Minutes of the 136th WP2 Meeting held on 04/12/2018

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AGENDA:

Agenda:1

1 GENERAL INFORMATION (G. ARDUINI)

2 UPDATE ON WP3 MAGNETS FIELD QUALITY (E. TODESCO)

Ezio presented a summary of past measurements for a discussion on whether an additional corrective action is needed. A particular concern is if any multipoles are off from their target value. It should be noted that the presented results are those of magnets at an early stage, not representative for production samples.

For MQFX, 5 short models and 1 prototype have been measured and the main concern is non-allowed multipoles. MQXFS6 has been measured only at room temperature. One correction is ongoing – an increase of b6 by 4 units. Up to 3-5 units have been also measured in a3 and b3 and shall be corrected by magnetic shimming.

For MBXF, 2 short models were measured, the main concern is b3, where 10 units have to be corrected, possibly by shaping the core. An attempt to correct b3 between MBXFS1 and MBXFS2 failed. At the moment, the b3 is expected to be around 15 units at 12 kA (when edge effects are included), while only 3 units are acceptable.

For MBRD, one short model has been measured without the iron. The main concern is the compensation of the two apertures, also the measurement is 15 units off from the expected value in b3. Measurements

with the iron are ongoing. Measurements of the skew components might have been affected by nearby magnets as no iron was present.

For MCBXF nested correctors, the b3 has to be checked: the nominal is -20 units, while +20 is measured. High order multipoles are small. A cold test has been requested.

For the Higher Order (HO) correctors, no issue has been detected.

For MCBRD, 2 short models and a prototype have been measured. The short models show -5 units of systematic b3 and the prototype with 2 apertures -10 units. For the actual device between -10 and -15 units of systematic b3 have to be corrected. All other multipoles are within limits.

In conclusion, **Ezio** noted that the results should be reported at a TCC by the end of January. By that time a cold measurement of the MCBXF and D2 with the yoke should be complete.

- **Gianluigi** inquired if the D2 has been tested at cold temperature to check the effect saturation. **Ezio** replied the plan for D2 is to be measured at room temperature, then to be moved to CERN. The saturation is a second order effect that will be measured at CERN.
- **Massimo** requested providing a synthetic table of error estimates to test the impact of large (order of 10 unit) deviations in the multipole strength; previous simulations imply the effect on dynamic aperture should be strong. **Ezio** supported the idea. **Action: Ezio to provide the summary tables.**
- **Paolo** raised a question if there is an agreement between WP2 and WP3 on the need for a magnetic measurement database. **Gianluigi** replied the WP2 would like to have such measurement database a later stage. **Ezio** commented there is no extra cost for the project as maintaining such a database is within the mandate of his group. **Paolo** summarized that it can be reported at TCC that there is a need for the table, but it will be covered by internal resources of the TE/MSC group with no extra funds required. **Gianluigi** inquired if the database is going to be maintained continuously. **Ezio** confirmed. **Massimo** pointed out an effort by **Piotr** to replace WISE. **Gianluigi** proposed to make a cross-check of existing tools to assign field errors to elements. **Action: Massimo, Ezio to coordinate the benchmark of WISE with the tools developed within the OMC team.**

3 CRAB CAVITY LOCATION OPTIONS (R. DE MARIA)

Paolo introduced the problem by pointing out that his WP has long been asking for a design of the crab cavity cryomodule for LHC and now that these design activities have started it turns out there are issues with space constraints for connecting the cryogenic lines. WP9 has started doing analysis and coming up with proposals to overcome the special limitations and solutions with a cryomodule shift were put on the table. A shift below 3 m would allow using the cores already foreseen by civil engineering, whereas a larger shift would require an additional effort.

Riccardo discussed different shift and crab cavity ordering options. Either one of or both cryomodules can be shifted. Two shifts: 3 and 6 m were considered for the analysis.

For the Nominal scenario the crossing angles are 380 and 385 µrad in the horizontal and vertical planes respectively. Moving one cryomodule by 3 m would lower the crossing angles to 367 and 373 µrad (hor. and vert.) or worse depending on the layout; by 6 m – 350 and 367 µrad. Moving both cryomodules provides similar performance. A minor gain might be obtained by optimizing the optics but losing the symmetry between IP 1 and 5.

For the luminosity, 360 µrad corresponds to a loss of 3.6% virtual luminosity and 1% integrated luminosity for the Ultimate scenario; 350 um - 5.6% virtual and 1.4% integrated luminosity for the Ultimate scenario. Although the reduction in integrated luminosity appear to be small, in the 350 µm Ultimate case the luminosity loss is 15% of the integrated luminosity increase provided by crab cavities when the baseline configuration is compared with the flat optics solution as pointed out by **Rogelio**.

- **Paolo** inquired there is an effect on the strength of orbit correctors. Riccardo replied that no significant effect is foreseen.
- **Gianluigi** raised a concern that optimization of the shift and cavity ordering can affect the ability to switch crossing planes. **Paolo** pointed out that at the moment the switchability cannot be provided. The infrastructure in IP1 and IP5 is the same only on paper, but not in reality. One first needs to check if the installation of the cryomodules is feasible, and then one can see what needs to be done to allow the switch. **Gianluigi** asked when the crossing planes have to be frozen. **Paolo** replied that the type of cavities to go into IP1 and IP5 can be decided a few years before the actual installation.
- **Gianluigi** noted that based on the analysis a weaker module can be put in the less critical location without affecting significantly the overall performance. **Riccardo** noted the 6 m figure in an upper estimate that comes from **Serge**, and the 3 m is likely the minimum possible, according to **Rama**. **Paolo** emphasized the importance of understanding the order of magnitude of the shift.
- **Sergey** asked if there could be an issue for flat optics. **Riccardo** replied the situation for the flat optics would be similar, although the crossing angle would be somewhat smaller.
- **Nicolas** inquired about the impact on beta-function at crab cavity locations, which is important for impedance and beam stability. **Riccardo** replied that a shift would lower them in both planes. **Benoit** followed up inquiring if the shift impacts the transitions and RF fingers in particular. **Riccardo** replied the transition is still an open issue. **Benoit** summarizes that an ultimate solution would need to be checked for impedance. **Riccardo** noted that the remote alignment will have to be checked as well. **Paolo** commented that if there would be a 3 m distance between the cryomodules the present remote alignment scheme could not be used and would need to think about another solution.
- **Michele** asked if costs of the proposed solutions have been discussed. **Riccardo** replied he does not obtain information on the matter.