Motivation of the MD ADT frequency scans ADT excitation with fixed frequencies tail measurement with BWS conclusion & outlook

Status of analysis of halo excitation MD

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Outline

1. Motivation of the MD
2. ADT frequency scans
3. ADT excitation with fixed frequencies
4. Tail measurement with BWS
5. Conclusion & outlook
Motivation of the MD

Testing a new technique for the depletion of overpopulated beam tails with present hardware. The study of the method could be very beneficial for RUN II and HL-LHC to avoid spurious beam dumps by providing an active halo control. This technique was envisaged to be studied in detail as a possible alternative to the hollow electron lens.

ADT narrow-band excitation, both horizontal and vertical.
**Procedure**

- prepare 3 bunches, either nominals or pilots and at 450 GeV.
- bunch-to-bunch narrow-band excitation with ADT, H or V.
- monitor bunch by bunch their intensities, the core and the tails:
  - by using the (F)BCT, BSRT, and BWS, whereas the BWS operate, both normal and saturated.
- collimator scans.
- measurement of detuning with amplitude with AC dipole.

*Main Goal*

→ showing to have an active halo/tails control without affecting the core.
MD overview

- Motivation of the MD
- ADT frequency scans
- ADT excitation with fixed frequencies
- Tail measurement with BWS
- Conclusion & outlook

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**Status of analysis of halo excitation MD**
measurement of detuning with amplitude

- Parabola fit (meas.)
- Measurement
- Model (preliminary)

fitted function is a base for present simulations of particle excitation [H.Garcia-Morales]
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Bunch scheme

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Bunch scheme

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Bunch scheme

spacing

ACTIVE ADT WINDOW

LHC LHC.BWS.5L4.B2H1:PROF_DATA_IN

b# 0 reference bunch

b# 1500

before preparational blow up

preparational blow up before ADT

b# 1700 witness bunch

profiles from beam wire scans

data aqu. software [A.Cudny]

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estimated ADT setup

- frequency range in terms of tune:
  \( Q_x \) 0.27 to 0.31
  \( Q_y \) 0.26 to 0.327
- tune step \( \Delta Q = 10^{-4} \) per time step of \( \Delta t = 1 - 2s \)
- amplitude set in low range within possible range of 0-1
ADT scan nominals - right approaching

Run n7 with $A = 0.1$, $Q_x[0.27 \leftarrow 0.2949]$

- blown up b# 0
- NOT blown up b# 1700
- BLM RS07

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Status of analysis of halo excitation MD
ADT scan nominals - right approaching

Run n7 with $A = 0.1$, $Q_x[0.27 \leftarrow 0.2949]$

- blown up $b# 0$
- NOT blown up $b# 1500$
- blown up $b# 1700$

bunch intensity / %

local time

0.29 0.285 0.28 0.275 0.27

$Q_x$

$\epsilon_x$

$\epsilon_x$

$\epsilon_x$

$\epsilon_x$

55 60 65 70 75 80 85 90 95 100

55 60 65 70 75 80 85 90 95 100

15:51:00 15:52:00 15:53:00 15:54:00 15:55:00 15:56:00 15:57:00 15:58:00 15:59:00

0 500 1000 1500 2000 2500

norm. emittance $\epsilon_x \ %$

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ADT scan nominals - right approaching

Run n5 with $A = 0.03$, $Q_x[0.285 \leftarrow 0.295]$
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BWS profiles before and after excitation

blown up bunch b#1500

before blow up
after blow up
after ADT excitation

witness bunch b#1700

Integrational measurement for full sweep (Q_{ADT,H}=0.295-0.285) (run n5)

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Run p4 with $A = 0.05$, $Q_x [0.2821 \leftarrow 0.2949]$.

- **b# 0** (blown up), $Q_x$, $\epsilon_x$.
- **b# 1500** (blown up).
- **b# 1700** (NOT blown up).

$Q_x$ normalized emittance $\epsilon_x$.

Higher amplitude shows strong effect.

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ADT vertic. scan pilots - right approaching

Run p10 with $A = 0.079$, $Q_y[0.2971 \rightarrow 0.307]$

$\epsilon_y$ b# 0
$\epsilon_y$ b# 1500
$\epsilon_y$ b# 1700

$Q_y$

b# 0
blown up
b# 1500
NOT blown up
b# 1700

bunch intensity / %

local time

comparable results of the ADT excitation in H & V plane
Run n6 with $A = 0.03$, $Q_x[0.2901 \rightarrow 0.295]$
ADT fixed frequency - nominals

Run fn3 with $A = 0.15$, $Q_x = 0.295$

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ADT fixed frequency - nominals

Run fn2 with $A = 0.03$, $Q_x = 0.295$

smaller amplitude leaves witness bunch #1700 unaffected → repeat settings for larger excitation time during next MD
ADT fixed frequency - nominals

blown up bunch b#1500

before ADT
after ADT excitation

witness bunch b#1700

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Idea for tail measurement with BWS

take basically two scans with different gains and benefit from the signal flank before saturation to amplify tails
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evaluate scaling value $K$ for gain pair $g_0 = 15\%$ and $g_k$ by
$\langle S_i, g_k / S_i, g_0 \rangle$ withing flank
b1500, gain= 771V, filter= 100%

before blow up

after blow up

horizontal position / mm

BWS signal / a.u.
b1500, gain=771V, gain=1002V, filter=100%, scaling applied
by increasing the gain to the chosen values we do not observe a higher tail resolution

- the gain probably has to be much higher
- for an extrapolation of the scaling values one needs more measurements/statistics
the runs with nominals showed stronger losses on the pre-blown-up bunch
the ADT frequency scans gave evidence of possible practical fixed frequencies → more narrow scan ranges are envisaged for planned MD
amplitude of ADT has to be chosen in low range
pilot runs gave similar results for horizontal and vertical plane
calibration of ADT amplitude and excitation kick requires a better understanding
correlation between emittance measurements of different bunches, probably noise, to be discussed
analysis of scraping with collimators in comparison with BWS will be done