LHC Beam Operation Committee

Notes from the meeting held on 31st July 2012

Participants

1. Recent Observations of Instabilities – T. Pieloni (slides)

T. Pieloni presented the results of the analysis of a number of fills during which instabilities developed causing beam losses and, in some cases, a beam dump. She explained that one of the aims of this analysis was to identify some systematic among the fills, which could help in understanding the origin of the instabilities. It was observed that instabilities always develop in the horizontal plane and three main scenarios were identified: towards the end of the squeeze (with IP2 and IP8 long range already in place), during the first minutes of IP8 adjust (when the separation in the other points is also reduced) and when the beams are brought in collision.
Beam 2 is normally the first beam experiencing the instability and then Beam 1 follows, in particular when the coupling is strong. In two cases Beam 1 drove the propagation of the instability.
Multiple lines in the tune spectrum characterize the instabilities which develop during the squeeze. The effect of long-range interactions in IP2 and IP8 on the development of the instabilities during the squeeze in IP1 and IP5 is still not understood. The instabilities can last for several minutes and affect initially a limited number of bunches with weak damping properties, then they propagate to the neighbor bunches. The "weak" bunches are those at the end of the train and thus experiencing less long-range interactions; the propagation of the instability cannot be explained only via the beam-beam. An eventual contribution of the damper should be investigated looking at the typical time propagation between bunches.
Losses occurring when the beams are brought in collision affect all the bunches and beam-beam is the main driver of the instability.
In other cases fast losses appeared during the LHCb rotation (during this phase the separation in IR1 and IR5 is reduced as well), but not always at the same moment of the IP8 "gymnastic", and dumped the beams. No sidebands were present in the tune spectra in this circumstance.
T. Pieloni explained also the expected effects of changing the polarity of the current in the octupoles. This would have the benefic effect of increasing the Landau damping for the separated beams (comparable with the head-on Landau damping for colliding beams) but the larger tune spread could induce higher losses and lower lifetime. Moreover, a positive current in the octupoles can affect the stability diagram for the single beam also when not in collision. End of fill studies will be performed varying the polarity and reducing the current of the octupoles both for separated and colliding beams. T. Pieloni also suggested, as long term countermeasures, the development of b* leveling (during squeeze). Bunch-by-bunch improved diagnostics is vital for further investigations.

Discussion:

W. Hofle commented that the damper provides only dipolar kicks and thus cannot explain the head-tail modes propagation between neighboring bunches.

A. Burov confirmed that impedance plays the main role in this phenomenon.

M. Lamont asked if all the observed instabilities could be related to the 100 Hz side band.
T. Pieloni answered that this is not the case for all the analyzed fills.

T. Baer asked what kind of improved bunch-by-bunch diagnostic is needed.
T. Pieloni replied head-tail monitors.
G. Arduini remarked that the BBQ could provide useful information on this purpose but that, at present, the system cannot be used for real bunch-by-bunch measurements.
B. Salvant commented that measurements can be triggered manually but it is not possible to save the data.

2. Fast Beam Losses During Beam Dump Process due to (missing) LR Beam-Beam kick – T. Baer (slides)

T. Baer reported on single turn Beam 1 losses measured by the diamond detectors in IR7 before the beam dump. This kind of losses occurred twice in July 2012 and in both cases the dump request was triggered by Beam 2 and Beam 1 was dumped one turn later. He showed that, due to the delay between the dumps, beam 1 did not see anymore the long-range beam-beam kick first in IP5 and then in IP1, IP2 and IP8. This results in a perturbation of the beam trajectory by several 10 μm both in the horizontal and vertical plane (from ring BPM readings) and, as a consequence, losses at the collimators in IR7.
Once Beam 2 was completely dumped, a perturbation of 15 μm in the horizontal trajectory could be measured, for Beam 1, by the ADT pickup (post mortem data).
Losses coming from beam in the abort gap could be measured in IR7 when dumping Beam 1.
T. Baer explained that, in collaboration with the beam-beam team, the expected missing kick could be calculated and compared with the BPM readings. He also suggested an end-of-fill test with bunch-by-bunch ring BPM acquisition for selected bunches.

Discussion:

W. Hofle asked why large orbit perturbations of ~100 μm translate in 15 μm at the ADT pickups.
T. Baer answered that this could due to the phase advance and to the fact that the ADT shows a real bunch by bunch reading while the ring BPM data is a convolution of all bunches; this is the reason to perform tests with a bunch-by-bunch ring BPM acquisition and compare the readings with simulations.

3. Next meeting

Tuesday, 07/08/2012: **LSWG meeting (15:30 in 874-1-011)**.