LHC Beam Operation Committee

Notes from the meeting held on 14th August 2012

1. Status of the Impedance-Damper Model (Nicolas Mounet)

N. Mounet presented the principles of the impedance model and the transverse damper (ADT). The latest impedance model also considers **coupling of different modes.** He explained that the **ADT acts formally as an impedance** and showed how it is implemented in the impedance model.

N. Mounet showed the corresponding stability diagrams which reveal that the **mode coupling has a strong effect on headtail modes.** He also shows that the **ADT does not only damp the mode m=0, but also higher headtail modes** (due to non-zero chromaticity), in particular m=±1. He compared the results to a simulation which reveals that additional **radial modes** might play a relevant role. Radial modes are not covered yet by the impedance model.

N. Mounet presented the stability threshold as a function of chromaticity and damper gain for both octupoles polarities (without beam-beam). He concluded that for both octupoles polarities **high chromaticity (Q'>10) and high damping rate is favorable.** In the absence of beam-beam effects, the stability is reduced to about half the bunch intensity with positive (new) octupoles polarity, compared to negative octupoles polarity (old).

N. Mounet underlined that the results are preliminary and that in particular radial modes are not included yet, which are expected to have a significant impact on the stability.

Discussion:

J. Wenninger asked if higher order modes have a dipolar component. A. Burov confirmed that a head-tail mode of order l has a dipolar component which is given by the l^{th} Bessel function.

M. Lamont noted that the current settings are almost always below the shown stability thresholds. N. Mounet replied that there are missing impedance components in the model (there are some indications that the actual impedance is about 2 times higher than one currently in the model). Thus, the absolute values are not exact and **the given stability thresholds should be only compared relative to another.**

G. Arduini pointed out that in the present configuration the bunch intensity has a particularly strong influence on the beam stability. Corresponding regions can be found in the stability diagram.

E. Chapochnikova asked if the stability diagrams on slides 8-12 are for a particular mode. **N. Mounet replied that all modes are considered.** For each point the least stable mode is shown.

J. Wenninger asked if operation without octupoles would be possible according to the results. N. Monet answered that without octupoles no sufficient stability is reached. A reduction of the octupoles currents seem to be possible, though.

W. Hofle noted that the effect of the ADT could be included in the impedance model also in time domain. A. Burov explained that this yields the same results, since also with limited frequency response the ADT does not mix different couple-bunch modes, in a framework of the equidistant bunches model assumed so far.

2. Nested HT Method: Impedance and Damper (Alexey Burov)

A. Burov presented an **alternative impedance modeling approach** which also includes the transverse damper (ADT). The model is based on a description of the particle distribution in a single bunch by many rings in longitudinal phase space with uniform population. **Radial modes naturally occur with this approach.**

A. Burov showed a preliminary stability diagram and pointed out that the next steps are to include multi-bunch coupling and beam-beam effects. He also underlined importance of two independent computations of the stability problem (his own and his together with N. Mounet), to make a cross-check against possible mistakes, since the problem is computationally heavy. One more point for the cross-check is against tracking results of S. White. All the three approaches are under development.

3. Instability Observations with new Octupole Setting (X. Buffat)

X. Buffat showed observations of beam instabilities with new (positive) octupoles polarity. During flat top/squeeze of fills 2928 and 2932 **the last bunches in each train became unstable, some in the horizontal other in the vertical plane.** No instabilities during the PHYSICS beam process were observed since the change of the octupoles polarity.

X. Buffat showed that **with the new (positive) octupoles polarity the stability is increased after the squeeze (compared to negative polarity) but is reduced at the beginning of the squeeze**, where long-range beam-beam effects are negligible. **Throughout the squeeze, the modeled stability thresholds cannot explain the observed instabilities.**

X. Buffat showed that **while collapsing the separation (PHYSICS beam process) a local stability minimum is reached.** During collisions, the stability region is comparably large due to landau damping by the head-on beam-beam effect.

Discussion:

A. Burov noted that **coherent beam-beam tune shift** is not included in the stability diagrams.

R. Schmidt commented that with respect to 2011, the tighter collimator settings imply an increased impedance during the PHYSICS beam process. He noted that

colliding during the squeeze would increase the stability region. X. Buffat underlined that.

R. Schmidt motivated to cross check the simulations and models with observations during the next MD block.

Upcoming meetings:

Tuesday, 21st August 2012 15:30 in 871-1-011: LBOC

Reported by Tobias Baer