Interim summary of the 28/04/2015 meeting on the advancement of the studies concerning the possible impact of HL-LHC civil engineering works on the LHC Run III exploitation And preliminary results of TTt1-TAG41 measurements

G. Arduini, P. Fessia

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Agenda

- Conveners: G. Arduini, P. Fessia
- Participants: G. Arduni, K. Artoos, I. Bejar Alonso, J.P. Corso, C. Cook, B. Delille,B. Di Girolamo, P. Fessia, M. Fitterer, M. Guinchard, S. Janssens, L. Lancy, H. Menaud Durand, M. Manfredi, J. Osborne, L. Scibile, J. Wenninger.

CE Induced Vibration on the LHC

Tuesday 28 April 2015

HL-LHC civil engineering recall - Salle conference BE (08:45-08:50)
- Presenters: FESSIA, Paolo

discussion - Salle conference BE (08:50-08:55)

HL-LHC CE detail planning - Salle conference BE (08:55-09:10)
- Presenters: OSBORNE, John Andrew

discussion - Salle conference BE (09:10-09:15)

vibration source: summary of data - Salle conference BE (09:15-09:30)
- Presenters: OSBORNE, John Andrew

discussion - Salle conference BE (09:30-09:40)

LHC limits - Salle conference BE (09:40-10:00)
- Presenters: FITTERER, Miriam

discussion - Salle conference BE (10:00-10:10)

orbit feed back - Salle conference BE (10:10-10:25)
- Presenters: Dr. WENNINGER, Jorg

discussion - Salle conference BE (10:25-10:30)

coffee break - Salle conference BE (10:30-10:45)

review of measurements around the world - Salle conference BE (10:45-11:00)
- Presenters: GUINCHARD, Michael

discussion - Salle conference BE (11:00-11:05)

possible other hardware tests - Salle conference BE (11:05-11:10)
- Presenters: FESSIA, Paolo

discussion - Salle conference BE (11:10-11:15)

SM18 tests results and next tests program - Salle conference BE (11:15-11:35)
- Presenters: GUINCHARD, Michael

discussion - Salle conference BE (11:35-11:45)

operation measurements and MD - Salle conference BE (11:45-11:55)
- Presenters: FITTERER, Miriam

discussion - Salle conference BE (11:55-12:05)

CLIC experience and possible stabilization of LHC triplet in the 1-100 Hz regime - Salle conference BE (12:05-12:20)

discussion - Salle conference BE (12:20-12:25)

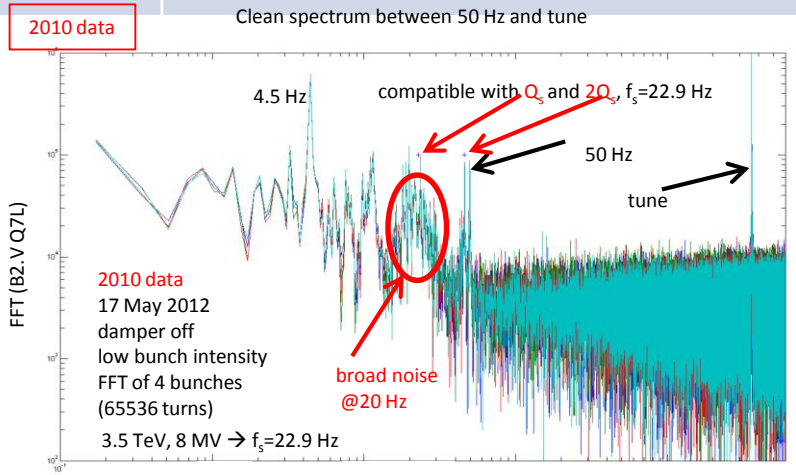
conclusions - Salle conference BE (12:25-12:45)

Summary I

talk	conclusions	actions
P. Fessia HL-LHC CE recall	NA	NA
J. Osborne CE engineering planning	• Condensed planning offer a challenging possibility to get into LS2 window	• Revise planning to take into account possible LS2 shift and elongation • Indicate in the planning the type and position of the vibration source as a function of time • Revise PT5 underground options for simplification • Extend evaluation to other system as concreting pump defining the place where it will be installed
J. Osborne Vibration source term	• Estimated value at 45 m from source displacement of 0.6 µm • Spectra from few Hz to 200 Hz, peak 30-100 Hz	• Clarify the definition of the quantities describing the noise spectrum at the source. A discussion of MME team with ARUP consultant needs to be organized

Summary II

talk	conclusions	actions
M. Fitterer LHC limits	• The worst case scenarios of alternated or side alternated IT movement are in reality the most probable. In this case 1 µm displacement in the triplet translates into between 20 and 340 µm displacement at the collimators. Probably more then 100 µm. High loss spikes were observed in 2012 for orbit excursions larger than 40 µm at the primary collimators. • A fast orbit feedback system using normal conducting magnets close to D1 and D2 could be envisaged and the magnet specifications look reasonable • Available spectra of turn-by-turn oscillation measurements (from the LHC damper – ADT - pick-ups) show already spectrum peaks at 8 and 20 Hz compatible with triplet resonances measured at SM18 (similar to SSS ones). This could be amplification of the cultur (factor 100 amplification at 20 Hz)	• Perform new measurements of the turn-by-turn beam oscillation during the squeeze in the next weeks during commissioning



Summary III

talk	conclusions	actions
J. Wenninger Orbit feed back system	• The present feed back system cannot cope with oscillations in the frequency range up to 100-200 Hz. A new one should be conceived and installed only for this use (no use for LHC exploitation). A FB loop operating at ~1 kHz requiring: ✓ A new kHz BPM acquisition system for ~ 50 BPMs, ✓ Possibly a dedicated Gigabit/Fast Ethernet network, ✓ A new kHz FGC/PC control system (radiation tolerance !), ✓ Adequate magnets and PCs. • We cannot rely on this as only defence line: it could be fall back system in case of delays or unknowns	• Perform a first evolution of what we need as hardware and resources. If needed we should start now development. The result of that could be important also for the development of a fast orbit feedback for HL-LHC in case no means is found to minimize the amplification of the ground vibrations by the new triplet structure

Summary IV

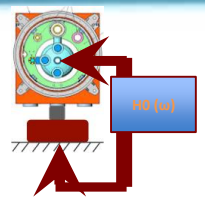
talk	conclusions	actions
L. Lancy Review of measurement around the world	• Interesting data no major impact. They can be used to cross check data from ARUP	
P. Fessia Possible other hardware tests	• TAG 41 and TT41 best option	Measurements organised on the 5th of May
M. Guinchard SM18 results and next test program	• Triplet cryostated CMs amplify vibrations of a factor 1 to 100 • With these transfer functions the present triplet during operation should already be vibrating at low frequencies (up to ~20 Hz) with amplitudes of 0.1 µm • Proposed measurement plan in TT41 TAG41 (next week) is satisfactory and should also provide information on the length of oscillation coherency	

Summary V

talk	conclusions	actions
M. Fitterer Possible measurement during operation and MDs	• Two MD requests (low frequency noise effect , high frequency noise effect). Measurement of the IT eigen-values during squeeze with the ADT observation system	• Go ahead with proposed measurement and MD proposals
S. Janssens CLIC experience and active stabilisation	• Present CLIC technology not applicable • Commercial solution would require disassembling of the whole triplet, floor excavation and use of 10 or more stabilisation feet for each cryostated cold mass installed under a support plate that will be the “new floor”. The system is not radiation hard and its interlocking with the rest of the machine and powering with UPS shall be studied and enforced	

Results about H0 (ω)

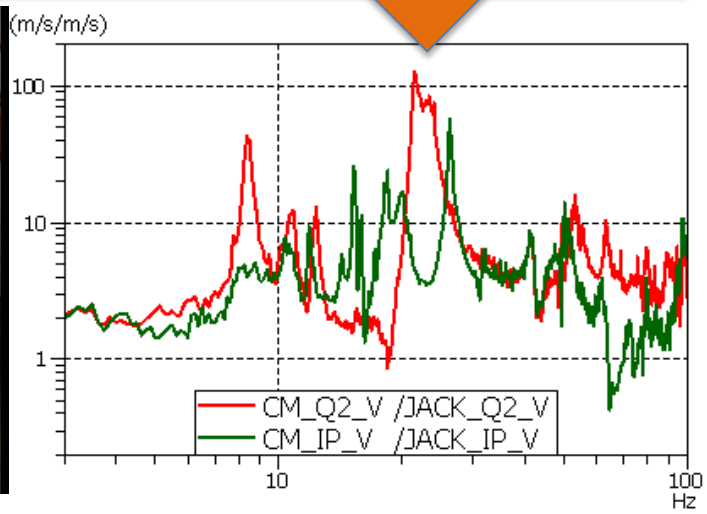
Courtesy M. Guinchard,
Lukasz Jerzy Lacny

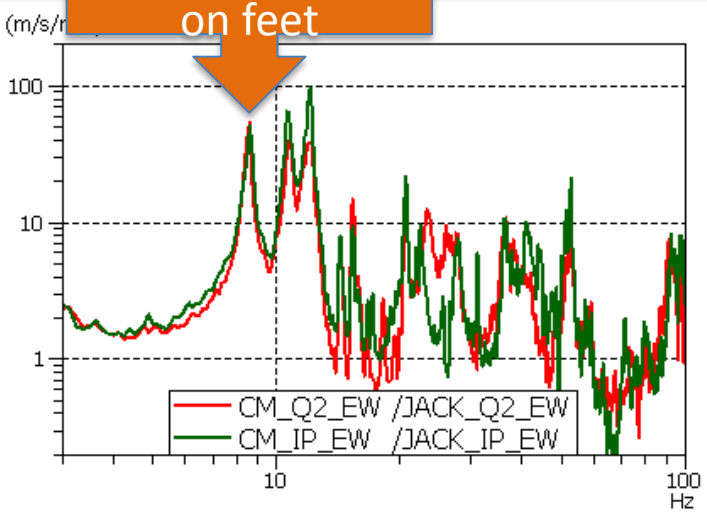


24 Hz
First bending mode

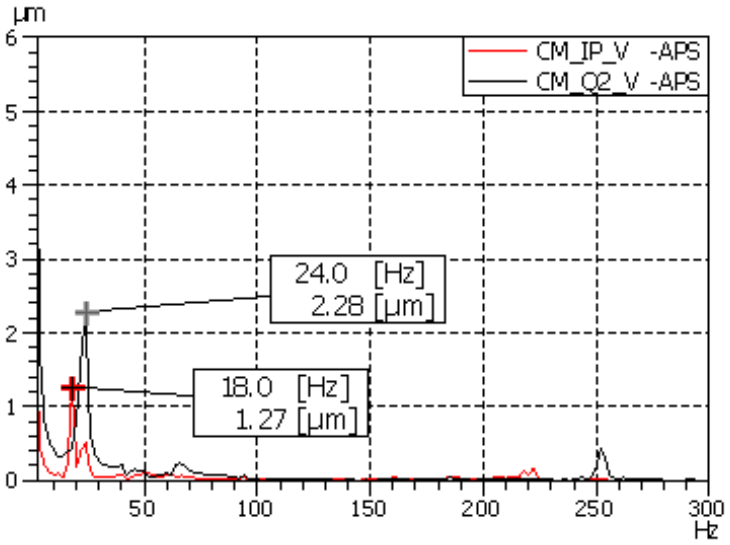
8Hz
Rigid movement on feet

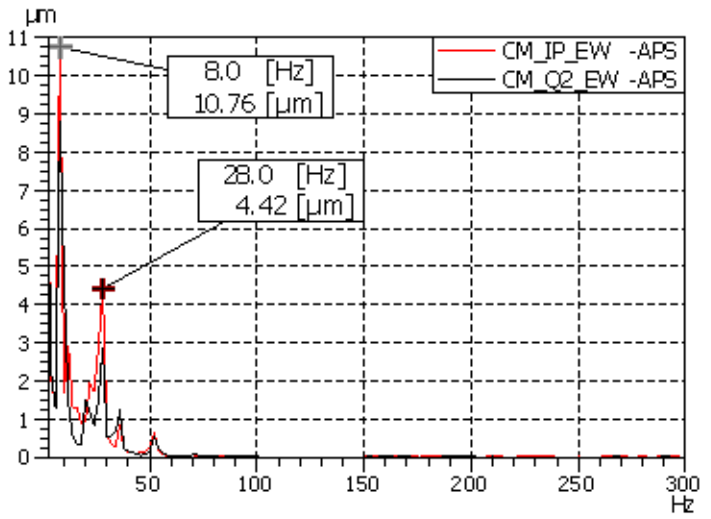
Ampl. factor with CE act,



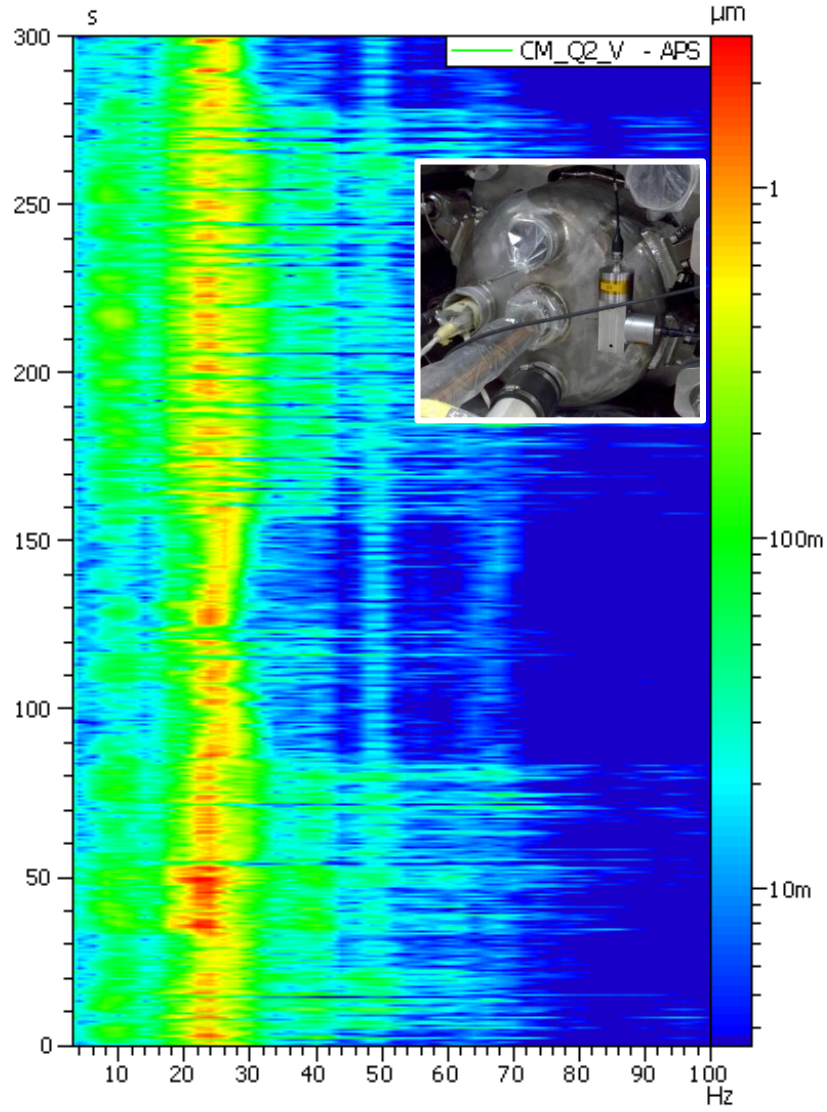


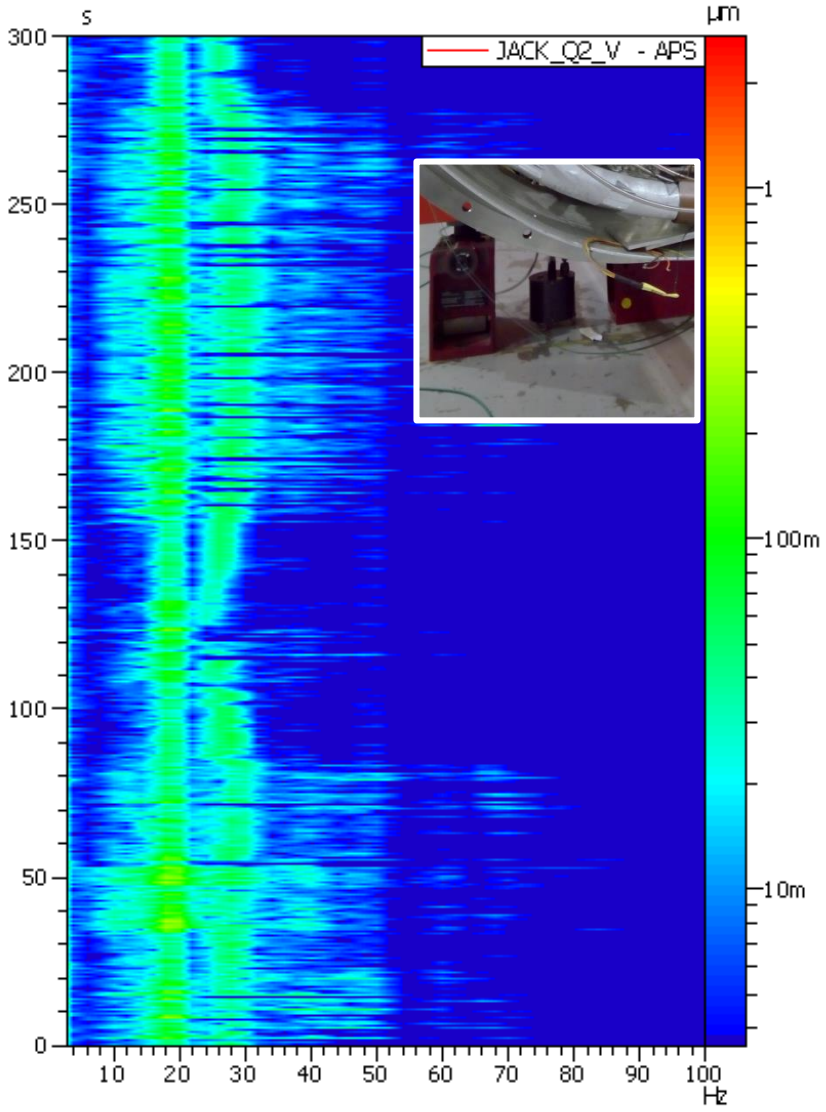
Displace ment with hammer impact





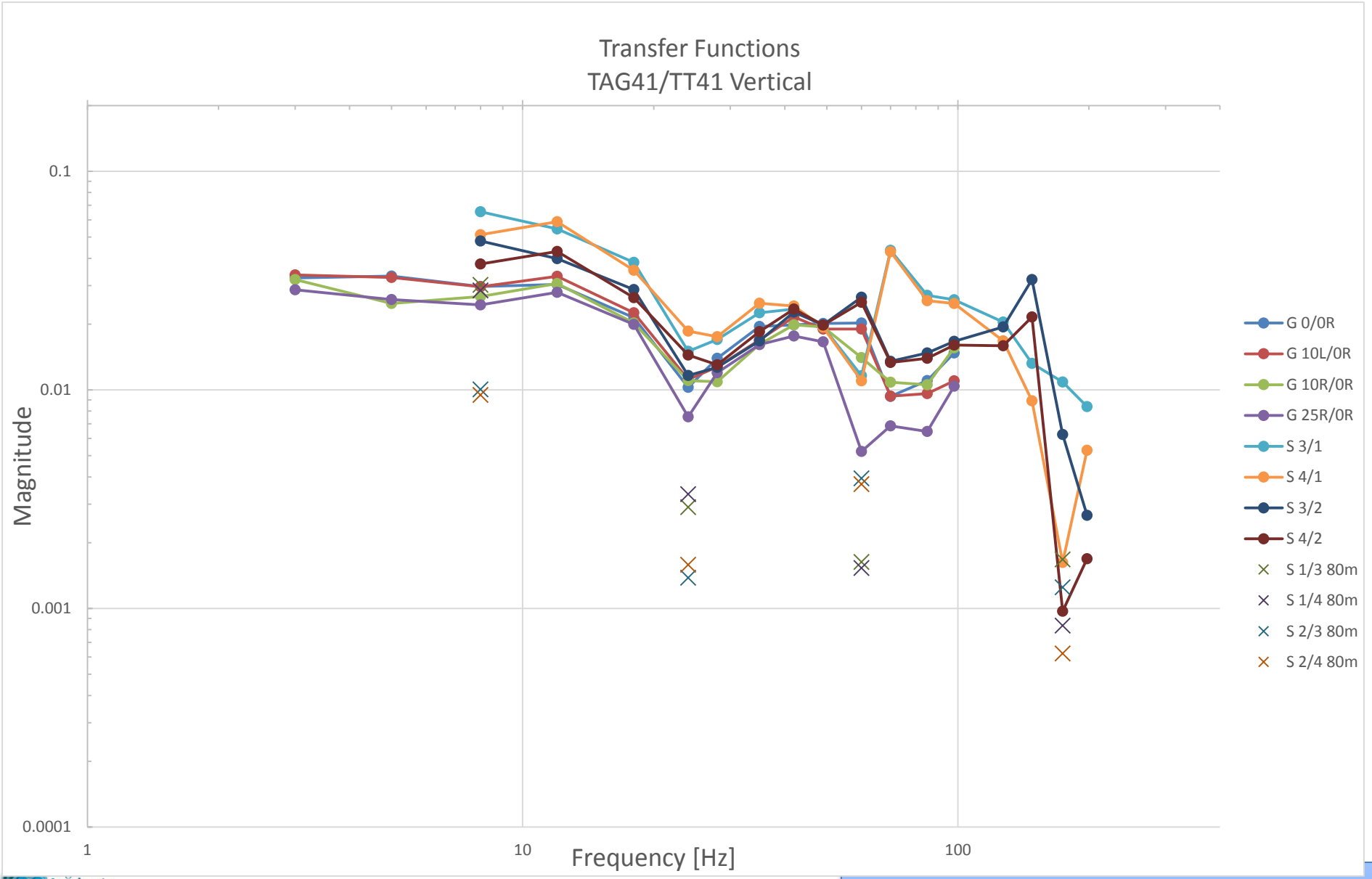
Results about vibration level during operation



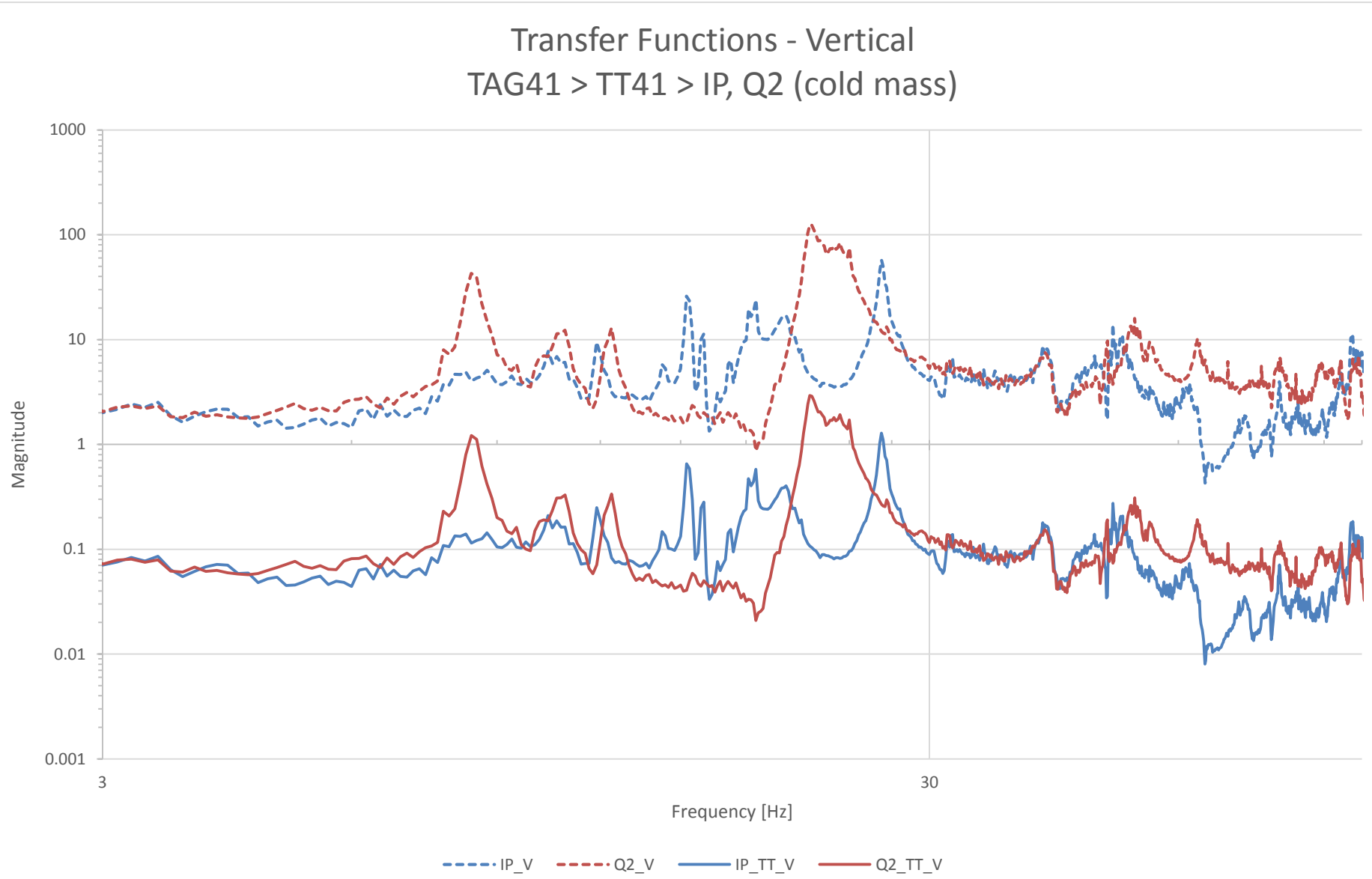


High Luminosity LHC

Courtesy M. Guinchard,
Lukasz Jerzy Lacny



Courtesy M. Guinchard, Lukasz Jerzy Lacny



Courtesy M. Guinchard, Lukasz Jerzy Lacny

HAGERBACH TEST GALLERY

Flums, Switzerland

The tunnel network currently consists of numerous galleries, caverns, testing areas, laboratories, training facilities as well as essential infrastructure such as electricity, ventilation, workshops, canteen and much more over a total length of more than 5 km. Tunnel cross-sections reach 130m2 in varying geologic formations.

AMBERG ENGINEERING

HL-LHC consequences

- The future Hl-LHC triplet shall be designed in such a way to dump the excitation coming from the ground motion.
- ACTION: WP3 take this aspect into account for the design of the Cold mass support, the cryostat and the cryostat support
- According to result coming from WP3 analysis an intervention on the tunnel floor in order to make it “vibration absorbing” could be studied and implemented but with non negligible impact on LS3 schedule

Conclusions

- Presently we do not see any margin to perform CE engineering work during operation (we need factor 10 and probably we see already signature today of the cultural noise)
- A fast feed back system (that is not required for LHC machine operation) can be developed but it can only be a fall back mitigation plan in case of delays. Such a system could be useful for HL-LHC if no mean is found to damp the HL-LHC triplet vibrations
- Vibration studies will go on for better quantification but…
- … today the only viable way is to perform work out of beam profiting of delayed LS2 and its extension