The transfer function of the SSS correctors

Alessandra Lombardi

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Aim of this work

- Do we need the ‰ or can we accept the % ?
- Review the measurements strategy for the correctors of the SSS [MQT,MO,MS,MCB]
- Add sketch of the SSS and numbers of correctors

contents

- Definition of transfer function
- Method (s) to evaluate the needed accuracy for the knowledge of the transfer function
- The issue of hysteresis
- Conclusions

Transfer function

Type of correctors

	Effect on	Number and family	Factor with the MQ
MQT	Tune		36 : 1
MS	Chroma		26 : 1
MO	Tune and higher order		300 : 1
MCB	orbit		7 : 1

Method

Evaluate the effect of the corrector on the relevant variable at injection

Compare this effect with the resolution of the measurement system

Gives the accuracy that we can achieve by calibrating the correctors with the beam. , gives the max tolerable hysteresis width

Compare this effect with the operational range

Gives the accuracy that we need to achieve during operation

Compare this effect with the width of the stability

Gives the accuracy that we need to start the machine

MQT

- 1units of one MQT induces a $\Delta Q=1.8\ 10^{-4}$

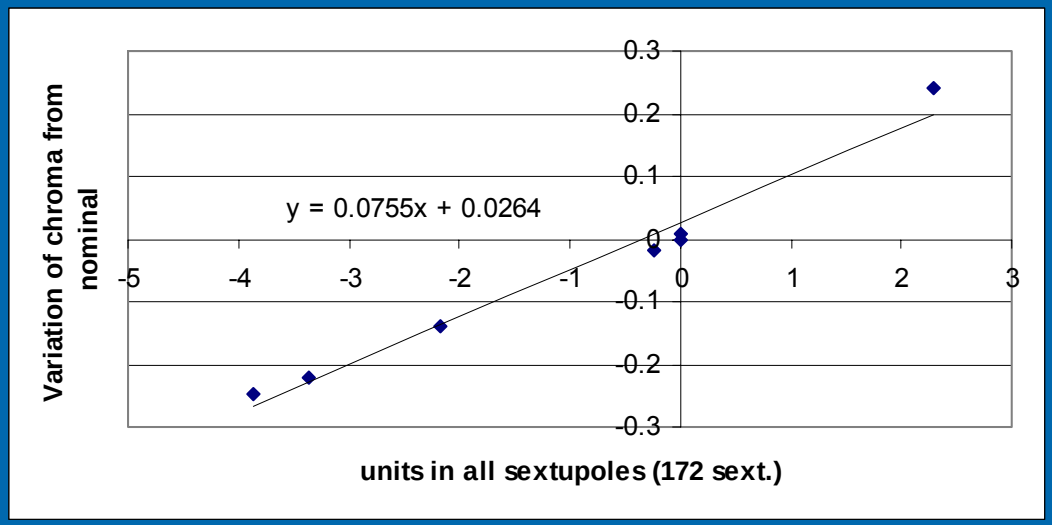
(equivalent to 0.0120 T/m)

- The MQT are powered in bunch of 8
- Assume that at injection the MQT are set at 1/16 of their max value (120T/m)
- The tune can be measured with an accuracy of $0.75\ 10^{-3}$
- The operational margin for the tune is $\pm 3\ 10^{-3}$
- The width of the stability island around the nominal working point is $\Delta Q=\pm\ 10^{-2}$

MQT

- In order to switch on the MQT and stay within $\Delta Q = \pm 10^{-2}$, we need to know the transfer function to the level of 10^{-2}
- By measuring the tune we can calibrate the MQT to better than the percent level (A measurement of the tune takes few seconds)
- The hysteresis can be ignored only if its width is less than 0.05 T/m

MS



With MADX vary the lattice sextupoles and compute Chroma.

Nominal value ξ=2 (x and y)

Ksd=-0.108498853

Ksf=0.06736214256

Δξ/DK=0.1

- MS are powered in bunch of 12
- Chromaticity can be measured to ±1
- Chromaticity should be within ± 5

MS

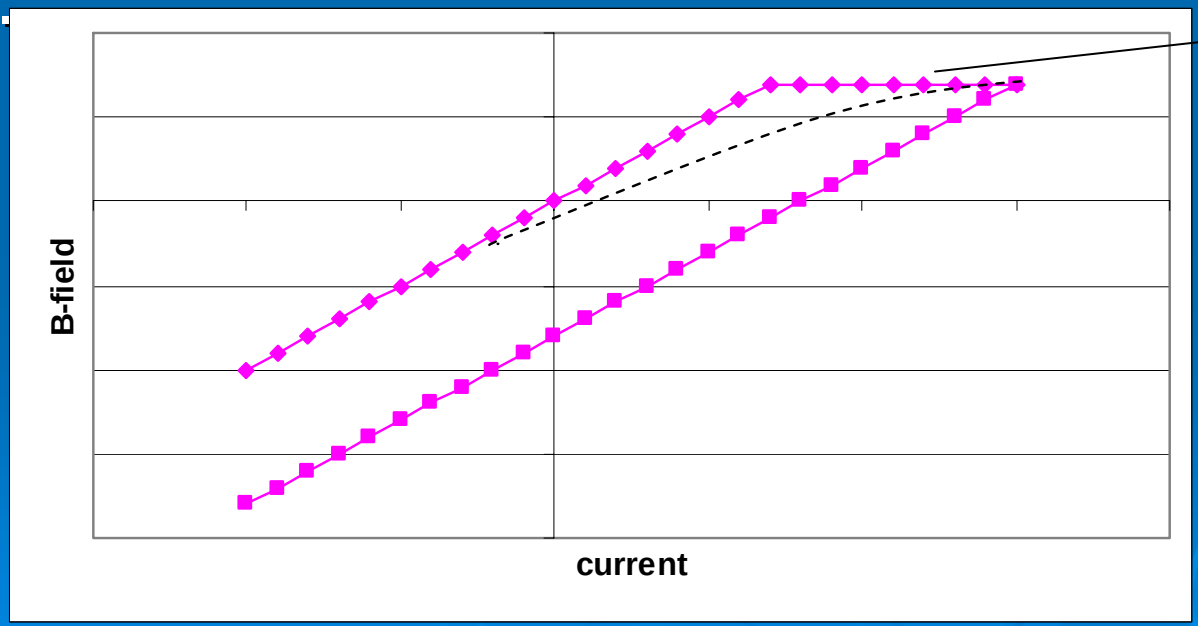
- Knowledge of the transfer function to the level of 10^{-2} is sufficient
- It's not possible to improve significantly the knowledge of the transfer function by measuring with the beam
- Chromaticity measurement takes about one minute
- The MS should not suffer from hysteresis as their nominal value at injection is not zero

MCB

- Used for orbit correction, individually powered.
- Their transfer function can be measured very accurately with the beam. BPM accuracy is xx microns.
- one units gives a kick of 0.008 μrad which generated a closed orbit change of 1.5 μm.
- Initial knowledge to the level of 1% is good enough.
- They are used in a orbit correction feed-back system and hysteresis is important

MCB-hysteresis

- Measurements are already underway to study the behavior of the hysteresis. The results can change he strategy of correction



"flat" behavior could blind the automatic system

MO

- Grouped by 12
- 1 : 300 with the nebouring MQ
- Tolerance on the random b4 of the MQ is 0.3 units (1unit systematic)
- Knowledge of the transfer function to the 1% level is within the acceptable tolerance of the machine.
- Hysteresis can be ignored if within 0.003 Tesla at the radius of 17 mm)

Conclusions

- Knowledge of the transfer function to the level of the % is sufficient to start
- Better accuracy (to the ‰) can be gained during commissioning with beam
- Hysteresis can’t be ignored for those correctors that are adjusted around zero at injection (MQT MCB and MO)