

DISCUSSION SUMMARY OF SESSION 4: STRATEGY FOR 2012 (PART II)

Chairman: Oliver Bruning - Scientific Secretary: Laurette Ponce

INTRODUCTION

The fourth session of the 2012 LHC Performance Workshop included the following presentations:

- **Beam Energy** by Andrzej Siemko
- **Optics Options** by Massimo Giovannozzi
- **Collimation settings and performance** by Roderik Bruce
- **Performance Reach in the LHC for 2012** by Gianluigi Arduini
- **MD plans in 2012** by Ralph Wolfgang Assmann
- **Ions in 2012** by John Jowett

BEAM ENERGY (A. SIEMKO)

- S. Myers asked concerning the case of an asynchronous dump, if there is a risk that more than octants around IP 6 could be affected. B. Goddard answered that the FLUKA simulations showed that this extend to the arcs and DS only, but what was not done is to transport the simulation around the TCTs.
- P. Collier mentioned that the RRR values used in last year simulation are more pessimistic than the real values. A. Siemko confirmed that the minimum has been found at $200 \mu\Omega$.
- F. Caspers asked if the contacts in the quench diode are gold-plated and if not, if it could be fixed. A. Siemko confirmed that the contact are nickel-plated, which is the worst possible according to F. Caspers. A. Siemko mentioned that it could be envisaged to go to silver-plated, but F. Caspers insisted on Gold. On the same subject, L. Bottura reminded that no major issue was found in the contact. The excessive resistance was localized in another part, so there is not real need to change the material.
- S. Redaelli asked if it is envisaged to step back in energy from 4 TeV to 3.5 TeV in case of excessive number of quenches. A. Siemko confirmed that in case we reached the number of 5-6 quenches, we will probably have to review the situation

OPTICS OPTIONS (M. GIOVANNOZZI)

- R. Assmann commented on the request to shift the collision point in CMS that this should not be a problem in vertical plane from collimators point of view as in principle TCTs can be moved further in (no risk of asynchronous dump in V plane). Maria reported that CMS do not have such a request anymore.
- J. Wenninger reminded that the 25 ns bunch spacing beam is not compatible with a β^* of 60 cm, so to test the 25 ns, we will have to use trains of 72 bunches maximum. R. Assmann replied that we need anyway a different crossing angle for 25 ns beam and G. Arduini added that the test is planned with train of 72 bunches with smaller emittance.
- P. Collier pointed out that in the last step from 70 to 60 cm β^* you gain less and less in terms of luminosity because of the geometric factor. So he asked if it is worth trying to go to 60 cm compared to 70 cm. M. Giovannozzi replied that it is true that the 60 cm β^* optics will be difficult because of tight collimators settings, impedance, ...
- R. Schmidt asked which crossing angle is used in the predictions and if we could gain by reducing it. W. Herr answered that the crossing angle used is OK and that the emittance is more important for the beam-beam effects.
- R. Assmann mentioned that even if 10 % gain in luminosity is not huge, it is anyway significant and it is worth to try. P. Collier added this is providing the fact that a 10 % increase on the peak luminosity do not have an affect on the machine availability.
- E. Shapochnikova asked if a longer bunch length is assumed because of potential impedance effect. M. Giovannozzi answered that the 25 ns beam need longer bunch length.
- S. Fartouk mentioned that two types of σ are used in the presentation, first the σ of the beam and then the σ used for collimators settings and he wondered if the collimators settings assumed the same position in mm in the calculation. R. Bruce answered that the position in mm is not the same but the protection is the same. He added that because of the long range beam-beam effect, they took a larger crossing angle.
- O. Bruning asked when the 500 m optics is planned. Benedetto answered that the 90 m optics in IP1 and

5 is enough for ALFA, it has to be discussed with TOTEM if the 500 m optics is needed before LS1.

COLLIMATION SETTINGS AND PERFORMANCE (R. BRUCE)

- P. Collier asked why we could not insert the tight collimators settings only when arriving to 90 cm β^* . R. Bruce answered that the tight collimators settings are scraping about 1 % of the beam and to avoid a flash in losses it is better to gently introduced them during the ramp lower energy.
- V. Kain wondered how important are the assumed 2.5 μm emittance at flat top. W. Herr recalled that it is very important to avoid long range beam-beam effects. V. Kain then asked if it is then setting a limit on the acceptable emittance. R. Assmann answered that it is not an important parameter for collimators and that the limit will be set by the beam-beam parameters which are just above design values.
- S. Fartouk noticed that the are 10 cm gained on the β^* value due to the reduced crossing angle and another 10 cm mentioned in the talk. R. Bruce clarified that this comes from the gain in emittance.
- S. Fartouk commented on the margin calculation that with an off-momentum β -beating of 0.015 per mil, you are not very well protected if the error are quadratically added as with ± 10 % beating, you already lose 1 σ in the 1.5 σ retraction margin. R. Assmann answered that for the margin on the dump kicker, you just really care of the core of the beam, not the tails. So as long as the beam is centered, you are protected.
- R. Assmann commented that a test of slowly moving in collimators was performed at the end of a physics fill without any problem. He also added that another test with reduced beam-beam separation made the ramp a bit more rocky, but they are confident that this could be improved. Adding linearly all the errors would mean that all the errors are going in the same direction.
- R. Schmidt mentioned that a large emittance would mean a reduction of dynamic aperture, inducing losses in the tails. V. Kain answered that the 2.5 μm emittance were achieved last year.

PERFORMANCE REACH IN THE LHC FOR 2012 (GIANLUIGI ARDUINI)

- L. Rossi questioned if we expect some impedance effect (single bunch) with the 25 ns bunch spacing beam. G. Arduini answered that it depends on the type of impedance as presented by E. Metral in the previous session.

- E. Metral mentioned that for the 25 ns beam is limited to the 3.5 μm emittance in the SPS because of the impedance with 4 batches, but this problem can be overcome with 1 batch.
- E. Shapochnikova asked what will be the strategy with bunch length in case of heating, as it was push to the maximum (1.35-1.4) for physics, if it will put a limit on maximum total current. E. Metral answered that a new MKI will be put in place in August and vacuum modules exchange during Christmas break, so they do not expect problems with heating.
- R. Garoby recalled that the luminosity life-time is better with 25 ns bunch spacing beam. G. Arduini answered that it could help but that we are also introducing tight collimators settings, so at the end, the Hubner factor will determine the gain in luminosity.
- A. Ball asked if we see any issue for the 25 ns bunch spacing operation which have not yet been addressed and that should be during 2012 run in order to plan intervention for LS1. G. Arduini answered that mainly the information on the e-cloud behavior and the heating effects are the most important.

MD PLANS IN 2012 (RALPH WOLFGANG ASSMANN)

- Benedetto asked if the high pile-up test could be done in STABLE BEAM during physics time.
- E. Metral commented that the beam heating was never a limit in 2011, only the MKI heating is problematic and the only solution there is to reduce the bunch length. R. Assmann added that even though it was not a limitation, we have to establish a limit to avoid damaging equipment.
- B. Goddard mentioned that even though one hour of waiting time for the MKI cooling is acceptable but that it could be far longer.
- S. Fartouk recalled that a limitation of momentum aperture could be a serious limitation so the large Pi-winski angle MD time should be first priority. R. Assmann confirmed that it is.
- A. Ball asked if the luminosity leveling could be tried during physics time instead of MD time as it would be important to test it early in the run, even manually.
- A. Siemko is commented on the request for quench tests. For the time being, quenches are not an operational issues but bench mark data are needed for modeling and interpolation for higher energy.
- S. Redaelli noticed that the combined ramp and squeeze should also be added to the list of MD request for 2012.

- R. Tomas reminded that an effort should be put on the commissioning of non-linear correctors in the IR as they could be needed sooner.

IONS IN 2012 (JOHN JOWETT)

- O. Bruning asked where the gain of factor 2 in luminosity comes from. J. Jowett answered that it is the result of the reduced emittance and β^* .
- D. Manglunki reminded that the SPS ion run is fragmented over the year. In September. Protons are stopped for the North Area physics, but will still be available in the complex for p-Pb run.