8th Meeting of the HL-LHC Technical Coordination Committee

Participants: C.Adorisio, A.Apollonio, A.Ballarino, M.Barnes, D.Berkowitz, L.Bottura, C.Bracco, R.Bruce, O.Bruning (Chair), O.Capatina, S.Claudet, B.DiGirolamo, R.DeMaria, P.Fessia, R.Jones, R.Kersevan E.Metral, Y.Papaphilippou, V.Parma, L.Rossi, F.Sanchez Galan, L.Tavian, R.Tomas, D.Wollmann, M.Zerlauth.

Excused: G.Arduini, M.Pace

The slides of all presentations can be found on the website and Indico pages of the TCC.

O.Brüning introduced the meeting by mentioning that there will be a change in the agenda, as A.Ballarino requested postponing her presentation in order to have more time for discussing with cryogenics. O.Brüning also added that I.Bejar Alonso would report on the ECR approval process in one of the next meetings. The ECRs concerned are for the temperature of Q6, the new baseline for electrical circuits and the temperature of the beam screen. M.Zerlauth reported that F.Mateos Rodriquez submitted the ECR for the electrical circuits, but the document was not yet circulated in EDMS and is hence not yet approved. L.Rossi mentioned that there should be a debriefing of the circuit review, before finalizing the approval. S.Claudet asked if there is any possibility to have some highlights from the LARP meeting. O.Brüning proposed to have a round table at the end of the meeting.

O.Brüning introduced the meeting asking whether there are any further comments to the minutes of the 7th TCC, apart the ones already implemented. L.Rossi wanted to congratulate A.Apollonio and the TCC team for the quality of the minutes.

O.Brüning reviewed the list of actions from the last meeting: An update on the chosen Q1-to-Q2a BPM configuration should be given in mid-June. F.Cerutti should come back to one of the next HL-TCC meetings to present the expected radiation dose on the BPMs, with the goal to finalize the BPM design by September. F. Rodriguez Mateos will come back to one of the next TCCs with a proposal for the protection of MCBXF correctors (Energy Extraction or Quench Heaters). V.Baglin should come back with a proposal for the optimal temperature window for the beam screen. A proposal for installation of BLMs or even diamond ones at COLDEX, next to the crab cavities (CCs) should be prepared by G.Vandoni. R.Jones stated that this is under way and it seems that classical BLMs can be sufficient.

L.Rossi wanted to make two announcements. He first announced a very sad event: Catherine Magnier, one of the first persons who worked on integration for HL-LHC, passed away two days ago. Condolences were sent to the family on behalf of the whole project. L.Rossi then proceeded to another important announcement about the internal review with L.Tavian of WP17, corresponding to all Technical infrastructure (TI), including Civil

Engineering (CE). A.Ball was the chairman of the review committee. The review revealed that there is a substantial increase of the cost. He reminded that in two weeks the council will provide a formal approval of the total budget, including the budgets of 2015 and 2016: it is therefore no longer, as in the past, an approval in the frame of the 5-year plan, but a new global approval of the HL-LHC Cost-to-Completion. Therefore, it will be difficult to accommodate any extra cost. It is indeed the time to review inside the project, if there are areas where cost cuts can be applied without too much impact on the HL-LHC scope and performance reach, in a top-down approach. Tough decisions may have to be taken and there is very little time available. The natural area to start will be CE, i.e. all WPs whose reduction can entail a reduction of CE demands. At the same time, all WP coordinators and group leaders will be contacted for reviewing cost. At a 2nd stage meetings with more WPs will be arranged. More news will be given in a special TCC on June 23rd. O.Brüning proceeded by introducing today's agenda and AOBs.

Follow-up of the TAXS integration, F.Sanchez Galan– slides

F. Sanchez Galan presented an update on the TAXS integration following the work done in WP8. First, he recalls the current layout. For the LHC, within the tunnel and experimental cavern, there is a region of 1.3 m length between the Q1 and TAS with a warm BPM, two vacuum valves, bellows, bake-out equipment, He tightness dome and Z-stops. This is a very tight area and it is quite difficult to access, thereby interventions need to be improved following the ALARA principle. The only advantageous point is that this area is a static environment. The idea for HL-LHC was to change the equipment to enable its moving towards the experimental side, supporting the structure to be lifted remotely. Although the radiation is higher, the area is larger and enables the necessary remote handling. On the other hand, this area is not static and interventions are driven by experiments' planning. Another challenge is that, when the ATLAS detector opens, the assembly has to enter inside the detector. This necessitates some machining and modifications of some of the forward shielding structures which will not affect the overall shielding performance. The main problem is that the BPM is at the limit of available space and it would be desirable to gain length in that area.

Additional considerations have been taken for routing out the services that run inside the tunnel. There are two possibilities currently: First, it is considered to take the services out to the external part and direct them to ATLAS, towards the modules. This is the preferred solution but there is an on-going negotiation with ATLAS, as some machine shielding is necessary and this work has to be done in LS2. O.Brüning asks if the machining can have an impact on radiation protection (RP). F.Sanchez Galan answers that this is not an RP issue but If the machining is not done, the clearance when opening the detector would be reduced (now is 60 mm), which is not easily acceptable by ATLAS. The other option is to pull services inside the TAS region but this is inconvenient for access. O.Brüning asks of what is the time-scale for converging on this. F.Sanchez Galan answers that this should be done by the end of the year and it is indeed quite ambitious. P.Fessia adds that we need to understand if it is necessary to maintain the BPM in this region. We need to shorten the Q1 area by 180 mm and this analysis will be done within the next few weeks. O.Brüning stresses that it is

desirable to have an updated layout by November, just before the next HL-LHC meeting in Paris. F.Sanchez Galan replies that the final decision for the BPM needs to be taken by September.

He proceeds then to the description of the CMS forward area, where the shielding is different. It opens and releases access to a structure that will be modified to put equipment inside and there seems to be fewer constraints. The modifications to be done involve the machining of the fixed nose's top plug, removal of chicanes and changing of the vacuum chamber support. The work has already started in collaboration with TE-VSC, as this support had to be changed anyhow and the works can be performed during LS2.

An overview of the expected radiation dose is further given. The residual dose until HL-LHC depends on the operational scenario and cooling time and it can be increased by a factor of 15 to 30 (and an extra 30-50 % for the ultimate scenario). For LS3, there is a factor of 3 higher doses in the experiment as compared to the machine side. The latest simulations show that the irradiation affects the surrounding structures in CMS and increases the radiation by a factor of 2. This is still acceptable though for CMS.

F.Sanchez Galan proceeds by describing the ATLAS TAS alignment concept. The TAS is inside the shielding and the survey targets and alignment points are outside. This is very inefficient (installation of targets takes 80% of intervention time) but after reviewing the history of LHC operations since the installation, the TAS was adjusted only twice for both sides. The question raised is whether it is worth to install motorization. O.Brüning asks what is the tendency of the movement. B.DiGirolamo answers that ATLAS moves upwards. F.Sanchez Galan stresses that a continuous alignment precision of 0.5 mm is needed. For CMS, the situation is much better, as they have fixed targets, so there is no dose involved for measurements. The history of measurements in CMS shows that there was not any re-alignment needed, since installation. The proposal used as baseline for HL-LHC is to include electrical motors, although there are still questions about the necessity. O.Brüning mentions that the alignment for triplets worked well, even if it was done only for the first time this year, i.e. 8 years after installation, so this option should be considered. F.Sanchez Galan adds that indeed 80 % of the time could be gained if the survey is done remotely.

He continued by recalling the space constraints with respect to the current situation. For HL-LHC, Q1 moves towards the TAS and there is no space. Right now there are only 550 mm (containing Helium link, bellows, double pump and quick connector) and the remote operation needs space. The CATIA installation and removal scenarios have to be finalized. The integration on paper looks ok but it is still under final development. A series of next steps has to be followed, including the choice of companies for shielding modifications, the survey proposal, the TAXS remote alignment, the BPM position supports and Q1-TAXS regions. A review meeting will be scheduled by the end of this year.

In conclusion, there was a lot of progress as there is a very good collaboration with the experiments. The shielding modifications could be advanced in LS2, as also preferred by them. For these modifications, there is also close contact with the vacuum team. The integration looks feasible, but there are lot of issues to follow-up. In particular, the decision about the BPM has a lot of implications. Finally, F.Sanchez Galan stresses that the Q1-TAS

area remains the most difficult access area in the accelerators, as there is new equipment and less space.

Discussion

O.Brüning, asks whether the review is synchronized with the HL-LHC meeting in November and the updated layout. F.Sanchez Galan replies that the review can be called as soon as the BPM issue is resolved. P.Fessia stresses that the new layout version cannot include this, as the production of drawings is a lengthy process and the work has to start in July, in order for any change to be included. In conclusion, a decision can be made but without updated drawings. A meeting with WP2 needs to be organized in order to address the new position of the BPM at cold, which may relax the static and dynamic alignment. On the other hand, it is essential that the BPM is not vibrating due to pumps, etc. The BPM is essential for WP2 as it provides redundancy for alignment.

L.Rossi asks if by advancing the changes to LS2, there is an increase in the expenditure profile during that period. This point may need to be checked with B.Delille. F.Sanchez Galan answers that the costs were already integrated but some refinement may be necessary.

R.Jones asks what would be an approximate length reduction of the BPM that could become useful. F.Sanchez Galan replies that ATLAS does not feel comfortable with the current clearance, so any reduction would be useful. R.Jones mentions that one cm reduction may be feasible. M.Zerlauth asks whether bellows are needed between each element, or whether the whole assembly cannot be removed in case of need. F.Sanchez Galan replies that bellows are needed for the removal of modules. Gate valves need to stay in place when changing the central module containing VAX and BPM, and the bellows closer to BPM are included by vacuum, for dynamic stability and to reduce the vibration effect of the pumps to the BPM. M.Zerlauth suggests noting this in the minutes for getting feedback from TE-VSC. This topic should be addressed during a future TCC, including the whole BPM integration topic.

ACTION: TE-VSC should comment on the necessity of bellows for each element in the Q1-TAXS area during the future discussion for the BPM integration.

Proposal for update of HL-LHC parameters for bunch length and momentum spread, R.Tomas – slides

R.Tomas gives a quick update of parameters triggered by the change of transition γ, due to the ATS optics. This impacts the bunch length and momentum spread but it has small implication in the overall performance. The numbers in black remain identical and changes are marked with blue. The change in bunch length triggers a change in momentum spread making IBS slightly weaker. L.Rossi asks if these are rms values. R.Tomas answers positively. The Piwinski parameter is also slightly larger. The loss factors with and without crab cavities

are reduced, i.e. there is more loss, decreasing the virtual luminosity by around 20 %. The peak luminosity value, pile-up and pile-up densities are also reduced. The changes are quite small but need to be officialised. Finally, in the previous considerations, an inelastic cross section of 85 mb was used. This value is now updated to 81 mb, giving a total of 111 mb, as published recently by TOTEM. L.Rossi asks that the coordination group approves these changes. A. Apollonio will update also the table in the TCC web-space. M. Zerlauth asks if the BCMS scheme should be updated as well. O.Brüning replies that all of the different options currently in the table should be kept. R.Tomas adds that for BCMS the same brightness was considered, so all values should be identical.

AOB

A round table discussion on the recent LARP meeting at SLAC took place. O.Brüning mostly commented the accelerator physics part that he followed. An important point was the discussion on the wide-band feedback system. The project support is guaranteed until the end of 2016 and then it should be reviewed whether it is only interesting for the SPS or also for the HL-LHC. Regarding the deliverables by US-LARP, it was confirmed that HL-LHC is strongly requesting that the US CCs should be delivered in the cold box, as without it, the qualification tests may be superfluous. The hollow e-lens SC solenoid cost seems to be quite high. L.Rossi suggested enquiring European partners, while gun, collector and modulator could be a nice complement of the US deliverable, if there is budget. There was also a half-day meeting for the future of US-LARP. The idea is that LARP will continue until 2017 and then it will become a production project. G.Apollinari and colleagues will have to negotiate with DOE of how to continue the R&D part (which is LARP) beyond that period.

L.Rossi complements the information for the magnet progress. There was a discussion to include cryo-stating also for the delivered magnets, as this could alleviate the load in the CERN workshop. The US has to sign a protocol with CERN for in-kind contribution of up to 250 M$, however for the moment they foresee 200 M$ in their budget for HL-LHC. The profile has to be finalised. There is indeed a problem with the availability of engineers at FNAL to carry out certain type of work like cryo-mechanical design, for both cavities and magnets.

O.Brüning added that the HOM analysis for the CC revealed that apart from the 920 MHz mode, the modes seem less harmful than anticipated, as the most dangerous ones were damped. The noise studies also seem to point that the impact will be under control. L.Rossi added that a comment was already made by the MAC regarding the usefulness of the CC test in the SPS. Compelling motivations for the SPS test must be evidenced. Y.Papaphilippou mentioned that crabbing was never done in a proton beam. O.Brüning adds that the CC operation transparency is indeed an important point to qualify through the tests. E.Metral comments that even with this single mode, an octupole current of 100 A is needed to damp the instability, and it is known from the present LHC experience that high chromaticity and octupoles of 500 A are needed and indeed may have impact to lifetime.

For more detail, the full US-LARP meeting agenda can be found here.

The next TCC meeting will take place on the 16th of June.