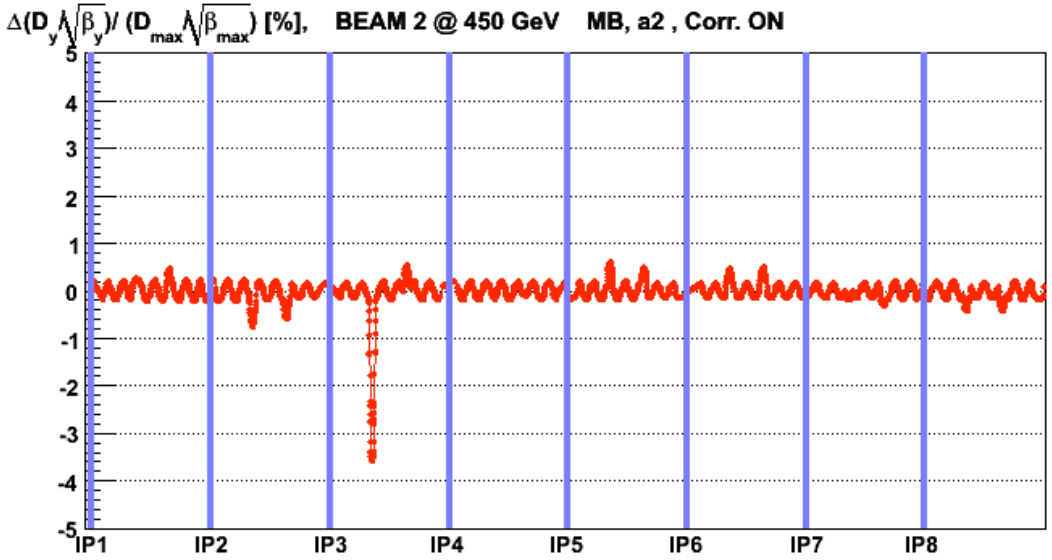
a2 errors in MB, corr. with all QS except QS 23-27 R3

MADX THIN : difference w.r.t. ALL QS

BEAM 1



BEAM 2



Corrector settings with and without QS 23-27 R3

BEAM 1

A2 CORRECTION BEAM 1				
PARAMETER	ALL MQS	NO MQS R3	DIFF	DIFF [%]
B11	7.90E-03	4.84E-03	-3.05E-03	-38.66
B12	-1.01E-02	-1.26E-02	-2.56E-03	25.46
B21	-2.48E-02	-3.45E-02	-9.66E-03	38.98
B22	-6.10E-03	-1.60E-02	-9.91E-03	162.40
B31	2.81E-02	1.39E-02	-1.42E-02	-50.63
B32	3.02E-02	2.10E-02	-9.26E-03	-30.63
B41	1.15E-02	1.12E-02	-2.62E-04	-2.28
B42	-6.43E-03	-6.26E-03	1.74E-04	-2.71
B51	7.45E-03	2.00E-02	1.26E-02	168.70
B52	2.07E-02	3.27E-02	1.20E-02	57.80
B61	2.39E-02	3.28E-02	8.90E-03	37.32
B62	5.10E-03	1.43E-02	9.17E-03	179.70
B71	-7.97E-03	-2.08E-02	-1.29E-02	161.40
B72	-2.11E-02	-3.33E-02	-1.23E-02	58.35
B81	-1.86E-02	-2.35E-02	-4.87E-03	26.13
B82	9.56E-05	-5.12E-03	-5.22E-03	-5,459.00
KQS.R1B1	3.01E-04	3.11E-04	1.00E-05	3.34
KQS.L2B1	3.01E-04	3.11E-04	1.00E-05	3.34
KQS.A23B1	-3.66E-04	-3.51E-04	1.50E-05	-4.10
KQS.R3B1	-3.09E-05	4.05E-05	7.14E-05	-231.30
KQS.L4B1	-3.09E-05	4.05E-05	7.14E-05	-231.30
KQS.A45B1	2.76E-04	2.81E-04	4.49E-06	1.63
KQS.R5B1	-1.59E-04	-1.87E-04	-2.78E-05	17.47
KQS.L6B1	-1.59E-04	-1.87E-04	-2.78E-05	17.47
KQS.A67B1	-3.61E-04	-3.74E-04	-1.35E-05	3.74
KQS.R7B1	3.90E-04	4.19E-04	2.84E-05	7.27
KQS.L8B1	3.90E-04	4.19E-04	2.84E-05	7.27
KQS.A81B1	-8.08E-05	-7.53E-05	5.48E-06	-6.79

Corrector settings with and without QS 23-27 R3

BEAM 2

A2 CORRECTION BEAM 2				
PARAMETER	ALL MQS	NO MQS R3	DIFF	DIFF [%]
B11	1.44E-02	1.39E-02	-4.83E-04	-3.36
B12	3.56E-03	4.86E-03	1.30E-03	36.44
B21	-9.31E-03	-8.46E-03	8.53E-04	-9.16
B22	-1.82E-02	-2.46E-02	-6.42E-03	35.23
B31	-5.38E-03	-7.69E-03	-2.31E-03	42.92
B32	2.68E-02	1.70E-02	-9.82E-03	-36.63
B41	1.61E-02	1.58E-02	-2.94E-04	-1.82
B42	-3.30E-03	-4.40E-03	-1.10E-03	33.36
B51	-1.30E-02	-1.33E-02	-3.58E-04	2.75
B52	2.02E-02	2.72E-02	7.02E-03	34.83
B61	1.40E-02	1.34E-02	-6.14E-04	-4.39
B62	7.71E-03	1.05E-02	2.75E-03	35.68
B71	1.40E-02	1.42E-02	2.46E-04	1.76
B72	-1.76E-02	-2.38E-02	-6.13E-03	34.78
B81	-9.70E-03	-8.86E-03	8.41E-04	-8.67
B82	-1.76E-02	-2.38E-02	-6.19E-03	35.24
KQS.A12B2	-1.13E-04	-1.37E-05	9.91E-05	-87.86
KQS.R2B2	1.10E-03	8.71E-04	-2.31E-04	-20.93
KQS.L3B2	1.10E-03	8.71E-04	-2.31E-04	-20.93
KQS.A34B2	1.27E-03	1.53E-03	2.58E-04	20.29
KQS.R4B2	4.92E-04	5.27E-04	3.49E-05	7.09
KQS.L5B2	4.92E-04	5.27E-04	3.49E-05	7.09
KQS.A56B2	2.30E-04	3.84E-04	1.55E-04	67.51
KQS.R6B2	5.78E-04	7.19E-04	1.41E-04	24.37
KQS.L7B2	5.78E-04	7.19E-04	1.41E-04	24.37
KQS.A78B2	-4.25E-04	-5.49E-04	-1.24E-04	29.24
KQS.R8B2	-2.65E-04	-4.90E-04	-2.25E-04	85.13
KQS.L1B2	-2.65E-04	-4.90E-04	-2.25E-04	85.13

NEXT

All to do's left from two weeks ago!

Think about implementing the possibility of plotting differences between optics (like betas at betamax and normalized dispersions) in OM in Java (Ilya) or python