LHC Beam Operation Committee

Notes from the meeting held on 11th October 2011

Participants

1. Correlation Between Emittance and Bunch Intensity in the SPS – K. Cornelis (slides)

K. Cornelis presented the results of emittance measurements as a function of bunch intensities in the PSB, PS and SPS for 50 ns beam and for high intensity single bunch (pileup MD).
In the SPS, horizontal and vertical emittance were measured at 26 GeV, at the end of flat-bottom, and at 450 GeV. While at 26 GeV the emittance varies linearly with bunch intensity, at 450 GeV a scattering is observed in the measurements, especially in the horizontal plane. Emittance increase seems to become flatter for single bunches with intensity above $2x10^{11}$ p^+ (single bunch for puile-up MD). The emittance blowup has to be understood; a device to measure emittance along the bunch trains and continuously along the ramp (e.g. ionization rest gas monitor) would be desirable to localize the part of the SPS cycle where the blow-up occurs and characterize the source of this blow-up. Emittance in the PSB and the PS was measured averaging over 6 cycles. It is shown that, also here, emittance increases almost linearly with bunch intensity. However in the PSB, a spread in the horizontal plane is observed. Recurring problems in the first Booster ring required more horizontal scraping in the SPS.

Discussion:

M. Lamont asked what are the conclusions based on this measurement.
K. Cornelis answered that the higher the bunch intensity the bigger the emittance.
J. Wenninger commented that this could be a limit on reachable luminosity: a non better than linear increase has to be expected by increasing the bunch intensity.

2. WireScanner Status – G. Crockford (slides)

G. Crockford presented the new features and improvements implemented to the WireScanner Front End and Software. 200MHz base line noise source in Beam 1 is not yet understood, investigation continues but, presently, the problem is solved with data filtering (subtraction of noise signal acquired in the abort gap). Damage threshold limit has been increased and now it is possible to acquire 12+144 nominal bunches in one scan. Multiple fit calculation is not set up as default, since it is slower, and has to be enabled by the user. Some new features have been implemented to the Wire Scanner application: manual bunch pattern selection plus save and recall buttons, new display of normalized emittance versus slot selection. Moreover, filters, voltage and gain can be defined in the front panel and no more only from the expert application.

Discussion:

G. Arduini asked if it is possible to load standard settings for voltages and filters at 450 GeV.
G. Crockford answered that this is true only for the first 144 bunches
J. Wenninger added that default data sets could be put in LSA and read back by the WireScanner application.
M. Lamont aroused the problem of using nominal instead of measured optics to measure the emittance.
F. Roncarolo pointed out that the difference between the emittance measured with the BSRT and the WireScanner does not depend on the optics used but that the absolute values can differ by 25%.
J. Wenninger suggested that R. Tomas put the measured optics in LSA so that this could be used instead of the nominal one.
S. Redaelli added that this would require a mechanism to follow optics changes.
M. Lamont asked if emittance measurements data are in the logging DB.
It was answered that this is not the case and that, at the moment, only the beam size is logged.
V. Kain asked if it is possible to fit the emittance directly in the Front End and log these data.
R. Jones answered that this cannot be done since the Front End misses the libraries for the fit.
E. Chapochnikova asked how many σ are used for the fit?
K. Cornelis and F. Roncarolo answered that it is possible to filter the data and select only the beam core in order to have a clean fit.
J. Wenninger asked about the possibility of measuring emittance in the SPS with IPM.
B. Dehning answered that the apparatus could be hopefully installed already during the next Christmas stop.
F. Roncarolo commented that the filter used to remove the 200 MHz noise introduces an offset in the profile measurements of Beam 1 and that, in order to avoid saturation, the maximum on the signal amplitude scale should be below 8000 units.

Actions:
Implement measured optics in the DB and use the measured optics data to estimate emittance. (R. Tomas and colleagues)
Implement Federico's fit routines in the wire scanner application and possibly on the front-end for all machines (A. Guerrero?)
Log emittance data based on measured optics for all machines (A. Guerrero?)
Implement the possibility of save/reloading (HV and filter settings) for measurements in operational conditions (12 nominal bunches, 144 nominal bunches) (G. Corckford?)

3. Analysis of MD on IR1 and IR5 Aperture at 3.5 TeV – Progress Report – R. Bruce (slides)

R. Bruce reported about the MD on aperture measurements at 3.5 TeV with 1.5 m β^* in IP1 and IP5. He introduced the used method that consists in opening the TCT collimators in step of 0.5 σ (starting from 11.8 σ) and applying a local bump with increasing amplitude. The TCT setting (in σ units) corresponding to losses at the triplet higher than losses at the tertiary collimator gives the aperture of the triplet. According to the model, an aperture of 14 σ was expected when imperfections are added up in the pessimistic direction while the measured aperture corresponds to 18-20 σ. The effect of closed orbit, different crossing angles and random kicks around the ring has been evaluated with MADX simulations. This showed that the method to directly relate the TCT opening to the triplet aperture is valid only for the assumption that the phase advance between the TCT and the kick is large and in case of no kick applied in between the TCT and the triplet (several MCBX correctors are in this region but had constant strengths during the measurements). Calculating the aperture from the local orbit in the triplet, and not the TCT opening, is more precise and shows a loss of $\sim$1 σ at the triplet aperture for the crossing plane in IR5.

Discussion:

M.Lamont asked what σ was used for aperture calculation (TCT setting).
R. Bruce answered that the nominal sigma σ (3.5 μm) was used and S. Redaelli added that the beam was indeed blown up in the SPS.
R. Bruce commented that the bigger aperture measured can be explained by the fact that tolerances are less critical than assumptions; in particular machine alignment and orbit at the triplet. He underlined also that this kind of measurements should be repeated when moving to further squeeze.
J. Wenninger added that uncertainty from the bump and BPM calibration should be taken into account. He also reminded that these and optics measurements should be repeated in IP2, with protons, in view of the ion runs.

4. Combining Ramp and Squeeze at the LHC – S. Redaelli (slides)

S. Redaelli presented a proposal of a new energy ramp combined with the squeeze in the LHC. This topic was discussed at the last Chamonix workshop and was considered too critical to be performed during 2011 operation. S. Redaelli explained that, at the actual stage of the commissioning and with the acquired knowledge of the machine, this option should be tested and would allow to optimize the operational cycle making it shorter (gain > 400 s) and less subject to human error. He gave an overview on the present operation cycle and settings generation and explained how to perform the new squeeze by forcing optics change during the energy ramp. A final β^*>3 m (3.5 m in IP1/IP5 and 3 m in IP8) would be reached, at the end of the ramp, in order to avoid the most critical optics corrections that would be done at flattop. The combined

squeeze/ramp requires starting with collision tune at injection; this was tested during an MD and no problem was found. Magnets functions were also tested, during no beam time, in 5 sectors, without inducing any trip. Simulations of dynamic errors were performed with MADX online to compute beta-beat (estimated ~ 10%) and calculate crossing angle and separation variations (feed-forward corrections are being prepared based on simulations). S. Redaelli concluded saying that there is still some work to be done but that the system is ready to be tested with beam. In particular, a MD with flat machine and collision tune at injection should be performed to measure the dynamic beta-beat.

Discussion:

M. Strzelczyk asked how settings are generated.
S. Redaelli answered that the optics (K of the magnets) is still changed manually but that the changes are so smooth that this could be implemented in a software.
M. Lamont asked how coupling correction could be done during the squeeze/ramp.
S. Redaelli answered that well defined knobs need to be integrated for this purpose and for chromaticity and tune corrections.

5. LHC Physics Program – M. Ferro-Luzzi (slides)

M. Ferro-Luzzi presented the planning for the last 3 weeks of the LHC protons run. He underlined that the highest priority is data taking with 90 m β* for TOTEM and VdM scan in IP2 and IP8. Ideally two slots of time (week 42 and 43) for 90 m β* measurements should be considered to perform data analysis in between. IP2 aperture investigation with protons will be performed in week 43 in preparation of the ions run. Remaining time will be dedicated to accumulate Luminosity.

6. Upcoming meetings:

Tuesday, 18th October: LSWG meeting. Planning of upcoming MD block.
Tuesday, 25th October: **next LBOC meeting (15:30 in 874-1-011)**.