Minutes of the 40th WP2 Task Leader Meeting held on 20/2/2015


Minutes, Follow-up of Actions, General Information (Gianluigi)

Minutes were approved without comments.

Draft for the program of the USLARP meeting has been discussed and the preliminary list of participants is under approval. On Wednesday after the LARP meeting, a Task Leader Meeting will take place with one of the subjects the organization for the preparation of the WP2 TDR contribution.

Gianluigi is finalizing a DRAFT of the last WP2 Hi-Lumi milestone report (MS32). He will circulate a draft for feedback from the task leaders this evening. **Action: Task Leaders.** By the end of May the last Hi-Lumi periodic report will have to be written.

From PLC:
During a presentation of the triplet interconnect design Cedric Garion mentioned a new design for the RF fingers. Gianluigi asked whether the impedance has been evaluated. Elias mentioned that measurements have been carried out *(https://indico.cern.ch/event/358583/contribution/2/material/slides/1.pdf)* showing that resonances are showing-up when the bellow is installed around, which is worrying for its possible use in the LHC. This will be followed up in the Task 2.4. Gianluigi suggested Elias to organize a summary of the measurements in a Task 2.4 meeting where vacuum people should be present.

HL-LHC and LHC MD requests have been collected and submitted for discussion and prioritization at future LHC Studies WG meetings on 3/3 and 24/3. At end of May, the approved MDs will be allocated for the first block in June.

Elias mentioned that an update on crab cavities impedance studies will be presented at a forthcoming Task 2.4 meeting.

Work is organized to study the impact on LHC operation of ground motion due to civil engineering work for the HL-LHC close to IP1 and IP5 and possible geothermal explorations in the Geneva Canton. A presentation will be given by M. Fitterer at the next meeting on the status of the study concerning the expected sensitivity to vibrations.

Gianluigi asked whether data on the impact on operation of civil engineering work in the vicinity of the Tevatron exist. Sasha will look into the available information. **Action: Sasha**

Next Technical Committee will be devoted to the Cost&Schedule review in which there will be no WP2 presentation. WP2 related resource requests have been transmitted.

Optics considerations for correct ability [R. Tomas]
Rogelio presented a preliminary analysis of the beta-beating corrections features of HL-LHC optics to formulate requirements for instrumentation (BPM, tune measurement) and power converters. The talk follows a first analysis (pdf) presented at 28th WP2 TL meeting.

From past experience, ATS optics at 20 cm in the LHC shows a factor 3 increase in random error and a factor 2 in systematic errors with respect to the nominal LHC optics at 60 cm.

The expected accuracy and precision of the measurement of the transfer functions of triplet (presently expected to be $10^{-3}$) would result in intolerable errors if directly plugged in the machine due to large value of $\beta$-functions at low $\beta^*$. It is then assumed that triplet $b2$ error can be reduced to $2 \times 10^{-3}$ thanks to local correction at larger $\beta^*$, however the correction from 10 to 2 units has not been demonstrated. The impact of global corrections has been estimated with Monte-Carlo methods. For this estimate measured $b2$ errors have used for existing dipoles, for the quadrupoles a set of RMS errors listed in the slides have been used, for the new HL-LHC dipoles the $b2$ values specified in the specifications tables (MBXAB v1_spec, MBRD v5_spec, MBH v1) have been used. Gianluigi and Massimo noted that the assumed values of the longitudinal misalignments of the quadrupoles might be underestimated and Massimo asked whether the longitudinal voluntary displacement of the quadrupoles to minimize the impact of the non-conformity of the PIMMS has been taken into account. The analysis shows that the uncorrected LHC optics at $\beta^*=60$ cm shows approximately a factor 2 to 3 smaller $\beta$-beating than HL-LHC at $\beta^*=15$ cm. This will reduce to a factor of approximately 1.5 after global correction.

The expected $\beta^*$ reconstruction for the HL-LHC ($\beta^*=15$ cm) after a local correction is worse than LHC and improved segment-by-segment correction techniques (to be tested during Run 2) are needed, furthermore errors as large as 10% or higher might remain if the $b2$ errors are larger than $2 \times 10^{-4}$. The above analysis does not use additional BPM amplitude data that could be gained by 1% linearity errors in the BPM (see previous talk).

The performance of the k-modulation (using Q1 only, Q2 and Q3 are less convenient due to $\beta_i/\beta_y$ imbalance) was presented showing that a tune measurement accuracy of few $10^{-3}$ (one order of magnitude higher than for the present LHC) is needed to determine $\beta^*$ with an accuracy below 20% in a range of 15 cm displacement of the waist. This has an impact on the requirements for triplet power converter in particular on ripple and resolution of the power converter. **Action: Task 2.2 to translate these constraints in requirements for the power converters.** The current of the quadrupole needs to be modulated at few Hz or lower frequencies. Sasha mentioned that frequency modulation is a good method for centering the orbit in a quadrupole. The main concern is quench protection. Sasha asked if detectors can provide the position of the waist. It was mentioned that the experiments can provide the longitudinal position of the luminous region with respect to their vertex detector.

Concerning $b2$ errors, M. Giovannozzi reminded the strong $b2$ components of D2 magnets and the potential mitigation of the impact of triplet transfer function errors offered by sorting. **Action Massimo: to check with Ezio if sorting strategies are possible.**

Thibaut asked to provide information concerning:

- Required accuracy of the triplet BPMs orbit measurement (the requirement on precision of 1.5 $\mu$m for keeping beam in collision and 30 $\mu$m accuracy for finding collisions has already been provided during the WP2 task leader meeting on 23/5).
- The need for an improvement of the performance of the BPMs in the arcs and he asked whether bunch-by-bunch orbit measurements in the arc are necessary
Action: Task 2.2 and in general Task Leaders

Report from Task Leaders:

- Task 2.2: an analysis of the time required to execute the squeeze has been carried out, an iteration on the powering options and corresponding specifications is on going
- Task 2.3: Dynamic aperture simulations are progressing for configurations with different chromaticity values and $\beta^*$, results are being studied.
- Task 2.4: Operational scenario for LOF positive and LOF negative, IP2/IP8 crossing angle, separation during the ramp are being studied. Elias reminded that a factor $\sim 1.2$-$1.3$ is currently obtained between beam-based (tune shift) impedance measurements and predictions, whereas a factor $\sim 4$ is obtained between the expected octupoles strength required to stabilize the single beam and the value used in operation $=>$ This still needs to be understood. C. Zannini is working on the effect of the aC coating of triplet beam screen on impedance. A new check of the stability limits with updated collimation settings is undergoing.

Reported by Riccardo and Gianluigi