181st Meeting of the Machine Protection Panel

The meeting took place on **September 27th 2019** in 774/1-079.
Participants: Chiara Bracco,   Mario Deile,   Dragoslav Lazic,   Anton Lechner,
Filip Moortgat, David Nisbet, Belen Salvachua, Raffaello Secondo, Matteo Solfaroli,
Jorg Wenninger, Daniel Wollmann, Christoph Wiesner, Markus Zerlauth.

The slides of all presentations can be found on the [website of the Machine Protection Panel](#) and on [Indico](#).

1.1 Minutes from the 177th MPP

No comments have been received for the Minutes from the last MPP related to LHC topics (177th MPP). There are four open actions from the meeting, which have been added to the MPP homepage.

1.2 New beta* reconstruction for Run 3 (J. Wenninger)

- The **beta* information** is provided by the SIS and distributed by the timing system via SMP. It is presently used for the collimator gap interlocks, for the calculation of the Stable Beams Flag and for the collimator BPM interlock of the SIS.
- The **current concept** to reconstruct the beta* uses two quadrupole Power Converters (PC) per IP such that the ratio of the PC currents provides a monotonous function of beta*. For each hypercycle, the table of beta* versus PC-current ratio and the associated PC names are saved as critical setting by the SIS.
- For the telescopic part of the squeeze, the concept had to be extended using additional tables. However, **for the flat optics no practical solution was found**.
- Therefore, a **new beta* reconstruction method is required for Run 3**. The following approach is proposed:
  - Select two representative PCs for a given IP and normalize the PC current by the beam energy or by the dipole current: $R_i = I_{Qi}/I_{MB}$.
  - Calculate the squeeze path in R_i space.
  - Determine the closest distance from the measured R_i values to the calculated squeeze path and find the corresponding beta* value.
  - For the interpolation between two beta* values, a brute-force approach is proposed that adds sufficient points between the beta* values and finds the point closest to the measured value. A beta* resolution between 2 mm and 4 mm is desired.
- It was possible to **identify suitable PCs** that fit all optics configurations, including the ATS flat optics. However, the choice of PCs might be adapted for the final setup.
- The present and the new method were compared by reconstructing the beta* from the logged PC currents. The **new method could cope with all current optics configurations**, including the ATS flat optics, which didn't work with the present method.

- Therefore, the proposal is to **implement the new method as future beta* reconstruction method**. The LHC state tracker publication of the beta* should be kept as backup for future optics configurations where the new method might fail in reconstructing the beta*.
- Markus asked if the present **strategy of minimum and maximum values** enforced within the SMP for the beta* are still adequate for Run 3 or whether they should be revised. Jorg commented that these windows were initially set to very tight values, but are now opened up significantly. Action (Raffaello/MPE-MI, Jorg/OP): Clarify the current settings of the SMP min/max beta* values.
- Markus asked if the **granularity of centimetres** for the beta* values is still sufficient for the SMP. Jorg confirmed that this should be the case. However, one could use the LHC state tracker to publish more accurate values for the Logging Database, while the SMP sends the rounded values.
- Daniel asked how to **switch between the new beta* reconstruction method and the state tracker**, if required. Jorg replied that in this case the values from the new method would simply be ignored and the SIS would directly forward to the SMP the value from the state tracker. However, this should only be relevant for very exotic configurations.
- There was **consensus that the new beta* reconstruction method should be implemented for Run 3**.

1.3 Update of MPP and rMPP membership lists (C. Wiesner)

- Christoph presented the proposed **updates of the MPP and rMPP membership** (see slides). No major changes have been required. However, several members that moved to new functions have been replaced or removed, while new members have been added from the Injectors, for Timing/Controls, for Vacuum, and from EN-SMM.
- There were no comments or additional proposals regarding the MPP and rMPP members. Action (all): All groups and teams should verify their proposed rMPP/MPP representative and inform Christoph and/or Daniel if they have comments.
- Roderik suggested to add a list of **alternate members for the rMPP**. Action (Christoph, Markus): Formalize the list of alternate members for the rMPP and update e-groups and slides on Indico.

1.4 Follow-ups from MPP workshop (D. Wollmann)

- Daniel summarized the list of **follow-up actions from the MPP workshop in May 2019**. The list was extracted from the presentations, discussions and executive session summaries. It should be seen as a proposal and all groups and teams are asked to provide feedback. The follow-ups will then be scheduled for upcoming MPP meetings. Action (MPP): Add follow-up list to MPP website and schedule MPP meetings on the different topics.
- All protection-relevant actions from the workshop have been **classified into three different categories**:
    - 1) Decision mandatory before restart after LS2

- o 2) Necessary for luminosity production
- o 3) Beneficial for long term operation
- The following actions were discussed in more detail.
- *"Define minimal acceptable phase advance values MKD-TCT & MKD-TCDQ"*.
  - o Roderik remarked that the study of the acceptable MKD-TCT phase is finished and the value should remain at 30 degrees. Chiara agreed and added that the acceptable MKD-TCDQ phase advance is presently defined as 90 degrees plus/minus 4 degrees. Roderik complemented that a potential new optics with larger phase advance of 110 degrees would increase the losses in IR7, especially on some of the TCLAs. This is presently under study and will soon be discussed in the Collimation Working Group. Chiara warned not to increase the risk for downstream elements in order to protect the TCDQ. She reminded that the main identified risk for the TCDQ are Type-2 MKD erratics, which have a low probability, which will further decrease with the ongoing MKD upgrades.
- *"Define strategy for TCDQ/TCT/XRP position thresholds and redundant limits (BETS, beta* & energy limits) and movements during collide and squeeze with beta* levelling"*.
  - o Replying to a question from Daniel, Chiara summarized that asymmetric BETS limits are presently not possible, but an artificial offset between the BETS settings and the LVDTs can be envisaged.
  - o Daniel asked how the existing method for the change of the TCT position thresholds can be used for the larger range of beta* values. Roderik replied that the details are under study but that the new method would be based on the same approach of using discrete steps for the thresholds. Daniel suggested to present the planned implementation in the MPP when available.
- *"Define/clarify damage limits of all concerned accelerator materials for asynchronous beam dump case"*
  - o Chiara mentioned that the studies for the TCDQ, dump and dump windows are ongoing. Roderik added that the damage limits for the magnets and the beam screens are not well known. Anton remarked that nevertheless the expected energy deposition for these elements should be well below the damage limits.
  - o Anton suggested to add the injection failure case to the list since the load on the TDI during an injection failure can be higher than the load on the TCDQ during an asynchronous beam dump.
- *"DOROS BPMs for collimators in IR7: Define how many DOROS systems for Collimator BPMs require interlocking in Run3 (+ tolerances)"*
  - o Belen stressed that it should soon be defined if the DOROS BPMs are required for interlocking in IR7. Roderik replied that these interlocks are not machine critical unlike the ones in IR6 and at the TCTs. Daniel underlined that if an interlock is implemented, it should be redundant. Anton reminded that the beam losses in IR7 are sensitive to orbit shifts as observed for the 10 Hz and 16L2 events, where we dumped on losses of 1e9 protons.
- *"BLM thresholds: ensure coherence between BLM thresholds and BCM thresholds"*

- o Anton commented that this topic will be discussed in the BLM Threshold Working Group. Markus reminded that the increased intensity from the injectors during Run 3 may have implications for the injection loss levels in Alice and LHCb. It was agreed that the topic would be moved from Category 1 to Category 2.
- *LHCb velo*
  - o Jorg reported that the option of going to Stable Beams at 450 GeV and then closing the velo has been recently discussed. However, this implies that the velo would be positioned close to the beam at around 8 sigma. Therefore, the feasibility of this option has to be carefully evaluated, and should be added to the list of follow-up actions.
- *"Evaluate the need for a bunch intensity interlock"*
  - o Chiara reminded that the main elements that would be protected by such an interlock are the upstream dump window and the TCDQ.
- *"dBLM: Define, which dBLM data are required in the post mortem & implement"*
  - o Answering a question from Belen, Daniel stressed that the required dBLM data depends on the use case (e.g. injection losses). Belen proposed that BI will trigger a discussion on the different use cases and collect the requirements.
- *"BLM thresholds: Update threshold models for collimators"*
  - o Roderik commented that this topic should be on the Category 3 list, not on the Category 2 list because it is not required for luminosity production but a nice-to-have feature. Daniel reminded that new Molybdenum-Graphite collimators would be installed in LS2. Anton emphasized that significant changes should not be implemented during a run, but during the shutdown period. It was agreed to split the action into two sub-actions: *"Update threshold models for Molybdenum-Graphite collimators"*, which will stay in Category 2 and *"Update threshold models for present collimators"*, which will be moved to Category 3.
- *"BLM thresholds: Evaluate if the operational use of LICs in IR7 will allow to remove bottleneck in short running sums due to the 23 Gy/s limit of the BLMs"*
  - o Belen commented that the LIC response has to be studied in more detail to understand deviations from the linear behaviour. Anton stressed that a unique and well defined response for all LICs is required for operational interlocking. It was agreed that the BLM Threshold Working Group comes back to the MPP before the end of the year with a wish list of changes.
- *"TDE: Study possibility of increased beam size at upstream window and consequences for operation, MDs and possibly required interlocks"*
  - o Anton commented that preliminary results indicate that the averaged horizontal and vertical beta function at the TDE can be increased from 4.5 km to 5.5 km, which might however not be sufficient to mitigate the higher load on the upstream dump window.
- *"Define wish list priorities for collimation software upgrades with OP (gen. of collimator settings in LSA, revised temperature interlocks disabling, ramp functions for crystals, …)"*
  - o Roderik proposed that this topic should be moved from Category 2 to Category 3 because it is rather a nice-to-have feature. Daniel replied that

the disabling strategy for the collimator temperature interlocks was already discussed in the MPP and should be clearly defined before going to luminosity production. It was agreed to split the topic into the following sub-actions: a) *"Implement revised automatic temperature interlock disabling in collimators"*, b) *"Evaluate the need to implement ramp functions for crystal collimators"*, which will both remain in Category 2, and c) *"Define wish list priorities for collimation software upgrades with OP (e.g. gen. of collimator settings in LSA, ...)"*, which will be moved to Category 3.

- *"Update emergency procedure for non-working beam dump, verify steps and train OP teams"*
  - o Jorg reminded that the procedure has to be reviewed again and that the OP teams have to be trained after the restart.

1.5 Open Actions

The actions from the meeting are:
- Action (Raffaello/MPE-MI, Jorg/OP): Clarify the current settings of the SMP min/max beta* values.
- Action (all): All groups and teams should verify their proposed rMPP/MPP representative and inform Christoph and/or Daniel if they have comments.
- Action (Christoph, Markus): Formalize the list of alternate members for the rMPP and update e-groups and slides on Indico.
- Action (MPP): Add follow-up list to MPP website and schedule MPP meetings on the different topics.