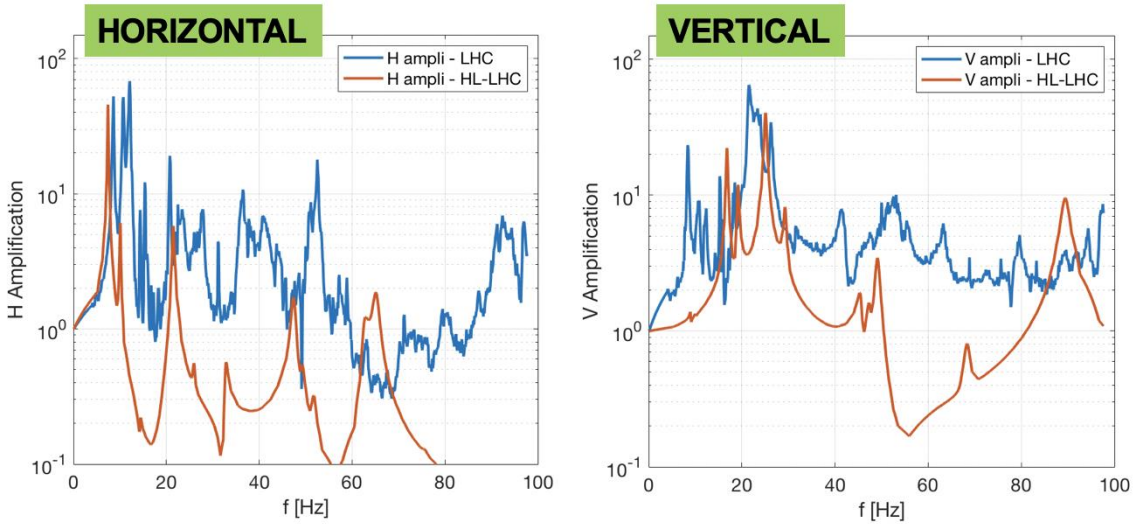
Effect of ground motion on triplet and beam screen stability

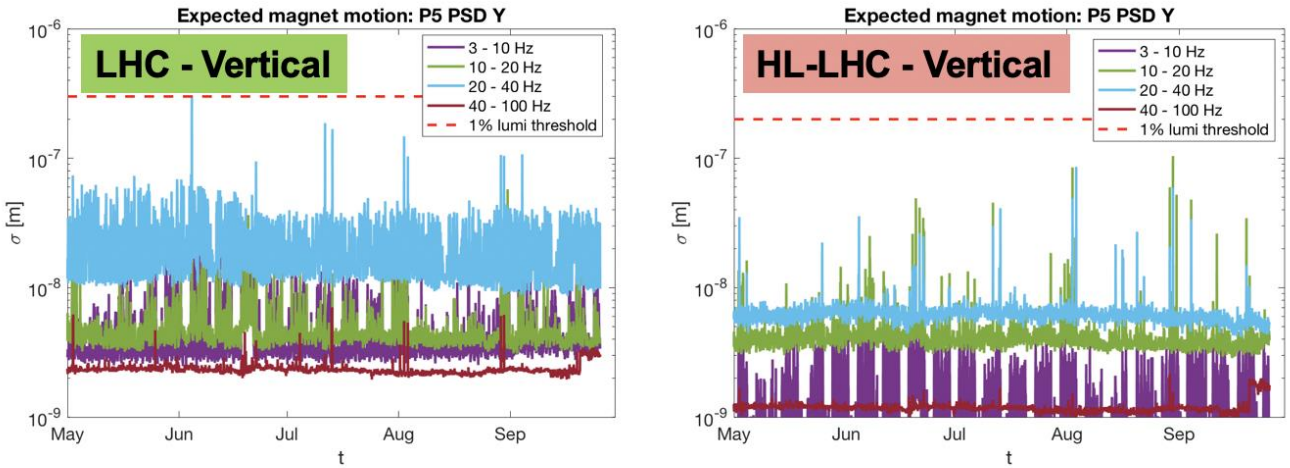
Main pending points:

- Amplification factor for the triplet movement wrt the movement of the floor to be determined
- Estimate of the movement of the beam at the collimator from losses
- Check with the DOROS BPM if possible
- Check the spectral data for the BLM at the TCP
- Explore the possibility to perform ground motion measurements closer to the beam line or even on top of the magnets
- Explore the possibility to perform transfer function measurements on an existing LHC dipole.

Amplification factor for the triplet movement wrt the movement of the floor to be determined

- Transfer function from mechanical model now exist
- In principle more forgiving than present triplets
  (see Davide's presentation at the last HL-LHC Collaboration Meeting)





- **LHC: measured** on Q1 spare assembly in SM18 (M. Guinchard, Oct 2017, link)
- **HL-LHC: simulated** (1% damping) by D. Ramos and M. Martos

- **HL-LHC slightly more sensitive, but triplet more forgiving (on paper!)**

D. Gamba et al., 8th HL-LHC Collaboration Meeting – 18/10/2018

Amplification factor for the triplet movement wrt the movement of the floor to be determined

- Measurements agreed upon so far:
  - Vibration measurements on an existing LHC dipole in 2019
  - Measurements on a Q2 prototype cold mass planned early 2020
    - Warm, using accelerometers
  - Possible measurements in STRING
    - optical – to be confirmed by alignment group
    - may cover cold measurements, coupling through interconnects, some technical noise sources

- Estimate of the movement of the beam at the collimator from losses
  - Rough estimate done (within a factor 2-3 from observation/prediction)
  - Strong dependence on beam halo distribution, difficult to do better than this

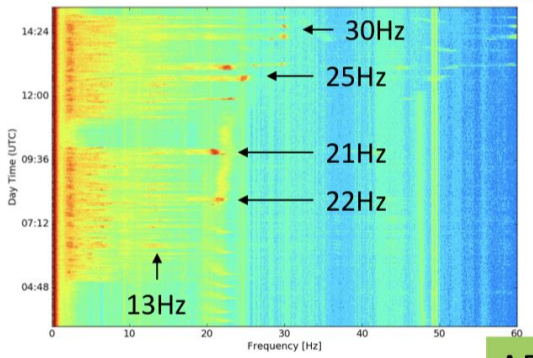
- Check with the DOROS BPM if possible
  - Not done so far, possibly to be prepared for Run3

- Check the spectral data for the BLM at the TCP
  - Some initial analysis done by Michaela in the past, but spectral data on ADT already confirmed consistency with ground motion sensors

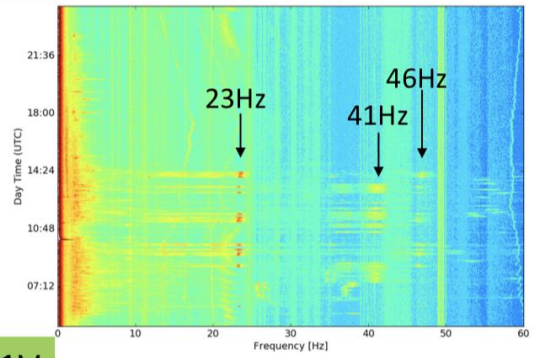
- N.B.: For all signals, spectral data analysis is very limited unless done on fresh data

Geophone

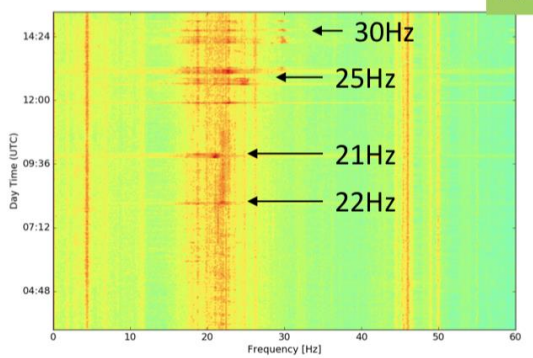
Fill 6757 (June)

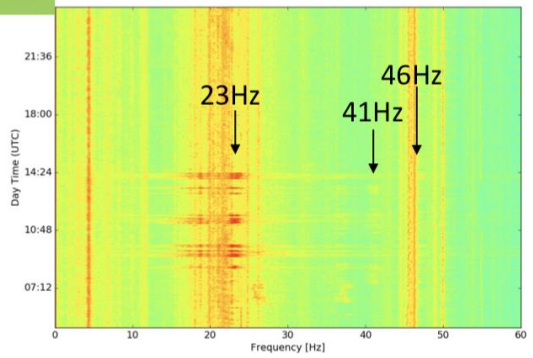


Fill 6919 (July)



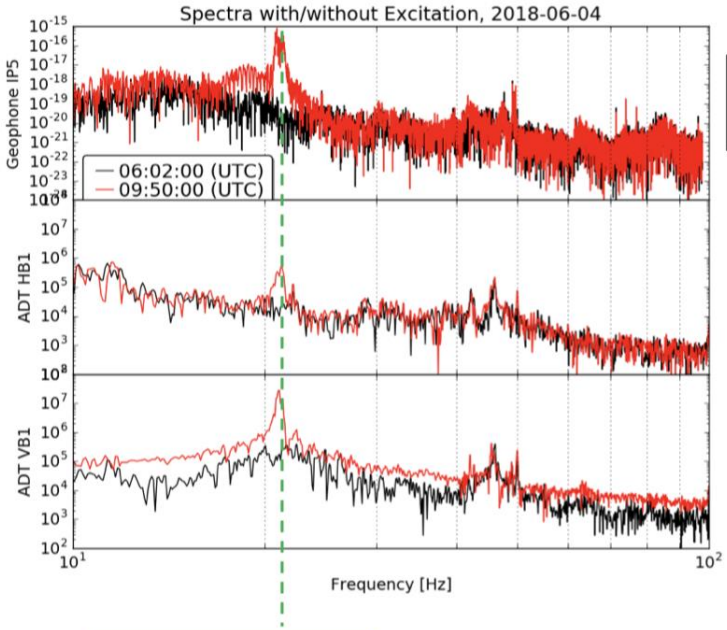
ADT B1V





Fill 6757 (June)

Clear correlation between GM and ADT spectra



Reference at 8:00 (local)
Spectrum for highest loss spike

ADT vertical plane baseline excitation.

Ground excitation at ~**21Hz** causes beam excitation

M. Schaumann, LMC - 15 Aug 2018

- Explore the possibility to perform ground motion measurements closer to the beam line or even on top of the magnets

  - Ongoing, but not favored by ground motion measurements team
  - Information on cryostat movement not really relevant
  - Main reason could be the detection of technical noise. However this makes sense only in realistic conditions (but without beam).
    Possible before beam at the end of LS2?

- Explore the possibility to perform transfer function measurements on an existing LHC dipole. > Planned (see previous slides).

Other actions - questions

- Vibrations of the beam screen:
  - no problem expected at high frequency since eigen frequencies are in the lower range. Main issue only if beam screen vibrates at tune frequency, 3 kHz and harmonics
  - Eigen frequencies of beam screen (13 Hz for Q1-type, 20 Hz for Q2-type) should in principle give negligible impact on field stability.
  - Still, some follow-up on vibration at these “intermediate” frequencies – evaluate maximum amplitude in resonant conditions (at 20 Hz beam screen “drags” about 10% of magnetic field).

- How far from dump threshold we would be for the expected vibrations in HL-LHC taking into account the higher beam current?
  - In principle the threshold will be scaled from the present situation with beam current – no big difference expected wrt LHC (Stefano confirms?)