

# Summary of noise observations and future MDs

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WP2 & EPC

## **References:**

50 Hz harmonics perturbation, LMC 31/10/2018

Status of noise studies in the LHC and expected impact for HL-LHC, WP2 26/11/2019

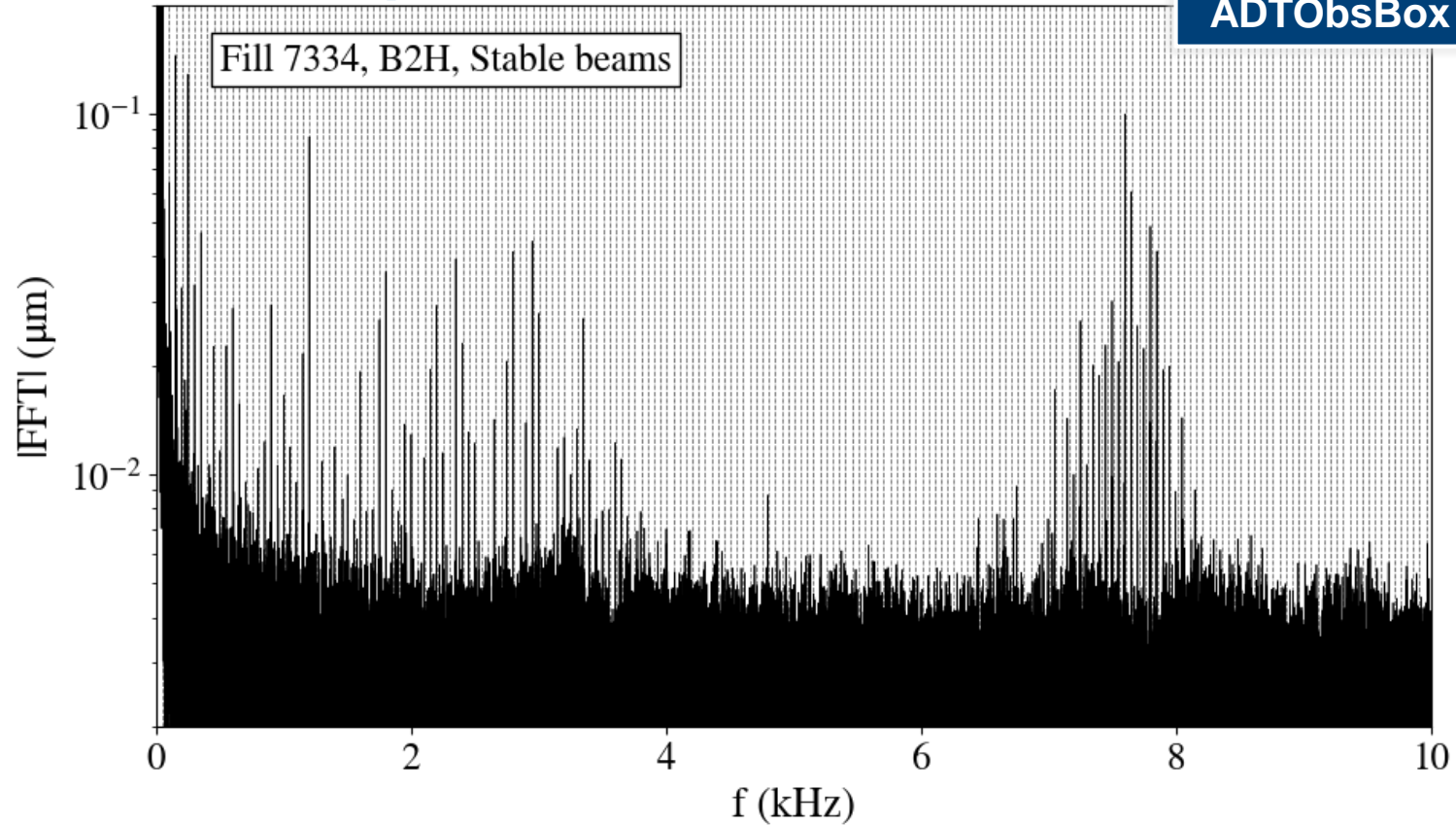
Sources of noise: 50 Hz harmonics on the beam spectrum, LMC 04/12/2019

## **The goal of the meeting is to discuss:**

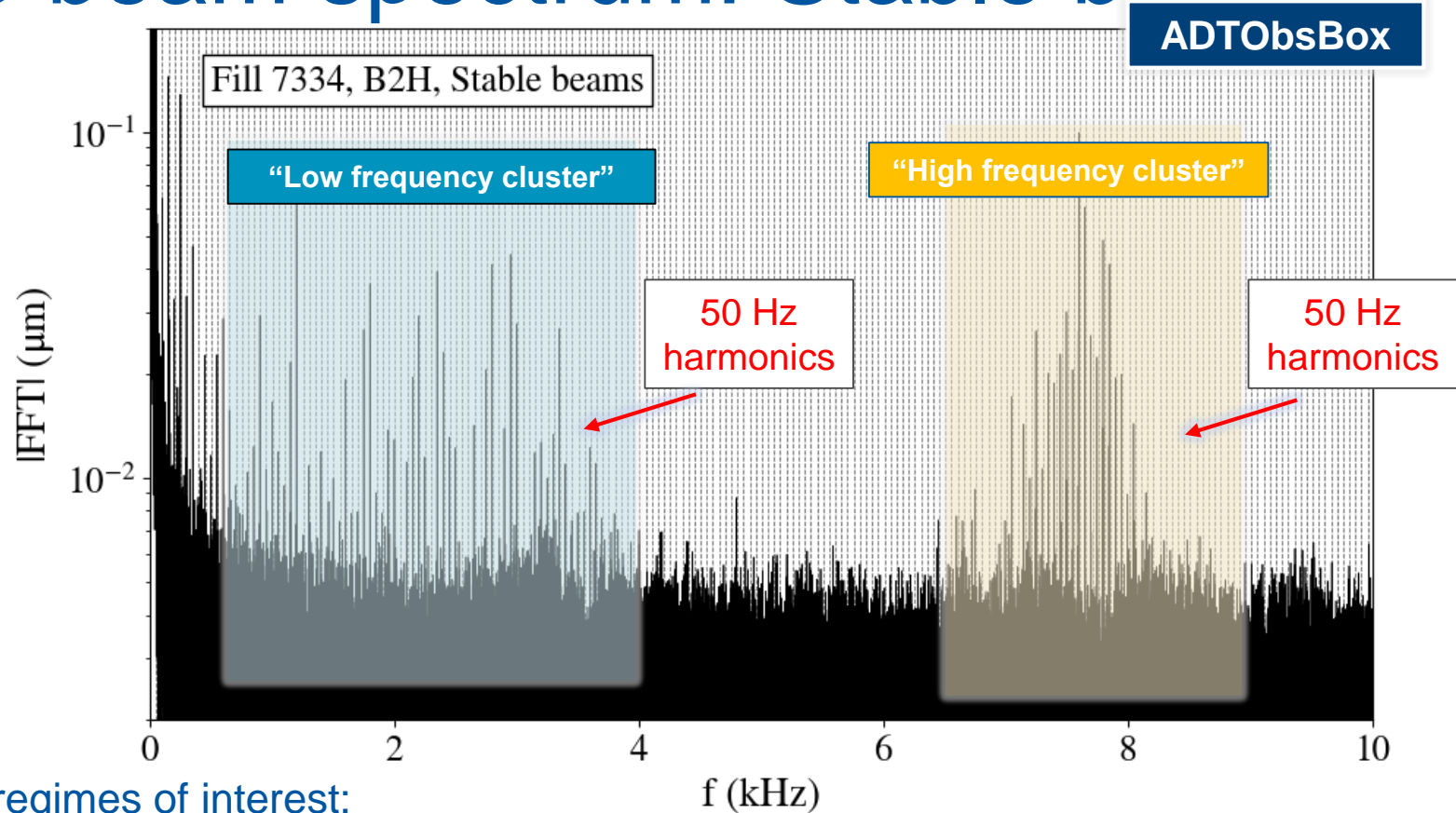
- Noise related observations collected in 2018 from the beam spectrum
- Ideas for future MDs (MD day <https://indico.cern.ch/event/867177/>)

# LHC beam spectrum: Stable beams

ADTObsBox



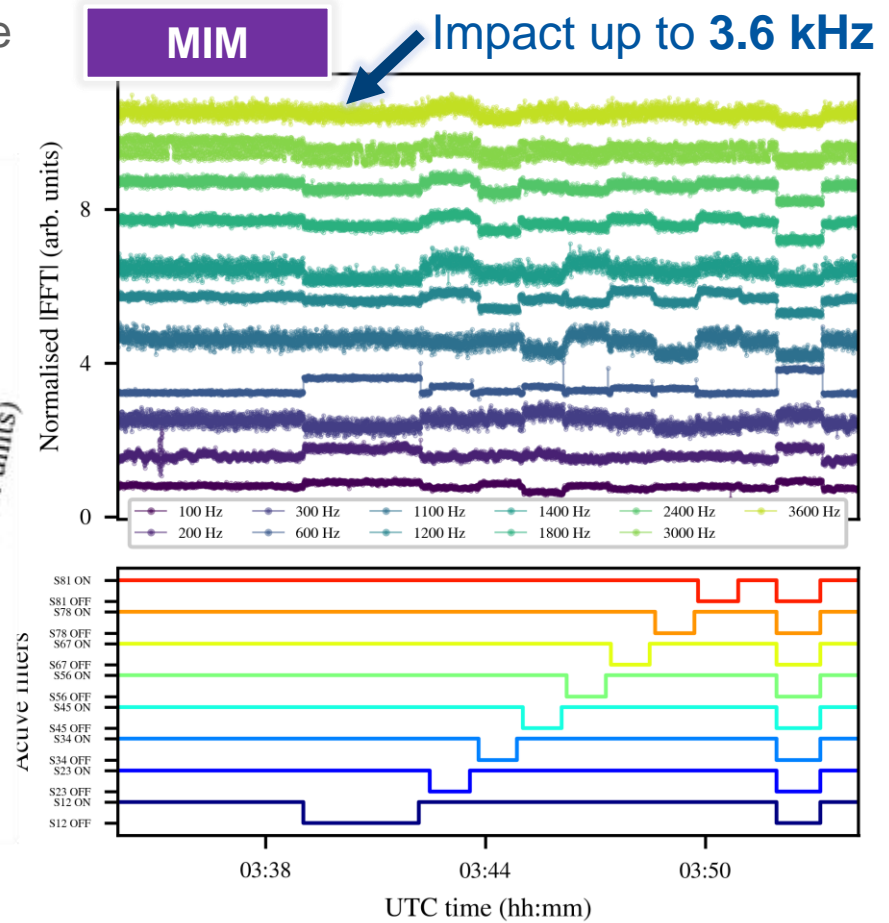
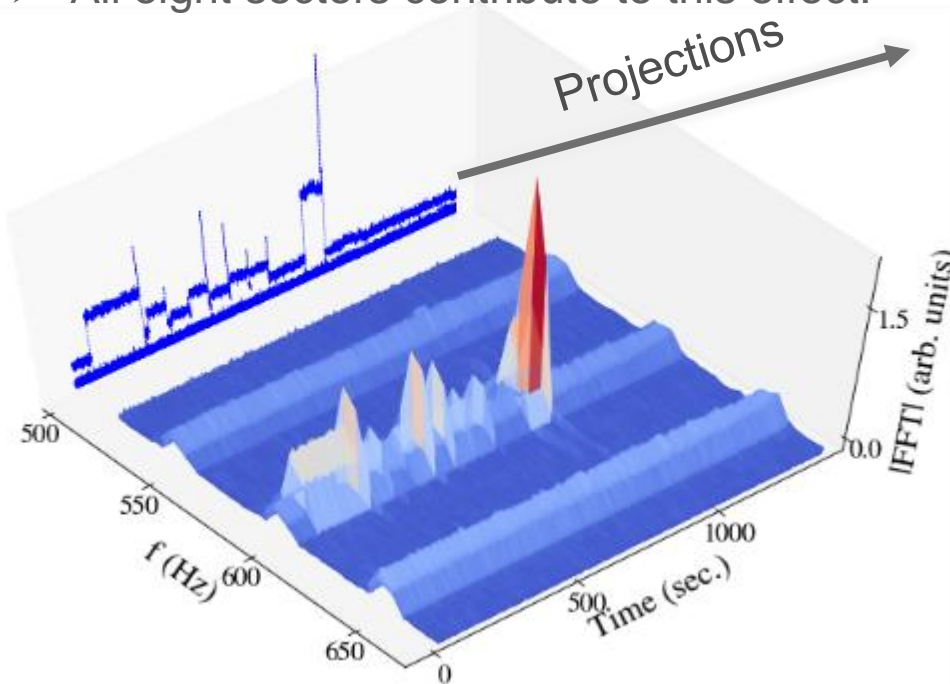
# LHC beam spectrum: Stable beams



- 1) Two regimes of interest:
  - I. **Low-f cluster**: up to **3.6 kHz**
  - II. **High-f cluster**: at  $f_{\text{rev}} - f_x$   
(where  $f_x$  is the betatron frequency)
- 2) The exact location of the **high-f cluster** is at  $f_{\text{rev}} - f_x$
- 3) The effect is **dipolar**-not sidebands around the tune (see appendix pg.18)
- 4) The **high-f cluster** is **not a sampling error**

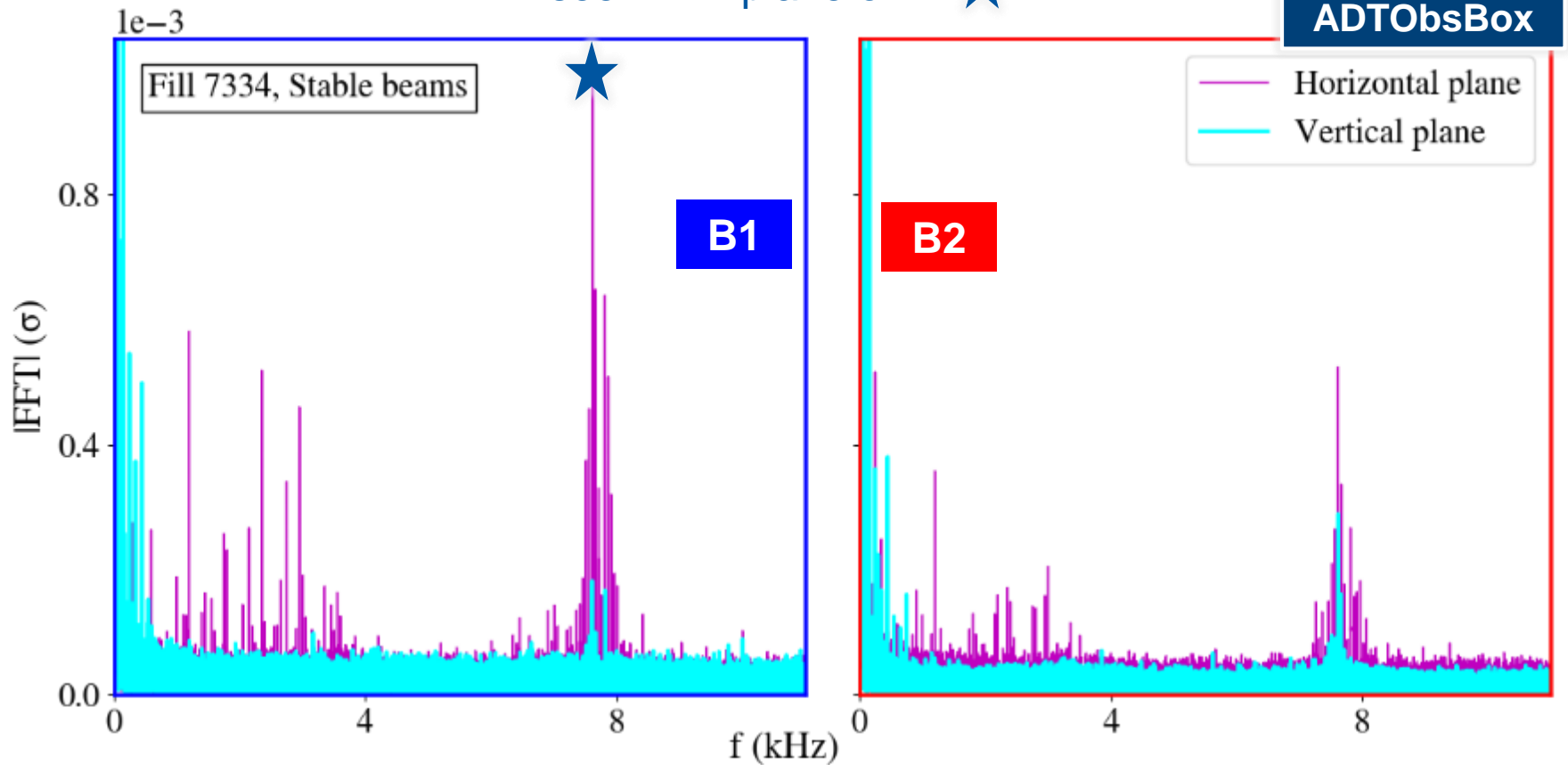
# MB Active filters

- Disabling/enabling the Active Filters of the main dipoles power converters has an impact on the harmonics of the **low-f cluster** in the beam spectrum.
- All eight sectors contribute to this effect.

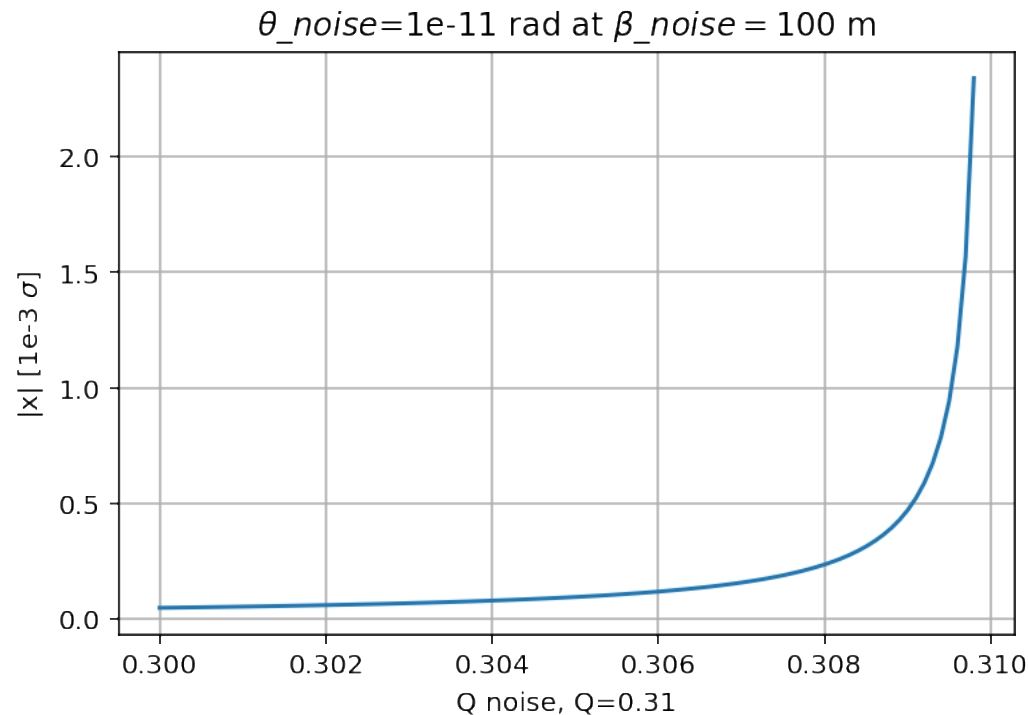


# Equivalent kick

If we consider the maximum offset seen in H plane of B1★



# Equivalent kick



- ★ (maximum 50 Hz offset) is equal to **0.1  $\mu\text{m}$**  or  **$10^{-3} \sigma_{\text{beam}}$**
- As a reference, considering a **single dipole** at  $\beta=100$  m corresponds to an equivalent kick of **0.01 nrad**
- Comparing with the kick of the main dipoles ( $\sim 5$  mrad), it would be equivalent to a **stability of  $2e-9$  for a single main bend at a frequency  $1e-3$  apart from the tune** → **In the absence of a transverse damper**

# HL-LHC Inner triplet

Similarly to SPS, can we inject noise in a warm quadrupole to verify these thresholds?

7 TeV,  $I_{OCT} = -300$  A,  $\varepsilon_n = 2.5$   $\mu\text{m}$  rad,  $(Q_x, Q_y) = (62.31, 60.32)$ ,  
 $Q_p = 15$ ,  $I = 1.2 \times 10^{11}$ ,  $\beta^* = 15$  cm, Noise IT right and left of IP1 & IP5

