New method for the validation of aperture margins in the triplet

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LHC collimation system

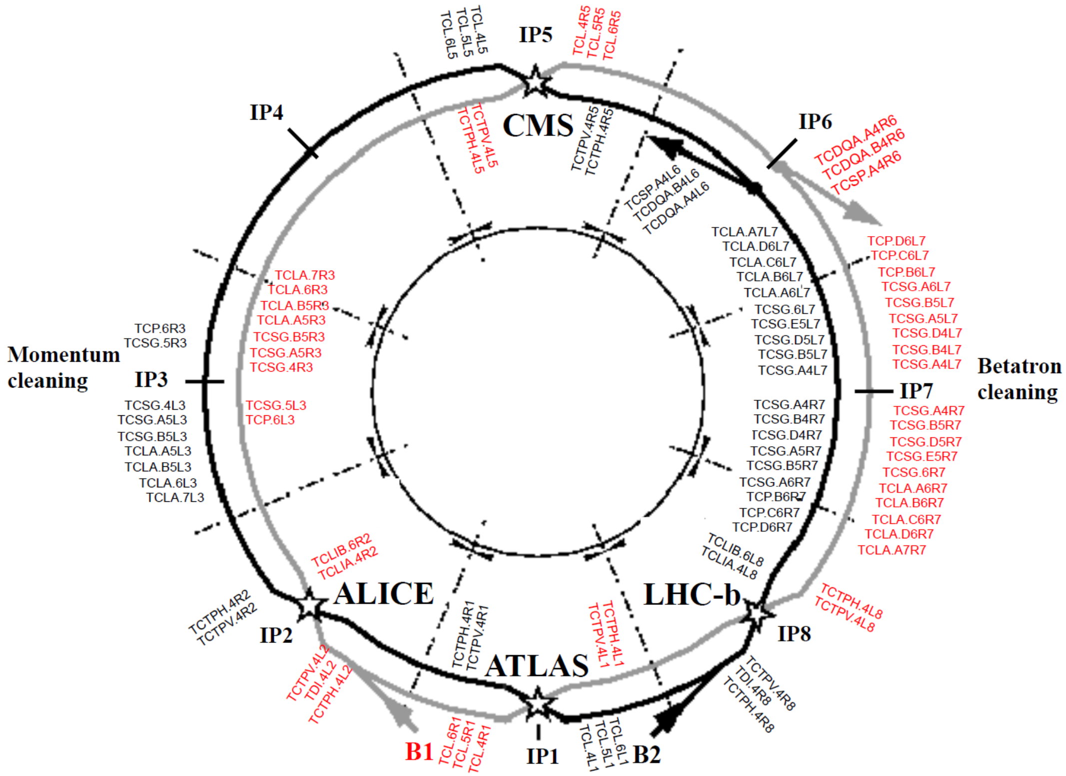
- Post LS1 layout

Additional TCDQ (block C) added

- Collimator retractions:

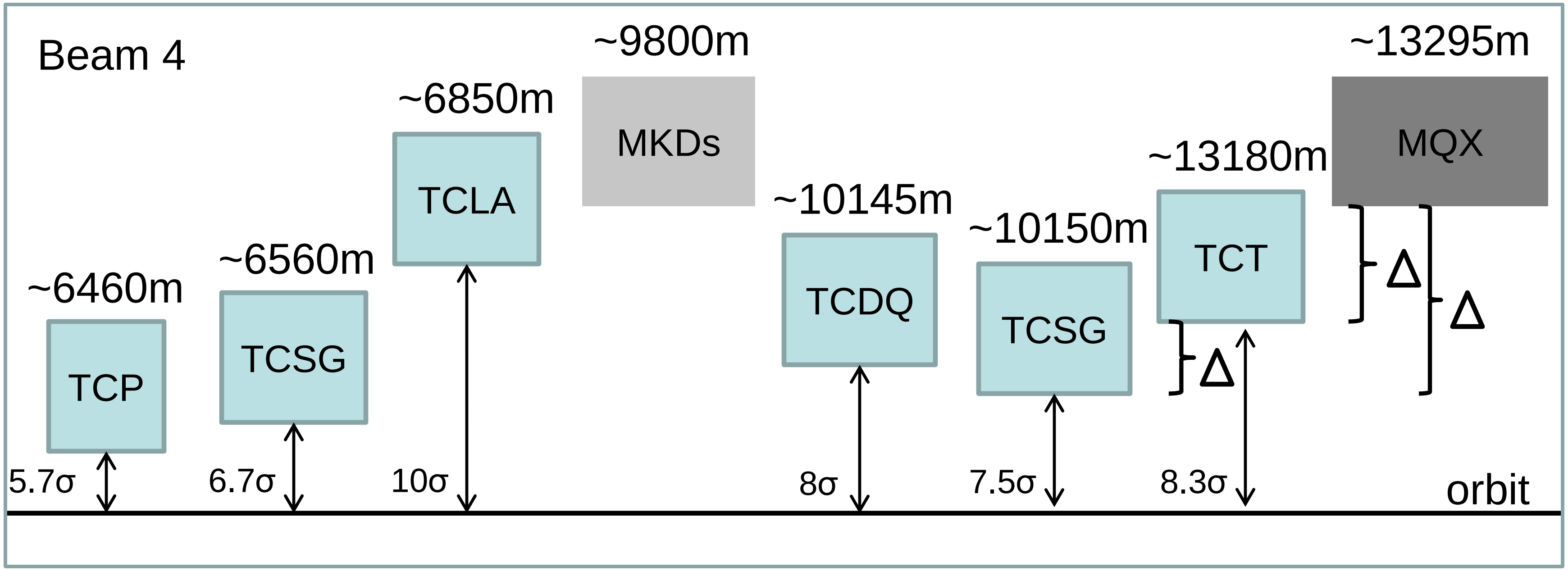
Collimator Type	N_i at 4 TeV in collisions (σ)	N_i at 7 TeV in collisions (σ)
TCL IR1	10	10
TCL IR5	10	10
TCT IR1	9	8.3
TCT IR2	12	8.3
TCT IR5	9	8.3
TCT IR8	12	8.3
TCLI IR2	parking	parking
TCLI IR8	parking	parking
TDI IR2	parking	parking
TDI IR8	parking	parking
TCP IR3	12	15
TCSG IR3	15.6	18
TCLA IR3	17.6	20
TCDQ IR6	7.6	8
TCSG IR6	7.1	7.5
TCP IR7	4.3	5.7
TCSG IR7	6.3	6.7
TCLA IR7	8.3	10

[G. Valentino, Fast Automatic Beam-Based Alignment of the LHC Collimator Jaws, CERN-thesis-2013-208]



[S. Redaelli, BIQ Workshop 2014]

LHC collimation system



How to measure the aperture margins:

1. Moving out TCDQ and TCSG → Beam will be impacting on TCT
2. Moving out TCT → Beam will be impacting on MQX

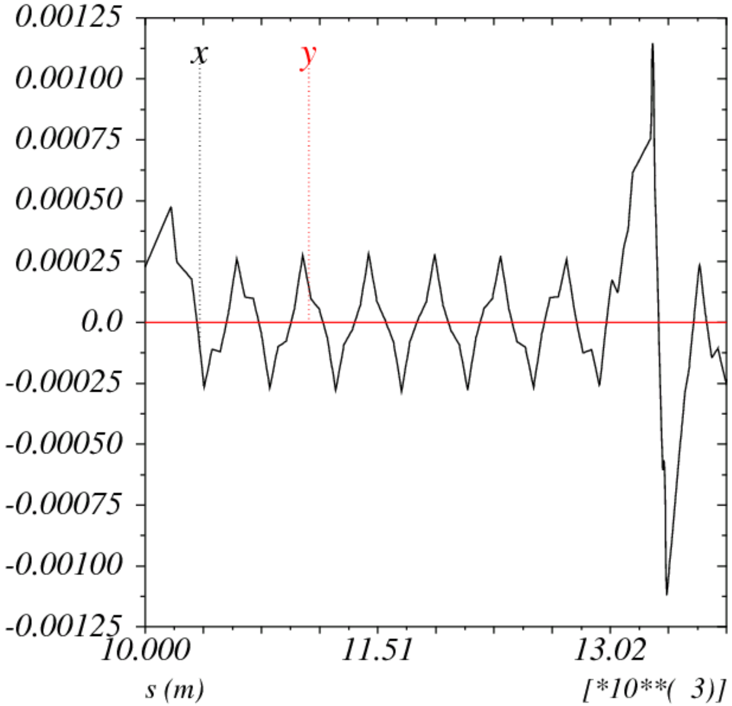
Method

- Creating a global 4-corrector orbit bump around the MQX in IP5:
  - MCBCH.7L5.B2
  - MCBCH.5L5.B2
  - MCBCH.9R6.B2
  - MCBH.11R6.B2
- Matching
  - the position (x=0) and angle (px= 0÷275 μrad) at MKD.H5R6.B2
  - the position (x=0) and angle (px= 0) at BPM.11L5.B2 and BPM.13R6.B2
- Retracting collimators
  - TCDQ/TCSG
  - TCT

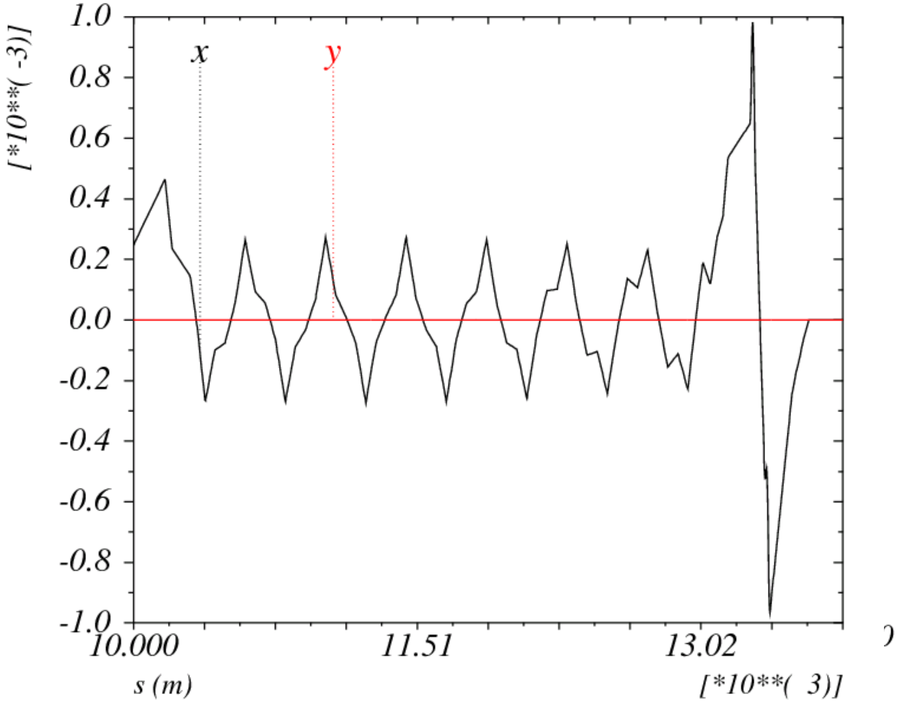
Advantages: performing the test in reasonable time (beam is not dumped)

Trajectory

- Orbit in case of MKD.H misfire



- Orbit in case of a 4-corr. orbit bump



Preliminary check was done:
Correspondence between deflection angle and multipole coefficient to be calculated

Preliminary results

Nominal collimator settings

- Nominal optics

Angle 10e-6 ÷ 80e-6 rad

- TCDQA.A4L6.B2..0 100

Angle 90e-6 rad

- TCDSA.4R6.B2 99.55
- TCDQA.A4L6.B2..0 0.45

Angle 100e-6 rad

- TCDSA.4R6.B2 100

- ATS optics

Angle 10e-6 ÷ 80e-6 rad

- TCDQA.A4L6.B2..0 100

Angle 90e-6 rad

- TCDSA.4R6.B2 99.91
- TCDQA.A4L6.B2..0 0.09

Angle 100e-6 rad

- TCDSA.4R6.B2 100

Preliminary results

TCDQ + 1sigma

- ATS optics

Angle 10e-6 rad

- TCDQA.A4L6.B2..0 99.92
- TCSG.4L6.B2 0.08

Angle 20e-6 ÷ 80e-6 rad

- TCDQA.A4L6.B2..0 100

Angle 90e-6

- TCDSA.4R6.B2 99.91
- TCDQA.A4L6.B2..0 0.09

Angle 100e-6

- TCDSA.4R6.B2 100

TCDQ + 20sigma

- ATS optics

Angle 10e-6

- TCSG.4L6.B2 100

Angle 20e-6

- TCSG.4L6.B2 100

Angle 30e-6 ÷ 80e-6 rad

- TCDQA.A4L6.B2..0 100

Angle 90e-6

- TCDSA.4R6.B2 99.9
- TCDQA.A4L6.B2..0 0.1

Angle 100e-6

- TCDSA.4R6.B2 0 100

Conclusions

- New method for the validation of aperture margins in the triplet is demonstrated
- The trajectories of the beam in case of a 4-corr. orbit bump and MKD misfiring are similar
- In case of TCDQ and TCSG retraction the losses occur farther downstream, however increasing the MKD deflection angle changes the loss distribution
- The work is ongoing