DEAR Technical Note IR-18

Topping-up effect on the background measured in the DEAR interaction region whens beams collide in the KLOE interaction point

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1) Introduction

In order to increase the integrated luminosity collected by KLOE, one has to minimize the time losses related with injections. Therefore is necessary to reduce the following contributions:

a) electron and positron injection times;
b) switching time from electrons to positrons;
c) switching time for the off / on of the KLOE chamber.

While c) is not relevant for DEAR, a) and b) also reduce the integrated luminosity collected by DEAR. One way to improve the situation is to adopt the so-called topping-up procedure of injection. As the whole system of DAΦNE runs at the operating energy of the collider, the current decay can be compensated by refilling the rings on top of the already circulating current (i.e. "topping up") [1]. This is a well known mode of injecting beams at synchrotron facilities to provide a beam with almost constant intensity [2] and requires an accurate timing of the whole accelerator which implies that the RF phase is the same for the interaction and the injection [3,4]. This procedure is particularly rewarding when high currents are injected. However, also at the actual hundred milliamperes regime of DAΦNE, a 20 - 30 % decrease in injection time could be obtained. For the present beam conditions the re-injecting happened

when the beam current had decreased down to a fixed value, say, about two thirds of the initial one.
How much these repeated injections affect the background measured on the DEAR side? The question, obviously, becomes really meaningful under the hypothesis that KLOE and DEAR are running together simultaneoulsy, with the machine following the procedure of injection most favorable to KLOE, which is the topping-up. As it is known, this, so far, is not yet possible. Anyway, we performed an evaluation of the effect on DEAR of the topping up technique adopted during KLOE data taking.

2) Measurements with the CCD detectors

In Figure 1, electron and positron beam current behaviours, in a run period of December 11, 1999, are reported. The beams were colliding in KLOE and were splitted with respect to the central orbit (in vertical) in the DEAR interaction region. The typical re-injection bumps of the topping up are apparent.

Figure 2 shows the number of clusters per CCD per minute as recorded by the CCD detectors of the DEAR NTP setup. The effect of the injections of positrons and electrons can be clearly seen. Up to several times higher background affects the CCDs just in the injection time interval. At the highest background peak the corresponding saturation of the CCD chips was already too high for a reasonable measurement. The occupancy, the number of hit pixels compared to the total number of CCD pixels, was about 60 %, a value far from tolerability. However, the effect lasts only for a few two minutes measurement periods during the injection and, therefore, it can be simply not taken into account in the analysis (no need for a switch-off of the setup, as it occurs for KLOE). Two stable periods in between the injections are visible and can be then used in data taking.

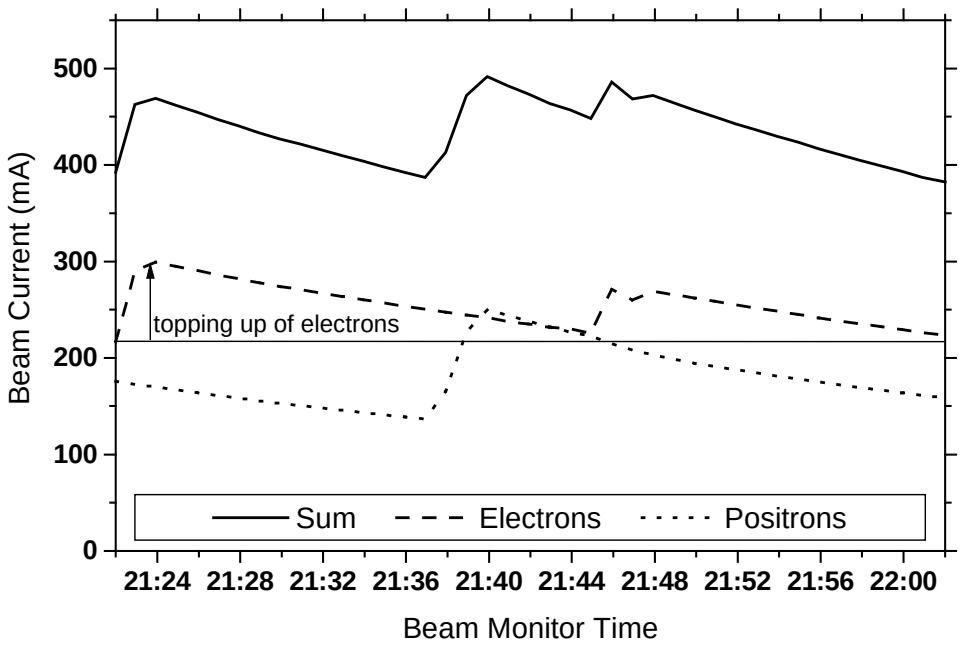

Fig.1: Electron and positron beam current and sum of both, as given by the DAΦNE beam monitor for the period 21:22 - 22:02 on December 11, 1999.

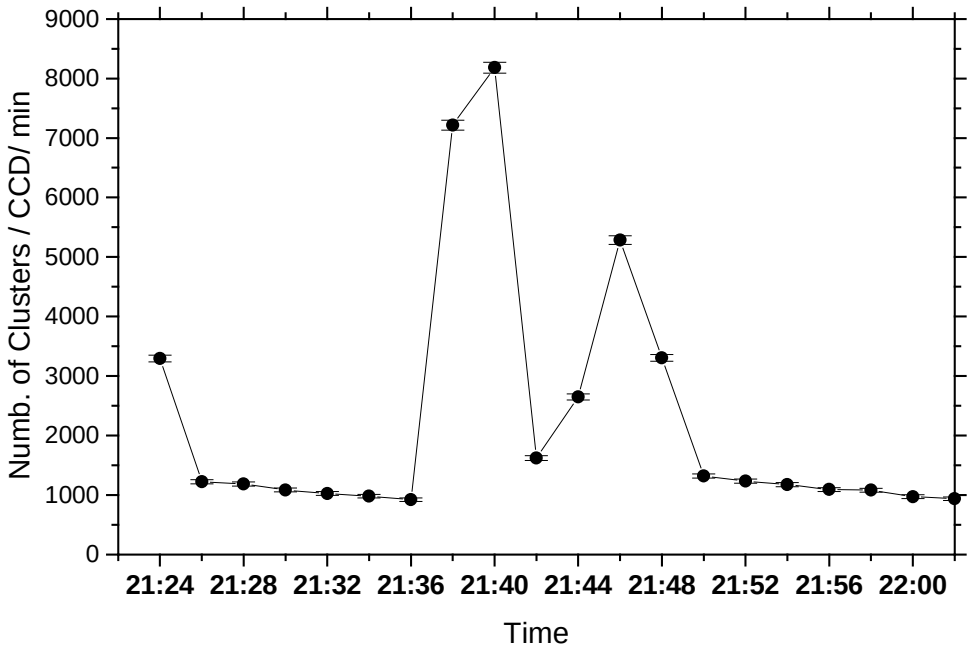

Fig.2: Number of clusters per CCD per minute recorded by the CCDs for the beam period shown in Fig.1.

3) Conclusions

The background created in the DEAR interaction region by the topping-up technique of injection in the main rings of DAΦNE - to reduce time losses and increase the integrated luminosity - was measured by the DEAR NTP setup. CCD detectors recorded cluster events which clearly followed the sequence of repeated injections of electrons and positrons. A partial saturation effect limited to the injection time interval was registered. Using two minutes measurements such periods of injection can simply be cut out of the analysed data. Contrary to KLOE, there is no need for DEAR to switch off its detectors during these injections and hence no extra dead time due to detector switching is accumulated.

References:

[1] M. Preger, "DAΦNE injection system and layout": http:www.lnf.infn.it/acceleratori/dafne/injection.html

[2] T.S. Ueng et al., "Topping up experiments at SRRC", Proceedings of the 5th European Particle Accelerator Conference (EPAC'96)', Sitges (Barcelona), Eds. S. Myres et al., Institute of Physics Publishing, Bristol and Philadelphia, 1996, p.2477.

[3] G. di Pirro et al., "Implementation and performance of the DAΦNE timing system", Proceedings of the 6th European Particle Accelerator Conference (EPAC'98), 22-26 June 1998, Stockholm, Sweden, p.1661.

[4] T. Korhonen, "Review of accelerator timing systems", Proceedings of the ICALEPS'99 conference, 4. - 8. October 1999, Trieste, Italy, p.167.