

26th MDI Meeting

People present: A. Apyan, A. Bartolesi, K. Artoos, G. Balik, L. Deacon, K. Elsing, M.A. Gallilee, H. Garcia, L. Gatignon, E. Gschwendtner, A. Jeremie, Y. Levinsen, H. Mainaud, M. Modena, D. Schulte, J. Snuverink, R. Tomas

On the phone: P. Burrows

Introduction (L. Gatignon)

Lau mentions the very nice QD0-presentation by M. Modena of this morning in the general CLIC meeting and encourages everybody to look at the slides. Michele's deputy group leader mentioned there that a (close to) full length prototype should be built as a next step. Lau considers this very encouraging.

Status of Post-Collision Line (L. Deacon)

Lawrence gives a status report on the CLIC post-collision line, which is from now on again part of the MDI mandate. Key issues of the post-collision line are the huge energy spread of the outgoing beam and the abundance of coherent pairs and photons. The primary goals and difficulties of the post-collision line are to minimise beam losses and protect magnets against them, to minimise background from backscattering to detectors and to provide diagnostics for in particular luminosity optimisation. Lawrence mentions the differences between the original design and the current status: similar concepts but the dump is now 315m away from IP; material change of the magnet mask from carbon to iron; intermediate dumps lengthened. The simulations are improved and are based on GuineaPig and Geant4/BDSIM. The latest versions shows a large lifetime increase for the most sensitive magnets (from 1-8 years in March to 12 years in November 2011). The most sensitive object in terms of lifetime is now 'magnet 5' (3 years).

Magnet 5 is a C-shaped magnet. Full field 3D calculations were performed by A. Bartolesi. Realistic insulation material has been included. The outcome is a minimum lifetime of only 0.4 years. Lawrence concludes that the protection and/or designs of magnets 5-8 must be optimised and some suggestions were presented. Comparisons are done with the simulations by Sam Tygier of Manchester University who does similar studies using FLUKA. Future investigations must also address the impact of stray fields and the required changes to the layout for the L*=6.5m option.

Daniel asks if the table of slide 12 is per bunch, Lawrence responds affirmatively. Daniel asks about the spatial distribution of neutrons, but Lawrence says there are very few, so it wouldn't be meaningful to show a plot. Lau asks whether it would be helpful to improve the protection against hadrons by replacing the last ~40 cm of the intermediate dump by Carbon. Lawrence says he didn't look into a hadron contribution yet. Michele asks if the magnet lifetime problem would be solved if the radiation hardness of the coils would be increased to 10¹¹ Gy. Lawrence confirms this and Michele thinks this can be done. Lau fears that the stray fields of the big magnets at the BDS could be important and that a study on this issue should be launched. Michele suggests Antonio will look into that. Daniel says that besides a L* change also a different energy design should be analysed in the future, since the BDS layout will change in that case, causing interference.

Stabilisation update (G. Balik)

Gaël presents an update of the QD0 stabilisation status. He mentions the ground motion measurements at LAPP, which in the 10-50 Hz range is a more noisy site compared to CMS. The stabilisation is based on an “active foot” consisting of piezo-actuators, elastomeric strips and a piezo accelerometer Wilcoxon 731A (8 to 130 Hz). A second sensor used is the GURALP CMG-6T geophone, covering the range from 1.5 to 90 Hz. Three different control loops are used: two feedbacks (one for the piezo and one for the geophone) and one feed-forward (geophone), all supervised by MatLab and dSpace ControlDesk.

The experimental setup at LAPP is described. For each feedback the attenuation (transfer) curves are shown. Due to a misalignment of the sensors an unexpected (and undesirable) peak for 10-20 Hz was measured. Due to limited time no re-measurement could be done before the meeting. Apart from this Gaël shows good correlation between theory and experiment and a 20dB reduction from 5 to 30 Hz. Gaël proposes several improvements to the set-up, improved controllers and better sensor readout (cables, noise reduction, etc). The present result corresponds already to a RMS of about 1 nm at 4Hz.

Kurt says that for the next experiment a mass should be put on top, as this will change the response of the set-up significantly. On another question by Kurt, Gaël replies that a mix between several filters were used. Phil (on the phone) asks if the factor 10 that is needed to meet specifications can be obtained with the improvements mentioned. Gaël thinks that is not possible, but maybe up to a factor 4 could be gained. He says that in addition a passive foot could be added. Lau mentions that if the misalignment problem would be solved, this might also be a significant gain in the integrated RMS. Daniel says that the attenuation curves could be put in simulation to see what next step could be taken. Daniel says that for example for the pre-isolator the tilt and resonance of the cantilever are also important. Daniel proposes to identify the current problems instead of adding complexity. Kurt asks about the gain factors and stability, Gaël says that the gain had to be limited for stability reasons. Kurt thinks that the GURALP is a limiting factor and says that its sensor is not ideal. Also Kurt suggested to replace the digital controller by a more precise analog feedback. Kurt can provide a circuit board and that LAPP is welcome to test their setup in the ISR at CERN.

Pre-alignment status (H. Mainaud)

Hélène presents news on the pre-alignment, which is not yet fully ticked off in the list of CLIC critical feasibility items. Daniel says that the CLIC requirements feasibility table presented is not completely fair and that pre-alignment should no longer be considered a feasibility issue, but instead that improvements are still needed in the technical design phase (to go from 11 μm achieved to 8 μm required for QD0 at $L^*=6$ m).

The pre-alignment consists of two steps. The first step is to determine the “zero”-position of the component to be aligned in the referential frames of its support and its sensor and the second step is to determine the position of the referential frame of the sensor on the component wrt a stretched wire considered as a straight reference. For the first step the CMM was proven to be the best solution. A mock-up of a magnetic axis measurement in a CMM is under test in collaboration with Michele Modena. Step two was already presented by Daniel in the SPC presentation last week. A vertical rms of 11 μm and a radial rms of 17 μm has been measured in the TT1 set-up. This was 11 months ago, but has so far not been improved due to several problems, among others the non-linearity of the sensor and the fact that TT1 sensors used were also spares for the LHC and indeed taken away for use in the LHC. New sensors have been ordered.

For the study of the CAM movers a 5 DOF mock-up is now installed in the ISR. A detailed test program is presented. At Nikhef tests of zerodur spokes are under way to check the repeatability of the contact to the spokes. So far the goal of $0.1\ \mu\text{m}$ was reached, but more tests will be done before summer.

As a final advice H el ene urges everybody to keep the accelerator components as small as possible!

QD0 multipole simulations (Y. Levinsen)

Yngve started recently as a fellow with Rogelio Tomas on BDS studies. He has been looking at the impact of the magnetic measurements of the QD0-prototype. He has in particular been looking at the sextupole and octupole components of the QD0 prototype, implementing the measurements by Michele and colleagues in the beam simulations. Skew sextupole components seem to be the worst and at the present level they are not acceptable: a luminosity loss of 27% was calculated for the QD0-prototype values, whereas the effect of 'normal' sextupole components was at the $\sim 5\%$ level. Lawrence asks if retuning of the machine was part of the analysis procedure. Yngve responds that retuning brings some relief (see later), but that more studies remain to be done.

Yngve also shows that in the simulation a small (but opposite) sextupole component in QD0 can lead to more than nominal luminosity. Daniel asks about the possibility of putting sextupole components in the quadrupole. Michele says this can be looked at. Rogelio considers a sextupole component as an error to be avoided, but Daniel insists that this would nevertheless be an interesting possibility to study.

Yngve presents some quick optimisation studies to compensate for the multipole errors. A reduction of the luminosity loss to 6% was achieved. From the discussion it follows that 2% is considered the maximum acceptable loss.

Michele says the measurements of the QD0-prototype are preliminary and that the sextupole components are in fact the least accurate measurement (due to limited time in view of other non-CLIC priorities) and that there will hopefully soon be time to redo the measurement. Michele also says that 5000A is the nominal current (not 6000 A) and that therefore the multipole components measured (in the forthcoming measurement) at that value should be used in the simulations.

A.O.B.

The time of the next meeting has not yet been defined, as the week of the CLIC collaboration meeting (9-11 May) turns out not to be convenient for all of us. Francois Butin will try to provide more input on the PAC rings. Konrad says the L^* of 6.5m detector study will start in June, so no results can be given yet in May.

Jochem Snuverink
