Latest on

Low Emittance Tuning

LER

Without Final Focus
& With Final Focus

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SuperB XIV General Meeting

Low Emittance Tuning:

- Place correctors and monitors
- Define Magnet Alignment Errors in the lattice
- Define strength of correctors in order to:

minimize vertical emittance

OUTPUT:

Table of tolerated misalignment values.

Steering:
Orbit and Dispersion Free Steering +
Coupling and Beta-Beating Free Steering

Response matrices **(RM)** for the following quantities are used for the correction.
R is the vector of BPM readings.

$$\vec{R} = \mathbf{RM}\ \vec{K}$$

Dispersion measured by :

$$\vec{\eta} = \frac{\vec{R}_{+\frac{\Delta E}{E}} - \vec{R}_{-\frac{\Delta E}{E}}}{2\frac{\Delta E}{E}}$$

DE/E=0.0025

Coupling measured by :

$$\vec{C} = \begin{pmatrix} \frac{\vec{x}_{+\Delta V} - \vec{x}_{-\Delta V}}{2\Delta V} \\ \\ \frac{\vec{y}_{+\Delta H} - \vec{y}_{-\Delta H}}{2\Delta H} \end{pmatrix}$$

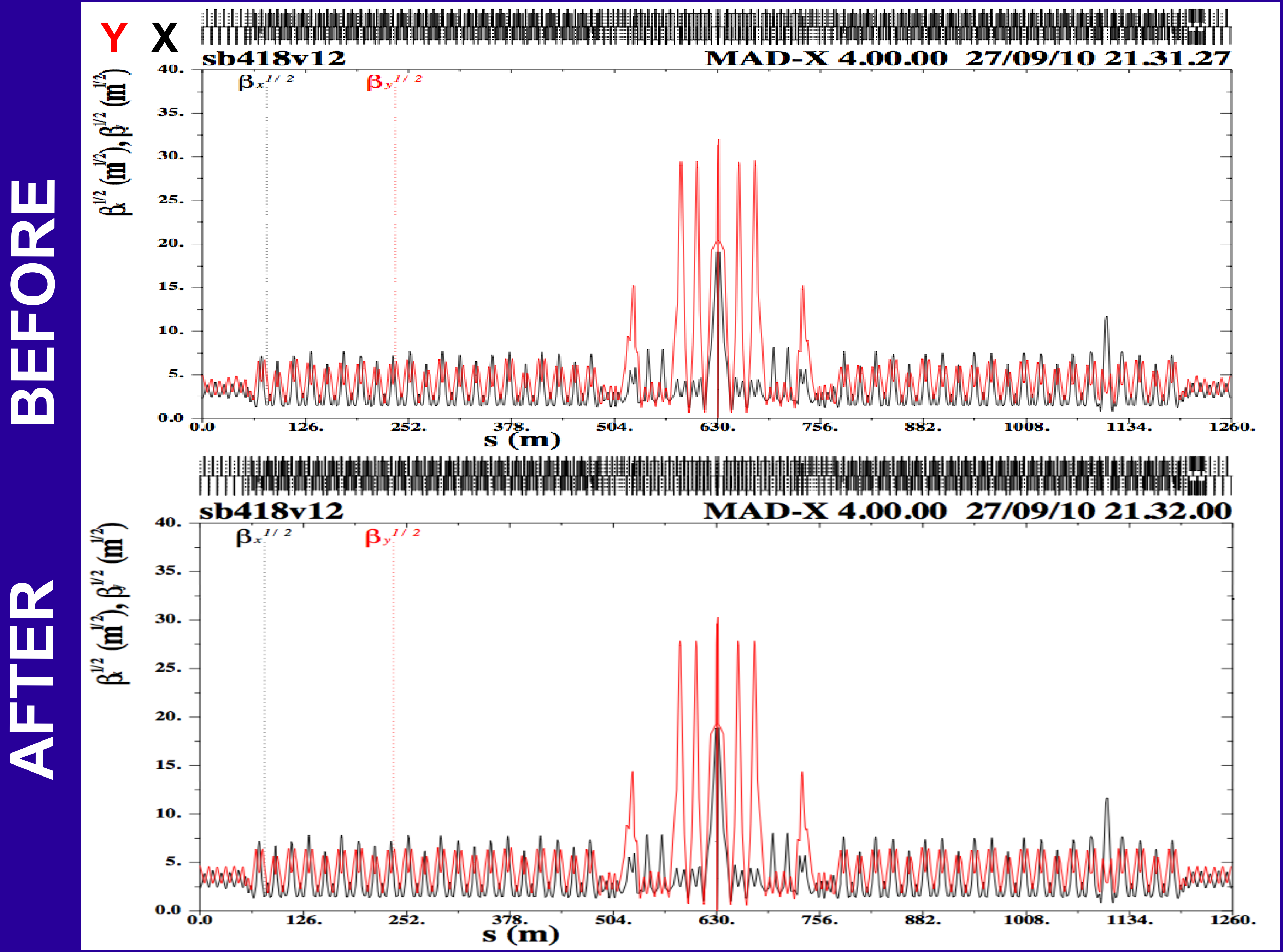
RM V Correctors

Beta beating measured by :

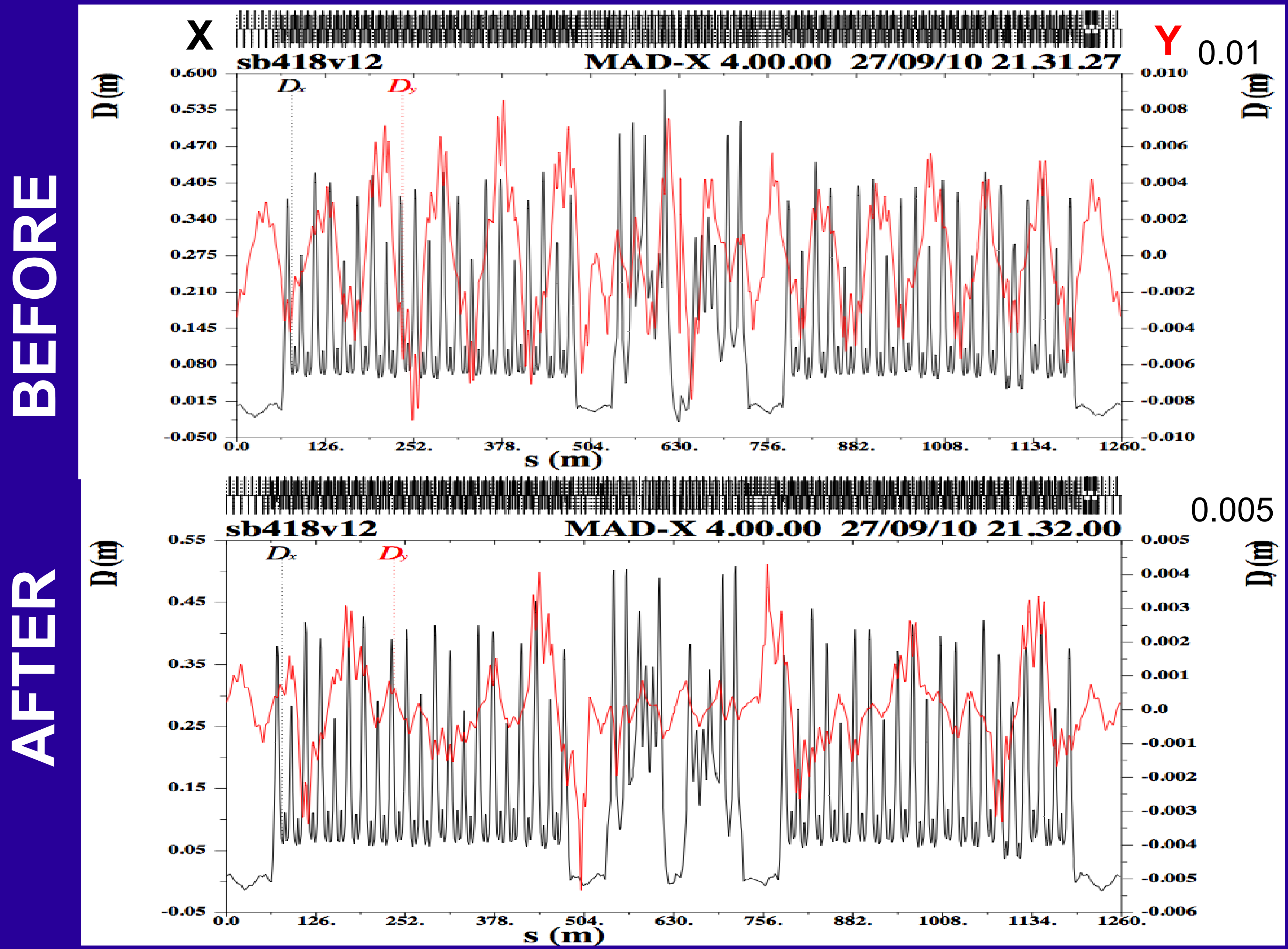
$$\vec{\beta} = \begin{pmatrix} \frac{\vec{x}_{+\Delta H} - \vec{x}_{-\Delta H}}{2\Delta H} \\ \\ \frac{\vec{y}_{+\Delta V} - \vec{y}_{-\Delta V}}{2\Delta V} \end{pmatrix}$$

RM H Correctors

Beta Functions before and after correction for a typical set of misalignment leading to ~2pm rad vertical emittance

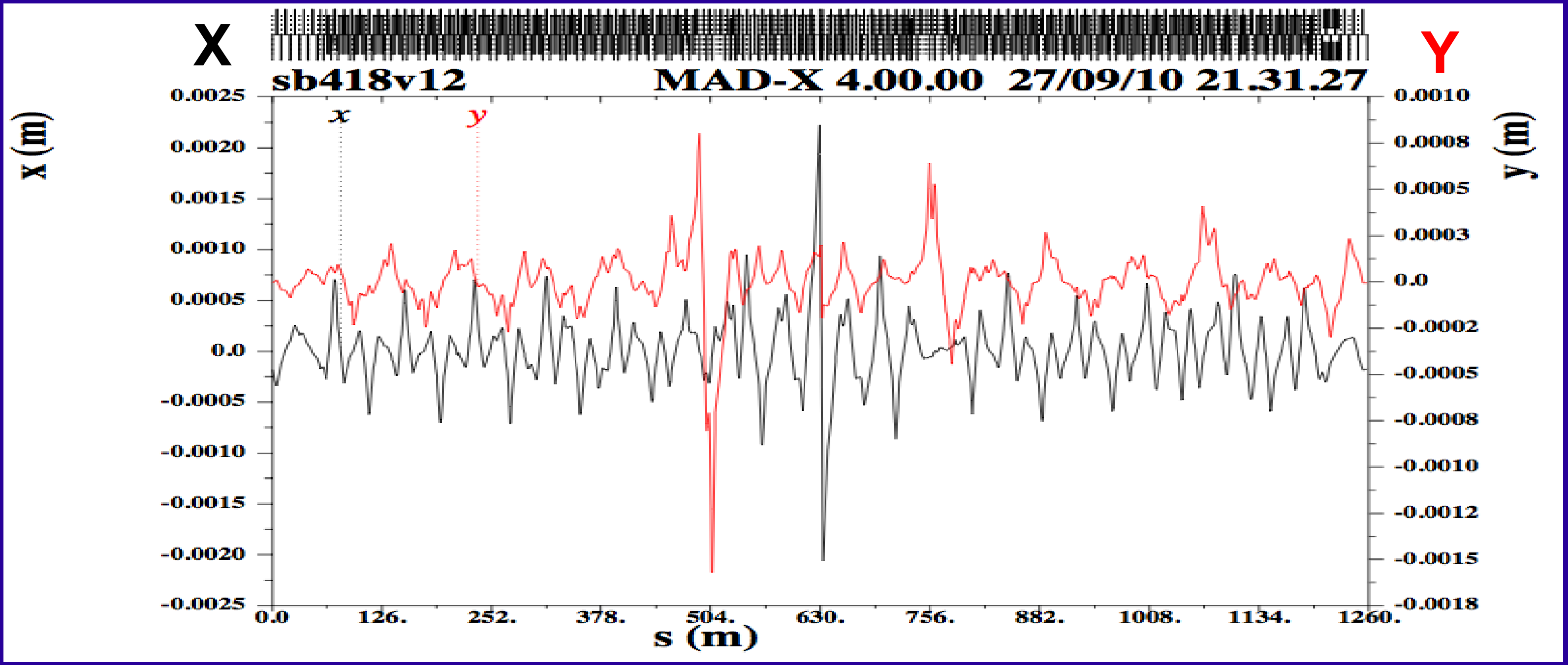


Dispersion before and after correction for a tipical set of misalignment leading to ~2pm rad vertical emittance

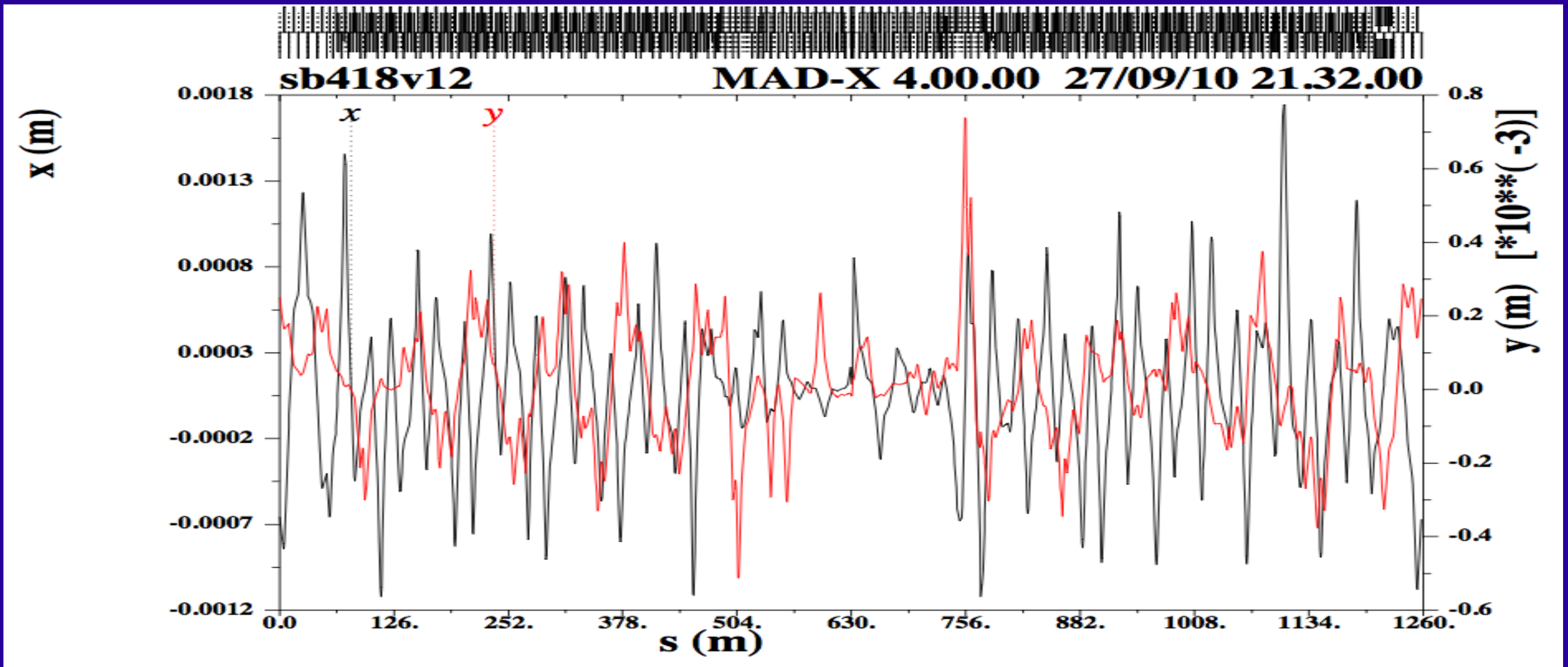


Orbit before and after correction for a tipical set of misalignment leading to ~2pm rad vertical emittance

BEFORE



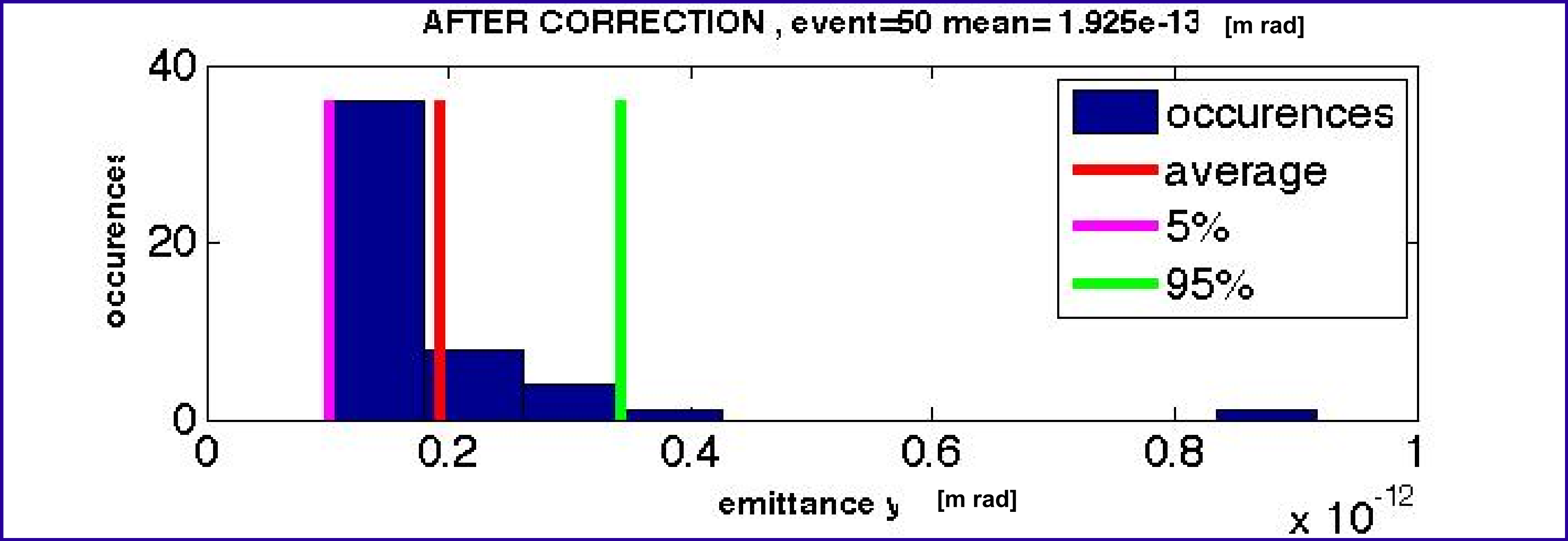
AFTER



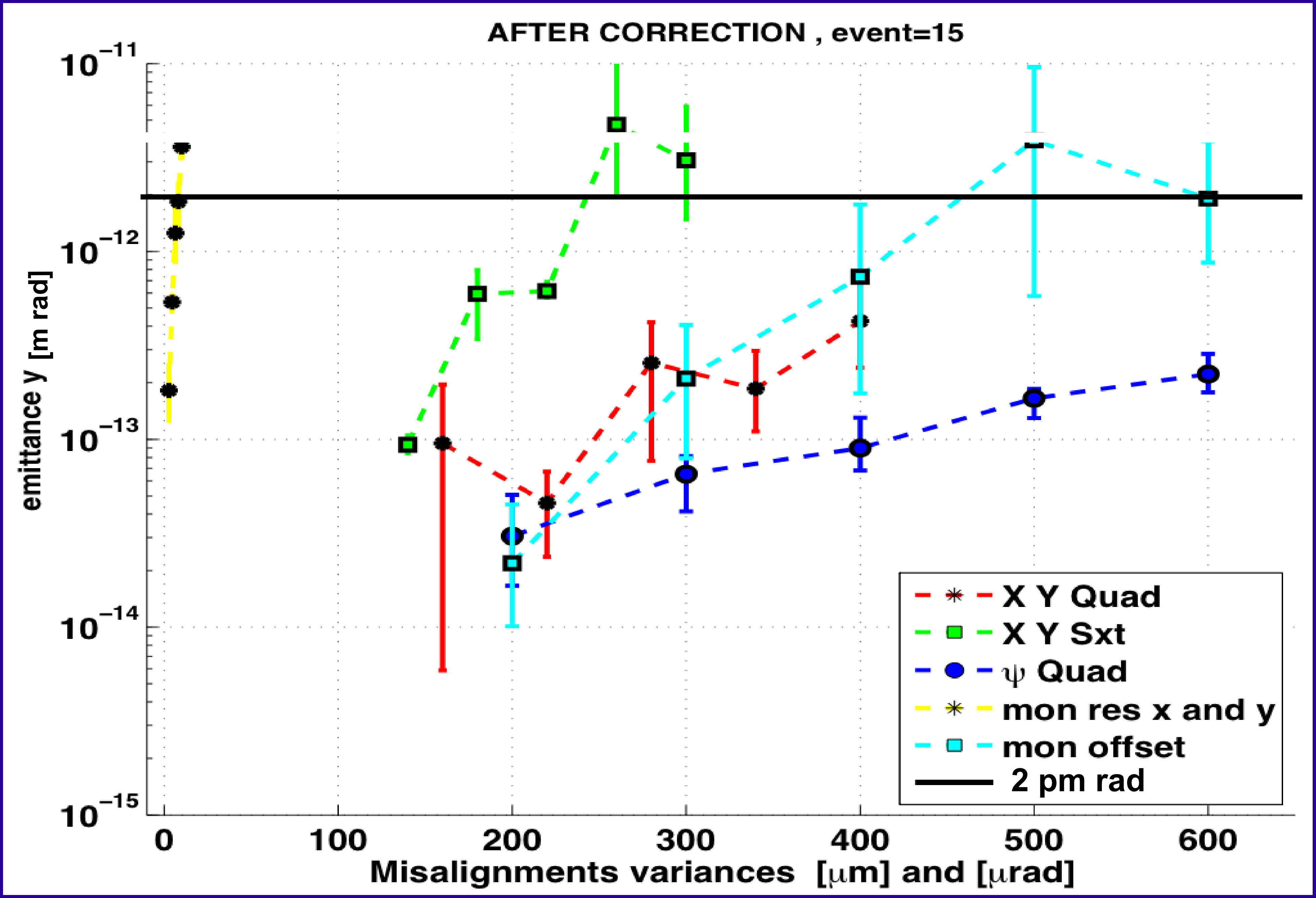
PREVIOUS WORK:
HER without Final Focus

Misalignment	Tolerated value
Quadrupole H and V	300 µm
Quadrupole Tilt	300 µrad
Sextupole H and V	150 µm
BPM offset H and V	400 µm
BPM resolution	1 µm

Corrector & Monitors
168 H and V



LER no ff no sol Different misalignment analyzed separately



SOLENOID OFF

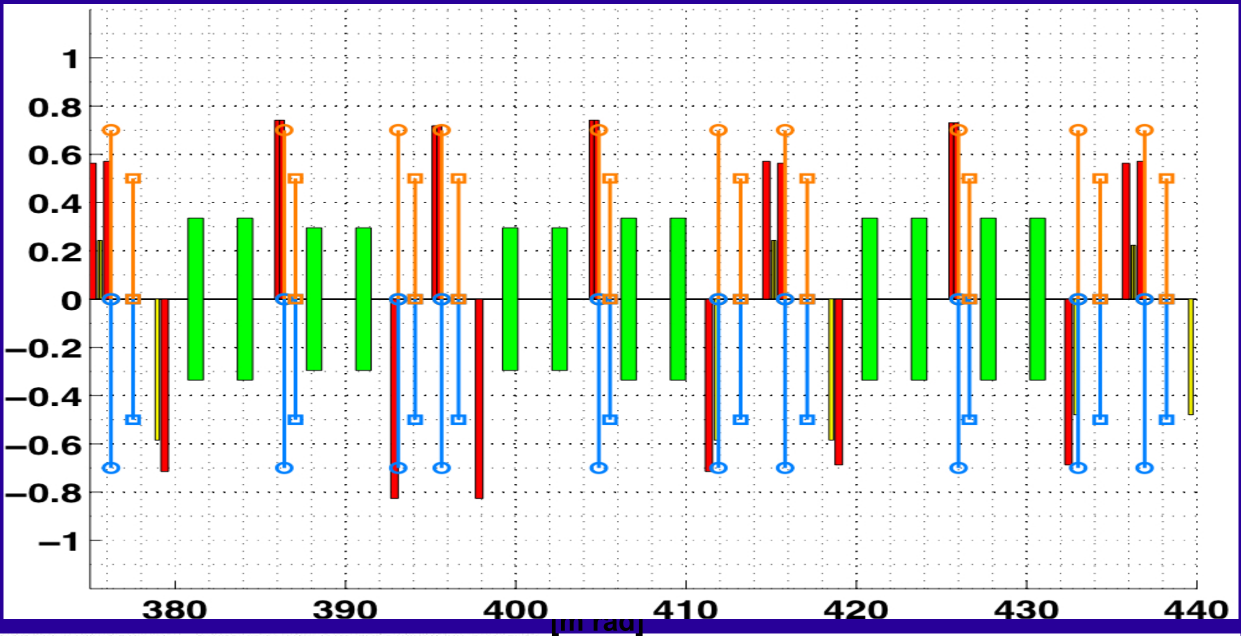
LER without Final Focus

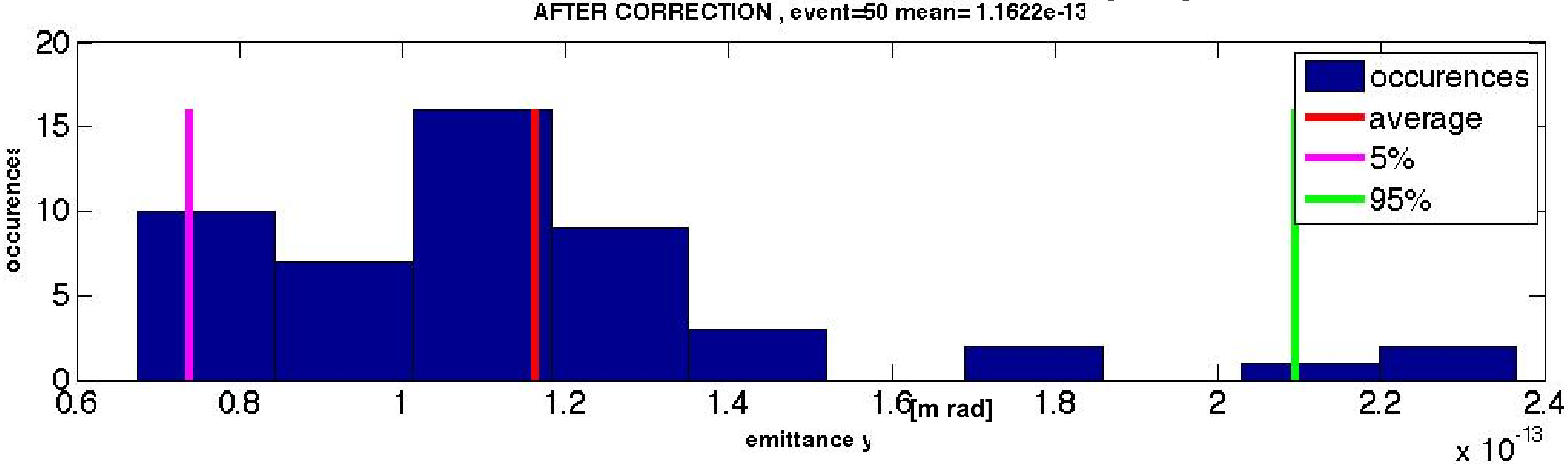
RF OFF

Corrector & Monitors **167 H and V**

Center of all drifts L > 1.2 m

Misalignment	Tolerated value
Quadrupole H and V	200 µm
Quadrupole Tilt	200 µrad
Sextupole H and V	100 µm
BPM resolution	1 µm
BPM Offset	200 µm





LER without Final Focus

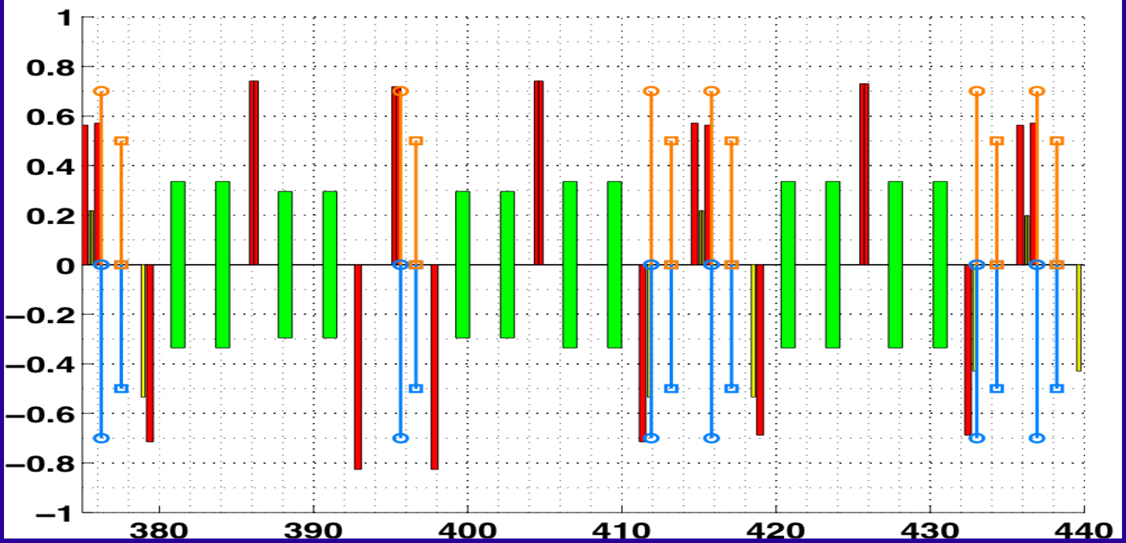
SOLENOID OFF

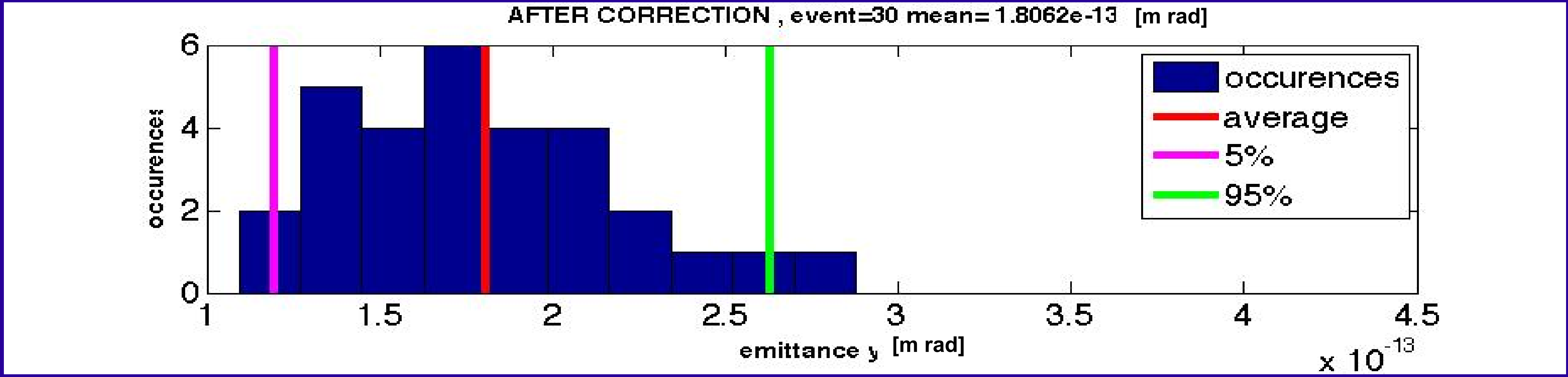
RF OFF

Misalignment	Tolerated value
Quadrupole H and V	200 μm
Quadrupole Tilt	200 μrad
Sextupole H and V	100 μm
BPM resolution	1 μm
BPM Offset	200 μm

SAME MISALIGNMENTS

Corrector & Monitors **109 H and V L > 1.2 m**

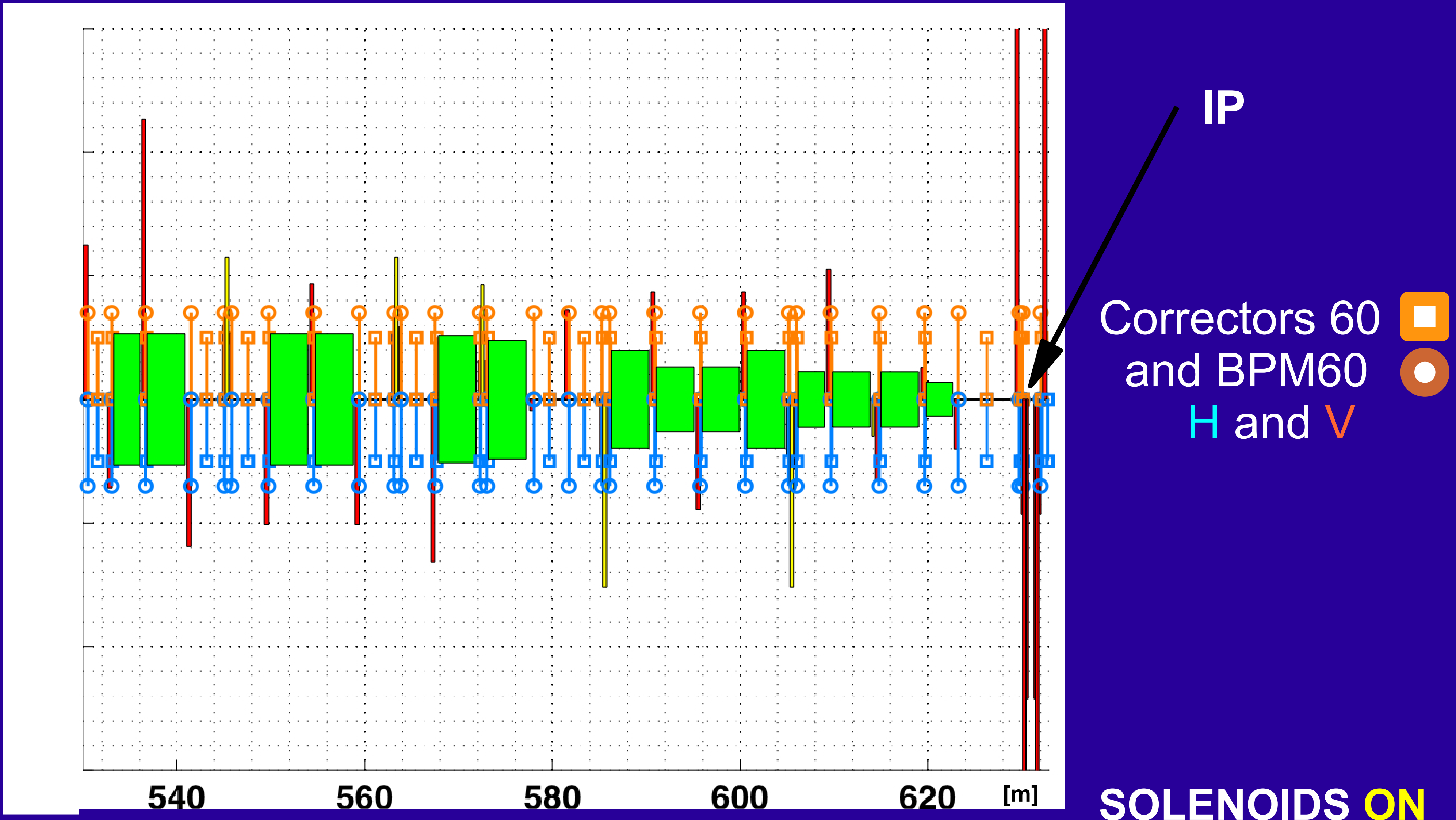




Average emittance increased of 50% respect to 167 correctors any way <u>10 times smaller than design emittance.</u>

Final Focus

- More sensible to misalignments
- Correctors and monitors at every quadrupole

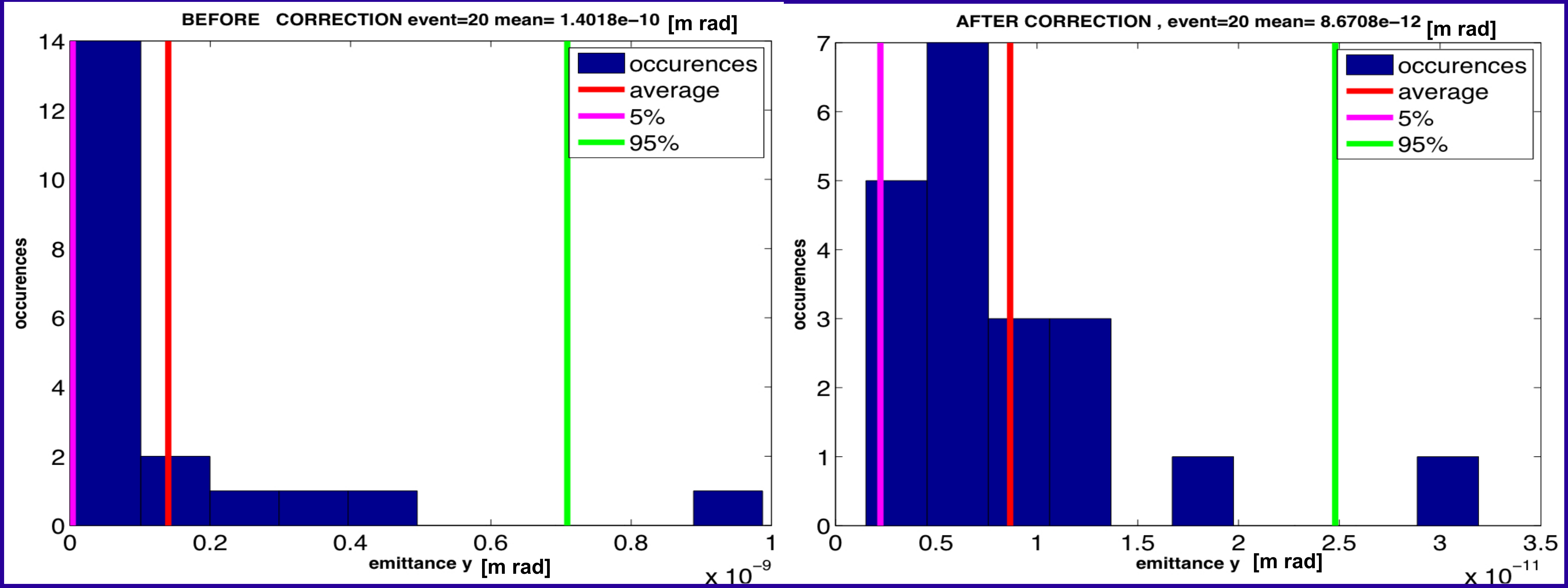


LER

Misalignment	Tolerated value	
	ARC	FF
Quadrupole H and V	**50 μm**	**20 μm**
Quadrupole Tilt	**50 μrad**	**20 μrad**
Sextupole H and V	**50 μm**	**20 μm**
BPM resolution	**1 μm**	**1 μm**
BPM Offset	**50 μm**	**20 μm**

Elements From QF1R to QF1L are considered as a single element.

167ARCS+60FF



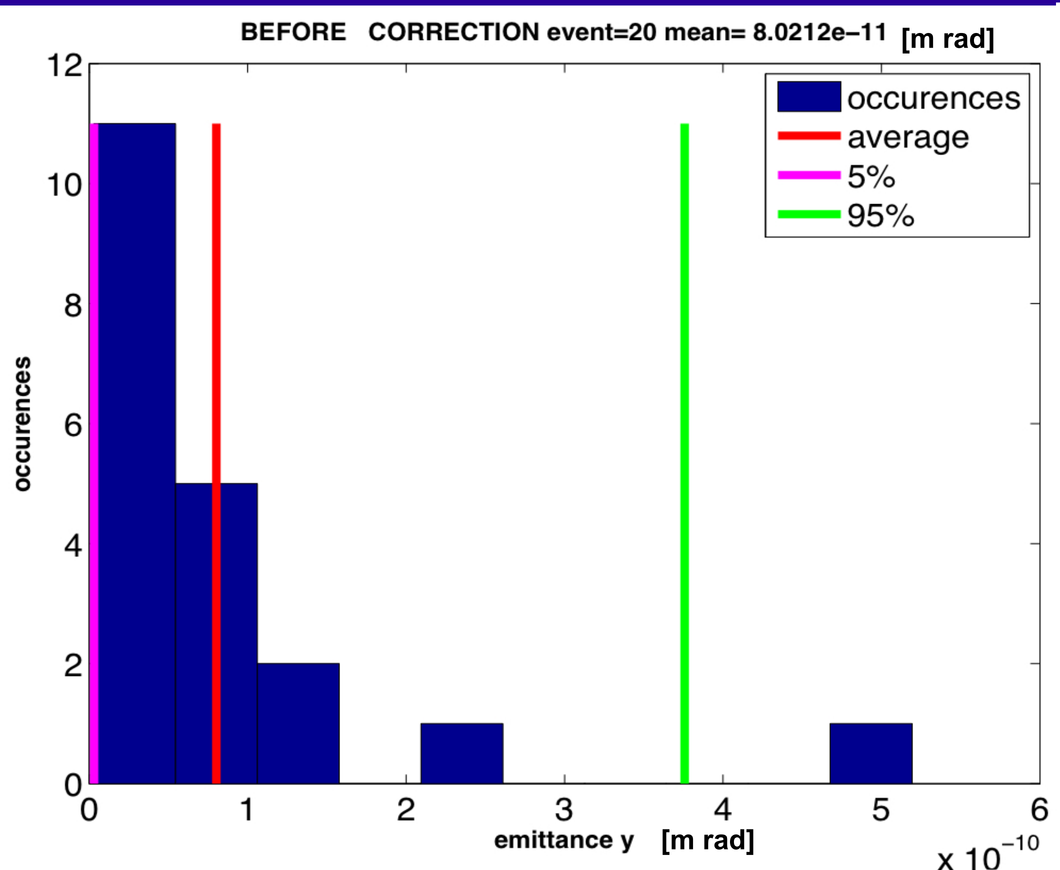
Tolerated Misalignments are smaller that this values.

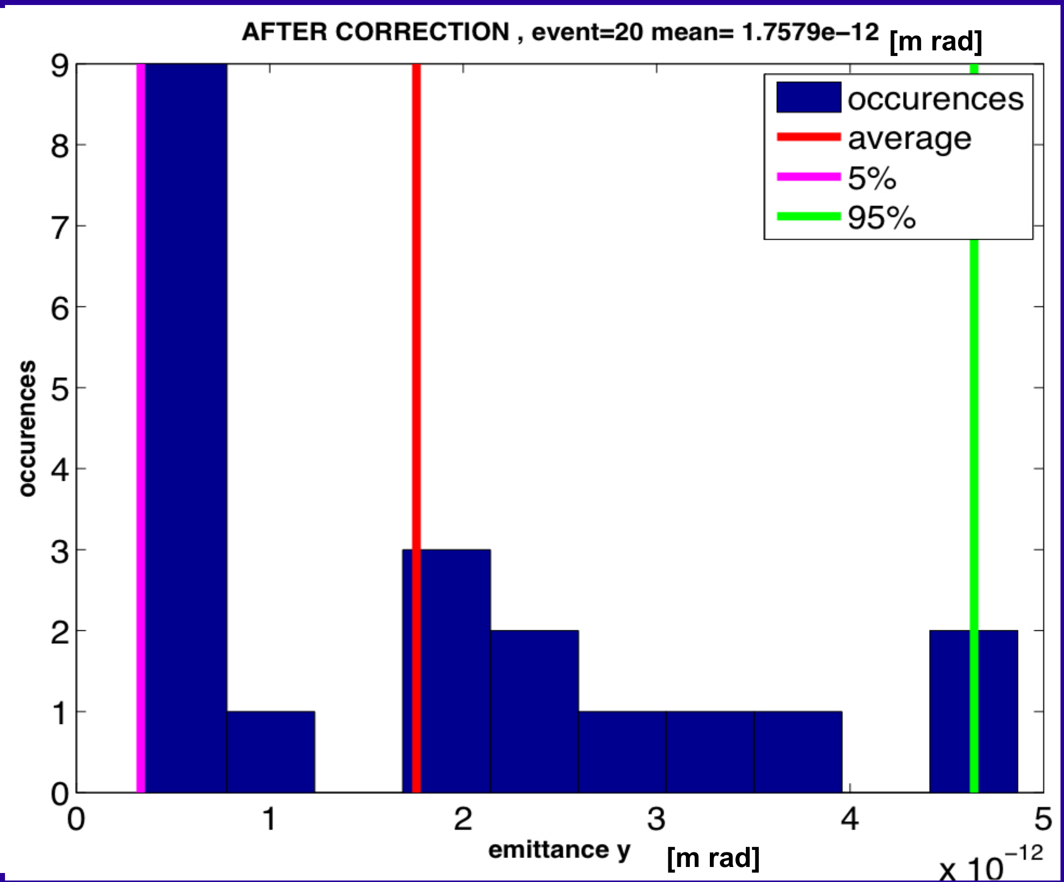
LER

Elements From QF1R to QF1L are considered as a single element.

109-ARCS+60-FF

Misalignment	Tolerated value	
	ARC	FF
Quadrupole H and V	**50 µm**	**20 µm**
Quadrupole Tilt	**50 µrad**	**20 µrad**
Sextupole H and V	**50 µm**	**20 µm**
BPM resolution	**1 µm**	**1 µm**
BPM Offset	**50 µm**	**20 µm**



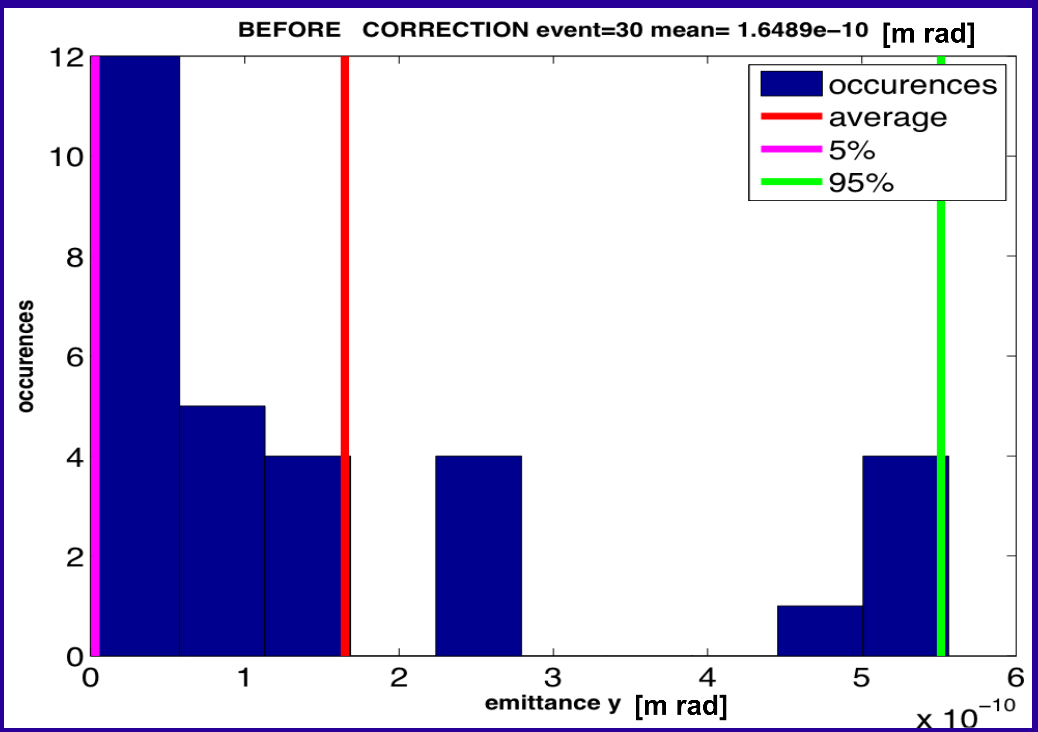


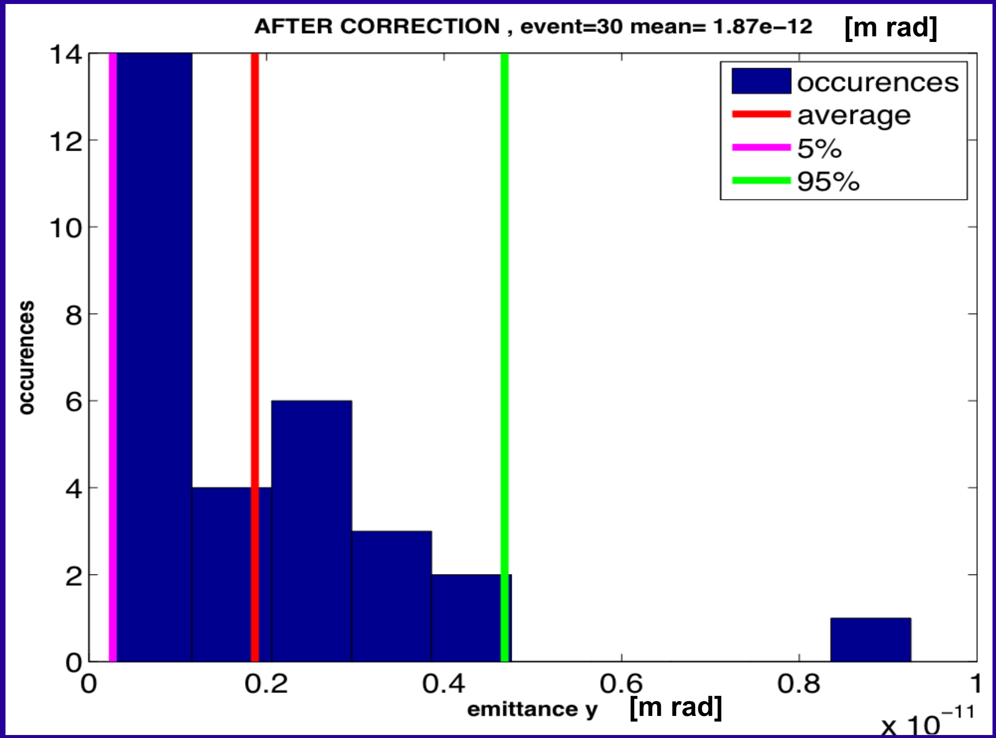
LER

Misalignment	Value	
	ARC	FF
Quadrupole H and V	**50 µm**	**00 µm**
Quadrupole Tilt	**50 µrad**	**00 µrad**
Sextupole H and V	**50 µm**	**00 µm**
BPM resolution	**1 µm**	**0 µm**
BPM Offset	**50 µm**	**00 µm**

Elements From QF1R to QF1L are considered as a single element.

109ARCS+60FF





The introduction of the Final Focus In the lattice defines more stringent tolerances also in the arcs

Conclusions

- LER ARC's tolerances are evaluated using a Response Matrix technique that optimizes orbit, in order to recover the design values for Dispersion, Coupling and Beta-beating, and obtain the lowest possible vertical emittance.

- Different sets of correctors are tested, showing that the number may be reduced to 109.

- The introduction of the Final Focus in the lattice introduces stringent restrictions on alignment of both Final Focus and ARCS