LHC ecloud simulations Meeting

Date: 11 February 2011
Meeting Room: 6-2-008

Attendees: Gianluigi Arduini, Chandra Bhat, Elias Metral, Humberto Maury Cuna, Octavio Dominguez, Tatiana Pieloni, Frank Zimmermann

Excused: Kevin Li, Giovanni Rumolo, Daniel Schulte

Plan for CERN-GSI workshop, reported by Frank Zimmermann
The mini-workshop will be held on 7-8 March 2011. The draft programme, set up by Giovanni Rumolo, was available in INDICO at http://indico.cern.ch/conferenceDisplay.py?confId=125315
Ubaldo Iriso might not be able to attend and to give the foreseen presentation on his simulation study for 75-ns bunch spacing. His results could either be presented by somebody else, or be included in somebody else's presentation (Giovanni Rumolo's?).
Perhaps, in the latter case, the available time slot could be used to schedule another presentation, e.g. by Karel Cornelis or by Mariusz Sapinski (see later).

Study of 75-ns spacing by Ubaldo Iriso for IR3 and LHC arcs, reported by Frank Zimmermann
Ubaldo Iriso's draft report was displayed.
A pressure of 320 ntorr had been assumed in Ubaldo Iriso's studies. It was suggested for the IR3 study to **change the pressure by a factor 10 in each direction** and explore the sensitivity of the result to the pressure value (**ACTION**).
Figure 5 showed the onset of multipacting in IR3 at SEY=2.3 for R=0.5. A change of R by 02 results in a change of the SEY multipacting threshold by 0.2 units.
Results for an arc dipole showed the multipacting threshold at SEY=2.5 at R=0.5 (Fig. 9).
It was recommended to r**epeat the "dipole-chamber" simulation without any magnetic field** (**or rather with an extremely small magnetic field of e.g. 1e-8 T**) to understand if the reason for the higher threshold in the arc dipole is due to aperture and/or due to presence of the magnetic field.
Referring to Fig. 7 it was suggested to plot the x-y distribution also for lower SEY values, e.g. at SEY=2.5 for R=0.5, to document the (possible) absence of stripes just above the multipacting threshold.
The tracing of individual electron trajectories in Fig. 10 seems to support Daniel Schulte's suspicion that the backtracking of lost particles to their impact point on the chamber wall could lead to a shift in the center of the cyclotron motion for the newly generated secondary electrons. Individual **electron trajectories should be plotted for a different number of time steps** (**ACTION**). One might expect that the size of the random-walk steps in the horizontal-longitudinal plane will increase inversely proportional to the number of interbunch time steps. If the suspicion was fully confirmed the interpolation routine for particle-loss trajectories in ECLOUD should be corrected.

The second appendix of Ubaldo's report discusses the static pressure rise expected from the electron cloud.
Gianluigi Arduini discussed possible long-time effects not visible when simulating only 4 batch passages. **Frank Zimmermann** commented that a saturation density might not be reached over a small number of batches for SEY values close to the multipacting threshold. There could also be memory effects from turn-to-turn depending on the value of the electron reflectivity R. Perhaps at LHC injection the outer stripes are populated (only) over many turns if the cyclotron radius is small.
A **first attempt at studying multiturn effects could be made with the map approach** (**ACTION**). If the map approach indicates interesting results, a full blown ECLOUD simulation might be warranted. For this case, as pointed out by Tatiana Pieloni, it would be goo to modify the ECLOUD code so as to be able to write all intrinsic data to a file after a number of batch passage and then to read them again in a next simulation run modeling the next time step.

Lxplus queue
Both Octavio Dominguez and Humberto Maury reported problems with jobs waiting in the queue for long periods of days, before being executed, even with ICE-queue priority assignment.
Gianluigi Arduini, Elias Metral and Tatiana Pieloni suggested a number of mitigation paths, including using the computer of Michel Martini, lxclic cluster, an EPFL super-computer or the collimation queue.

Actions from past meeting
Humberto Maury reported that for the number of steps 150 had been used in the past, 2000 gave only zeroes as result, and 450 also gave zeros. He could not yet repeat the simulation for 150 since jobs were pending in the queue.

Octavio Dominguez pointed out that in his simulations 7500 time steps had been used without getting zero as a result.

SPS & LHC simulations by Octavio Dominguez
For the SPS simulations the goals had been to reproduce the **plot of stripe location versus bunch intensity** from the LHC Design Report. The flux was shown aas a function of x for 90 and 100% of the primary electrons created inside the beam volume. There was an excellent agreement with previous simulations from 2003 for a 100 G field. There was little difference in the prediction between 90 and 100%, certainly not enough to conclude if one or the other model was more correct.
It was clarified that the electron-cloud monitor had changed. It used to be in an MBA type chamber in 2003, while now it was inside an MBB chamber.
Changes in the code since 2003 included a correction of the angular dependence of epsilon_max (not delta_max!), and two changes in the model of low-energy electron reflectivity.
The question "what is the best model for the primary electrons?" could not yet be answered from the benchmarking.
Frank Zimmermann suggested trying to extract information from BI if there was any background signal from PM/BGI monitor data in the SPS and LHC that could indicate how many, if any, electrons were being generated outside the beam volume. Mariusz Sapinski would be contacted (**ACTION**, Frank Zimmermann).

Concerning LHC studies, previous simulations has been repeated with larger seed pressure, e.g. for SEY=2.5, R=0.7. An Nb scan had been performed for LHC at injection with 90 and 100% of primary electrons launched inside the beam, and for two different interbunch steps.
Frank Zimmermann observed that **for 100% the flux extent in x was much smaller than the beam size** [this should be clarified [**ACTION**)], while for 90% one could see one or several stripes, which also depended on the pressure value.
Comparison with Ubaldo Iriso's result seemed to show that the stripe structure looked cleaner for the latter.
The maximum flux of electrons above 10 eV was found at bunch intensities between 5e10 and 7e10 for 50 ns spacing, in a dipole.
Elias Metral suggested checking also the intermediate values of 99% and 99.9% of primary electrons generated inside the beam (**ACTION**).
Lastly, great progress had been made on ecxtracting R & SEY from the IR3 pressure rise measured as various distances between two batches.
The simulations were performed on a grid in SEY-R space, iteratively zoom in on interesting regions.
Temporary conclusions on the value and range of SEY and delta_max were drawn.
The next step would be to repeat the same simulations settting as seed pressure the actual value from the pressure measurement obtained at each batch spacing (**ACTION**).
Gianluigi Arduini remarked that additional information was available, e.g. the pressure for trains containing different numbers of bunches.

The next meeting will be announced in due time.

Reported by Frank Zimmermann