MD 3318
LHC secondary and tertiary collimators
tune-shifts measurement


LHC Studies Working Group
4/12/2018
MD procedure

• First part of MD dedicated to ADT set-up

• Inject two nominal bunches per beam
  – $1.3 \times 10^{11}$ ppb and emittance $\lesssim 1.6 \mu m$

• Ramp with full octupole current target at flat-top
  – Once at flat top, all IR7 TCSG were opened to reduce impedance
  – Chromaticity was reduced to 5/5 for both beams

• **Tune shifts** caused by different collimators were measured
  – One bunch in each beam **kicked** with the ADT (second bunch kept as spare)
  – The beams were kicked every 7s
  – Turn by turn position **data recorded** with the ObsBox
  – Meanwhile each collimator was moved from its nominal gap $g_{nominal}$ to $g_{nominal} + 10 \text{mm}$
MD procedure

- Many different collimators measured
    - Will be replaced by low impedance collimators in LS2
  - IR2 TCT: TCTPH.4[L/R]2 and TCTPV.4[L/R]2
    - Have lowest beta function for TCTs ⇒ smaller physical gaps ⇒ higher impedance
  - TCSPM.D4R7.B2
    - Check the effect of one year of beam exposure on Molybdenum coating and Molybdenum-Graphite bulk
    - Different gaps measured to allow reconstruct the materials resistivities
  - 2 TCP B1: C6L7 and D6L7
    - Re-check the measurements performed in 2016
ADT set-up phase

- Careful set-up of the beam and the ADT gave large kicks and long decoherence time
  - No large beam loss during the whole MD time (~5%)
  - Thanks Martin and Daniel for the help during the ADT set-up!

Turn #

Bunch position at ADT

Bunch position at ADT
TCSGs measurement

• Clear tune-shifts observed, in the order of $1 \times 10^{-4}$

Collimators opened and closed in quick successions, while kicking the beam.
TCTs measurement

- No significant tune shifts observed
  – TCTP jaws are made of low resistivity material (tungsten)
TCSPM measurement in B2 at 4.5 $\sigma_{coll}$

- Molybdenum coated stripe: tune shift as well in the order of $\sim 0.6 \times 10^{-4}$
  - No large change compared to last year measurement
TCSPM measurement in B2 at 4.5 $\sigma_{coll}$

- Molybdenum-Graphite bulk stripe: tune shift in the order of $1 \times 10^{-4}$
As expected, clear tune-shifts observed, in the order of $2 \times 10^{-4}$
B1 measurements summary

- Large tune shifts for the primary and secondary collimators
  - Hierarchy respected: TCP exhibits largest tune-shift (smallest gap), then TCSGs
B2 measurements summary (TCSPM excluded)

- No B2H measurement
  - Fast kicking caused an ADTObsBox crash for this plane

- Beam 2 TCPs were not measured: the TCSPM was measured instead
Conclusion

• Measurement method proved again to be effective
  – Careful set-up of the ADT is required to get best kick signal
  – ADTObsBox was pushed to its limits (possible network congestion)
  – But collimators measurement is then straightforward

• We now have a large set of individual collimators measurements
  – IR7 Beam 1 TCPs (also done in 2016)
  – IR7 Beam 1 and Beam 2 TCSGs (also done in 2016 but with poor results)
  – IR2 Beam 1 and Beam 2 TCTs
  – IR7 Beam 2 TCSPM (also done in 2017)

Next steps

• Compare the measurements to predictions from Sacherer formula and/or tracking simulations
• Treat the TCSPM.D4R7.B2 data for the different stripes and gaps
MD overview

![Graph showing bunch intensity and beam energy over time]

- **Bunch intensity (p.p.b.)**
  - 0 and 550 lines

- **Beam energy (TeV)**
  - 0 and 500 lines

MD3318: collimators tune-shifts measurement