Instability during TOTEM run

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Observations

- Fill 5146 (31 July 2016)  
  Instability on not colliding bunches
- Fill 5284 (7-8 September 2016)  
  Instability on not colliding bunches
- Fill 5312 (19 September 2016)  
  Instability on colliding bunches
- Fill 5313 (19-20 September 2016)  
  Instability on not colliding bunches
Observations

• Fill 5146 (31 July 2016)
  – Observations
• Fill 5284 (7-8 September 2016)
  – Observations
  – Simulations
• Fill 5313 (19-20 September 2016)
  – Observations
  – Simulations
Observations

• Fill 5146 (31 July 2016)
  – Observations

• Fill 5284 (7-8 September 2016)
  – Observations
  – Simulations

• Fill 5313 (19-20 September 2016)
  – Observations
  – Simulations
Fill 5146

- 2 bunches ~ 7e10ppb
- Higher intensity in non colliding bunch
• Emittance blow up in H plane both beams at \(~19:35\)
Fill 5146

B1 H BBQ-FFT: 31/07/16 19:20:00 -> 31/07/16 19:39:59

TCP.D6L7

Reduces gap

Blow-up before going to smaller TCP gaps
Fill 5146

TCP.D6R7

Reduces gap

Blow-up before going to smaller TCP gaps
Fill 5146

- Mode -1(?) B1H instability
- Mode -1(?) B2H instability

Rise time ~ 60s

- Sussix analysis on the unstable lines: not clear which mode is unstable, 0, -1?
- Analyzing in more detail...
Observations

• Fill 5146 (31 July 2016)
  – Observations

• Fill 5284 (7-8 September 2016)
  – Observations
  – Simulations

• Fill 5313 (19-20 September 2016)
  – Observations
  – Simulations
Fill 5284
Fill 5284

- 3 bunches with 7-8e10 ppb
- Intensity losses at ~20:16 in B1 and ~20:20 in B2
• Losses are associated to instability only on non colliding bunch
• The other bunches shrink due to halo cleaning?
Fill 5284
Fill 5284

B2 H BBQ-FFT: 07/09/16->07/09/16

B2 V BBQ-FFT: 07/09/16->07/09/16

TCP.D6R7

2σ

Reduces gap

4σ
• Peak of lines not clear... to be analyzed in more detail...
- Peak of lines not clear... to be analyzed in more detail...
Observations

• Fill 5146 (31 July 2016)
  – Observations

• Fill 5284 (7-8 September 2016)
  – Observations
  – Simulations

• Fill 5313 (19-20 September 2016)
  – Observations
  – Simulations
Simulations for fill 5284, B1 – collimators settings

Col. settings (sigma)

Col. settings (mm)
Simulations for fill 5284, B1 – impedance

Close TCP.D6[L/R]7 → Visible impact on transverse impedance
Simulations for fill 5284, B1 – tune shifts

Close TCP.D6[L/R]7 → Visible impact on expected tune shift (w/o damper)
Simulations for fill 5284, B1H – risetimes

Rise time of order of 7s expected for Qp = 10 (value observed during the fill)
Simulations for fill 5284, B1H – oct. threshold

Octupole threshold for 1e11 -> Above limits at $Q' \sim 10$

Case: 20h15, TCP.D6[L/R]7 at 4σ

Case: 20h20, TCP.D6[L/R]7 at 2σ

Oct. current limit

$\tau = 7.2$ s
Observations

• Fill 5146 (31 July 2016)
  – Observations
• Fill 5284 (7-8 September 2016)
  – Observations
  – Simulations
• Fill 5313 (19-20 September 2016)
  – Observations
  – Simulations
Fill 5313

Timeseries Chart between 2016-09-19 20:30:29.106 and 2016-09-20 00:04:45.792 (LOCAL_TIME)

Timeseries Chart between 2016-09-19 20:30:29.106 and 2016-09-20 00:04:45.792 (LOCAL_TIME)
Fill 5313

B1: instability at 22h16

B2: instability at 22h04
Fill 5313

RP half gap / mm

Tune
Fill 5313

B2 H BBQ-FFT

B2 V BBQ-FFT

RP half gap / mm

Tune
$m = -1$

$l = 0$?
Observations

• Fill 5146 (31 July 2016)
  – Observations

• Fill 5284 (7-8 September 2016)
  – Observations
  – Simulations

• Fill 5313 (19-20 September 2016)
  – Observations
  – Simulations
Simulations for fill 5313, B2

- 21:15 Roman pots not fully in
- 21:40 two vertical Roman pots in, 0.34mm and 0.86mm gap
- 22:04 two horizontal Roman pots in, 2.4mm and 3.5mm gap
Simulations for fill 5313 – Roman pots model

From N. Minafra

Rectangular roman pot (54mm long)  Cylindrical roman pot (100mm long)

- Impedance geometric part from CST (Benoit), inversely scaled with the half-gap
  \[150k\Omega/m \times 0.1mm \times \text{(halfgap)}^{-1}\]
- Impedance resistive part: 5.4cm (x5) or 10cm (x6) long roman pots, stainless steel
- 11 Roman pots included in the model: 5 horizontal, 6 vertical
Simulations for fill 5313, B2 – impedance

Roman pots in → Visible impact on transverse impedance
Simulations for fill 5313, B2 – tune shifts

$\beta_x$ values are high (636m for XRPV.B6L5, 862m for XRPV.D6L5)
Roman pots XRPV.B6L5 and XRPV.D6L5 in \( \rightarrow \) visible impact on tune shifts
Other roman pots are farther from the beam: negligible tune shifts
Simulations for fill 5313, B2H – mode

Mode 0 for $Q_p = 10$, corresponds to the observed instability
Simulations for fill 5313, B2H – risetimes

Rise time of order of 7s expected for Qp = 10, lower than observed (52s)
Simulations for fill 5313, B2H – oct. threshold

Case: 21h15, Roman pots not fully in

Case: 22h04, Roman pots fully in

Octupole threshold for 7e10 -> Below limits at Q’~10
Conclusion

• New (rough) impedance models for the high $\beta^*$ run
  – With closer collimators settings
  – And the Roman pots impedance
• Roman pots have a non negligible contribution on the impedance
• Reasonable agreement reached with the rough model
• For future high $\beta^*$ runs
  – Refine the impedance model
  – The planned parameters will need to be checked w.r.t impedance