Electron cloud meeting #1, 22/07/2013

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The beginning of the meeting was delayed by about 20', because the door to Room 6-2-008 was stuck and could not be opened. The meeting was finally moved to the BE Auditorium, which appeared to be temporarily free.

Introduction (G. Rumolo)

As explained in the attached slides, the structure and goals of this series of meetings will be:

- Set & review all together the objectives of the electron cloud studies machine by machine, according to the new/existing requests and needs
- Present the work progress and generate/follow up actions
- Discuss all the relevant new results as well as raise issues or questions of different nature

The presentations scheduled on each meeting are just meant to be informal. Their purpose is mainly to animate discussion and brainstorming on specific points. The core invitees to these meetings are those included in the be-ecloud-members e-group. According to the topics discussed in the meeting, additional subgroups of people might be invited to attend for information or feedback. Meetings will be documented at the Indico subcategory: Home >> Projects >> Electron Cloud and Numerical Simulations >> Electron Cloud meetings

url: https://indico.cern.ch/categoryDisplay.py?categId=

Meetings will take place about monthly, but occasionally more or less frequently following the arising needs. Time and location will be identified every time according to the availability of the core + additional invitees.

A series of topics has been identified for follow up in each machine (PS, SPS, LHC), details to be found in the attached slides. Additional ongoing studies cover future project like HL-LHC and the CLIC Damping Rings, but also some side items that may have an important impact on the machine specific activities (e.g. the distribution of synchrotron radiation in LHC, the use of islands to efficiently scrub the vacuum chamber, etc.)

Update on LHC observations in the LSS and simulation studies (O. Dominguez)

- A survey of the observations at the different LHC vacuum gauges from the LSS was presented. The gauges that are compared are all placed in very

similar conditions (i.e. in warm-warm transitions, VIG-type with same geometry, with more than 7m long NEG sections on both sides). There are 173 such gauges.

- Observations with 50 ns beams in 2011 are based on three specific fills. They were chosen such that the first one is before any significant 25 ns beam was in the LHC (14 October 2011), the second one was in between the 25 ns MDs (i.e. between 14 and 24 October) and the third one after the complete 25 ns scrubbing (after 25 October). The stored intensity was about the same for all these fills (1.37e11 ppb, 1380 bunches per beam).
- Observations from 25 ns beams in 2011 (24-25 October) are also shown
- At injection (450 GeV)
    - Sector 1 – 2: The worst vacuum observed with 50 ns beams (i.e. 1.5e-9 mbar at VGI.137.7R1.B) improved after the 25 ns beam on 14 October (pressure rise starting later and reaching to no more than 8e-10), while all the other gauges that had anyway some pressure rise before 14 October did not exhibit any more pressure rise after this date. During the 25 ns beam operation on 24-25 October all the pressure gauges showed readings as high as 7e-9, indicating a strong electron cloud activity. After the 25 October, all the vacuum gauges remained at values well below 1e-10 with 50 ns beams.
    - Sector 2 – 3: same behavior as Sector 1 – 2, but a residual pressure rise in VGI.697.5L3.B survives with 50 ns beams even after 25 October.
    - Sector 3 – 4: same behavior as previous sectors, but two vacuum gauges still exhibit pressure rise after 25 October.
    - Sector 6 – 7: again same behavior, all pressure rises disappear after 25 October
- Observations with 50 ns beams in 2012 are also based on three fills (June, August, November) with increasing beam current values (1.47e11, 1.52e11, 1.65e11 ppb).
    - Some pressure rises at 450 GeV were found higher than the last fill in 2011. The dependence of the electron cloud on bunch intensity seems not to support this, so it could be instead a sign of deconditioning from the year before. Then, pressure rises were sometimes higher for the second fill (again difficult to explain based on the dependence on the bunch intensity) and then in all cases lower for the third fill (with the largest bunch intensity and also the highest estimated buildup thresholds, see next bullet)
- Simulation study on the dependence of the buildup on the bunch intensity for 50 ns beams:
    - At 450 GeV the thresholds are all very close (dmax = 1.45-1.55) in the intensity range 1-1.6e11 ppb. However it would seem that intensities around 1.3-1.4e11 ppb exhibit the lowest thresholds clearly below 1.5, while lower or higher intensities have thresholds of about 1.5;
    - Similar thresholds are found at 4 TeV;

    - Due to the uncertainty we have in the modeling (especially of the low energy part of the SEY curves) it is likely that this tiny difference in the thresholds is hard to establish experimentally.
- Behavior of vacuum pressure with energy:
    - Sector 1 – 2: although no pressure rise is detected at 450 GeV, a clear signal (more or less strong, according to the gauge) at ~2.4 TeV is observed during the ramp.
    - Sector 2 – 3: not all the gauges behave identically along the ramp. Some exhibit the same revived signal at ~2.4 TeV, but some others, especially those that already exhibited a pressure rise at 450 GeV show a strange pre-ramp behavior (linear pressure increase with sometimes a spike) and no enhancement of the signal along the ramp. It was noted that the funny pre-ramp behavior of the pressure signal somehow follows the bunch length dynamics.
    - Sector 6 – 7: No increase of the pressure along the ramp is observed in the test fills. In some other fills, an increase is measured, but the behavior is different than the gauges in Sector 1 – 2, because it appears earlier in the ramp and then returns to zero after the ramp.
    - It is not clear whether the behavior with energy, when observed, is compatible with the enhanced electron cloud from the production of photoelectrons (which should start in the 1.5-2.0 TeV range). It would be interesting to check if the distribution of synchrotron radiation at the location of the different vacuum gauges and see whether there is a correlation between those that react during the ramp and the amount of photons that they are supposed to receive.
- Interpretation of data with simulations. A method based on matching ratios of observed pressure rises with ratios of electron fluxes from simulations was already applied in 2010/2011 to estimate the SEY history (and infer the reflection coefficient at low energy R) of a few selected vacuum gauges. Pressure rise measurements taken in April-May 2011 showed that the pressure rise increase linearly with the number of trains in the LHC, but also exhibits a smoother transient for small numbers of trains before getting to the linear growth regime. This behavior seems to be reproduced in simulations only when we assume low values of reflectivity at zero energy ($R<0.3$), otherwise the linear behavior with the number of bunch trains is established already for 1 or 2 trains in the LHC.
- It was discussed that it could be desirable to have a more complete picture on the behavior of the pressure gauges around the LHC to try to find correlations based on a larger statistics (and not only on few sample fills) and see possible trends along the year or even correlations with some other changes in settings. In order to do that, we would first need to agree on which quantities should be checked fill by fill (e.g. pressures after the last injection, pressure before the ramp, pressure after the ramp, pressure in stable beams) and then set up an automatic procedure to retrieve the data and produce the overview plots.

Progress in the understanding of the electron cloud in the PS (Sergio)

This presentation is postponed to the next meeting due to lack of time.

Adjournment

Next meeting will take place in about two weeks, exact time and location will be communicated in due time.

GR, 01/08/2013