DEAR Technical Note IR-25

Check of the background sources with the NTP setup

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1 Introduction

Background sources (for clusters and X rays) were investigated in the period 27 July - 5 August 2000, with the NTP setup at DAΦNE, with electrons and positrons beams circulating together, separated - not colliding - in the DEAR I.R., and colliding in the KLOE I.R.

Two kinds of measurements were performed:

- with polyethylene sheets covering the inner walls of the aluminium container of the NTP target;
- with lead-bricks covering the entrance window inside the target.

The motivation and the results of these two measurements are reported below.

2 NTP target with polyethylene inside

During the period 27 July - 3 August we performed measurements at DAΦNE (e^+ and e^- beams circulating together, separated in the DEAR I.R. and colliding in KLOE I.R.) with the NTP setup, in which polyethylene sheets were added inside target - on the aluminium walls. 1 cm thick layers of polyethylene (0.5 cm on the CCD-sides) were covering completely (apart from the entrance window and CCD windows) the aluminium walls.

Table 1: Clusters/CCD/beam loss (mA) and X(R.O.I)/clusters for the NTP setup with polyethylene inside.

Run number	Clusters/CCD/beam loss (mA)	X(R.O.I)/clusters
14739 - 14756	506 ± 40	$(8.7 \pm 0.6) \cdot 10^{-4}$
14882 - 14931	551 ± 40	$(9.5 \pm 0.6) \cdot 10^{-4}$
14932 - 14972	693 ± 60	$(8.8 \pm 0.6) \cdot 10^{-4}$
14974 - 15011	556 ± 40	$(8.9 \pm 0.6) \cdot 10^{-4}$
Mean value	577 ± 40	$(9.0 \pm 0.6) \cdot 10^{-4}$

The goal of this measurement was to investigate the possibility of reducing the X-ray background eventually generated in the aluminium walls by the use of polyethylene. The measurement without polyethylene (reported in [2]) gave an X-ray spectra in which an aluminium-peak was present. This could have meant that part of the X-ray background could be generated in the aluminium walls. The 1 cm thick layer of polyethylene would reduce the X-ray background produced in the walls for example by electrons and positrons bremsstrahlung by more than 90% (for X rays energy between 1 and 10 keV).

Few runs, with series of 1 minute measurements, were performed.

Results, in terms of clusters per CCD normalized to the beam loss, are reported in Table 1. In the table the ratio X rays in the R.O.I. (the Region of Interest) divided by clusters - as defined in [2] - is, as well, reported.

Beam intensities were ranging between 350 mA (at the beginning of the runs) and about 140 mA (at the end of the runs). The ratio Clusters/CCD/beam loss (mA) was approximately constant during each run and

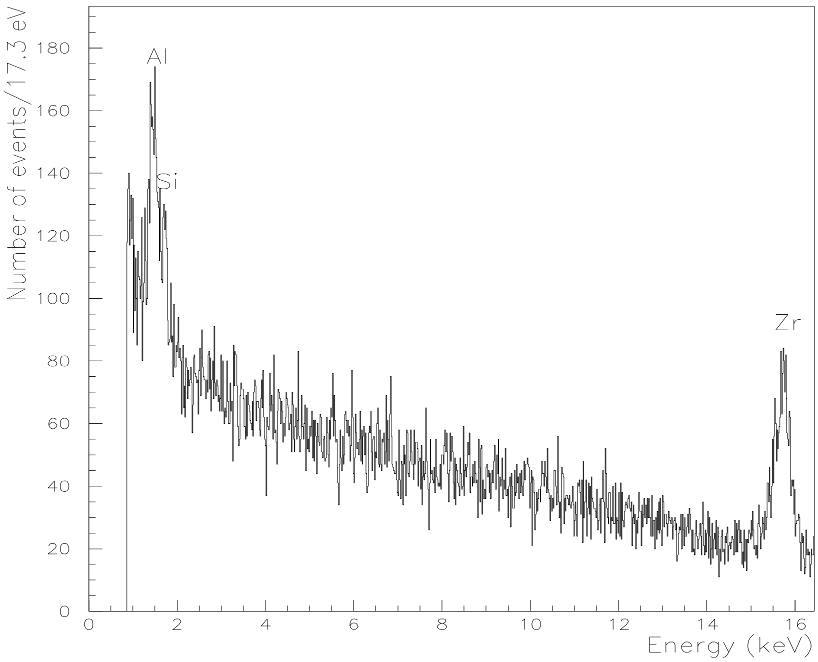

Figure 1: X-ray spectrum collected with the NTP setup with polyethylene inside.

occupancies - apart from the first 3-5 minutes - were below $5-7\%$.

The X-ray spectrum corresponding to all the runs in this period is presented in Fig. 1.

As can be seen from Table 1, the ratio Clusters/CCD/beam loss is, in the limit of the errors, the same as the one reported in [1] (measurement with the same setup, in the same conditions but without polyethylene), which, in fact, is not surprising, since clusters (i.e. charged particles) should *not* be reduced by the used thickness of polyethylene shielding. The ratio X(R.O.I.)/clusters is as well the same as in the runs without polyethylene inside - which demonstrates that polyethylene *did not* act on reducing the soft X-ray background actually.

The aluminium electronic peak (about 1.4 keV) is present in the X-ray spectrum in the same way in which is present in the spectrum without polyethylene. The fact that the X rays were not reduced by the employed polyethylene, means that these soft X rays - seen by CCDs - are produced near (or inside) the CCDs: in the aluminium frame of the CCDs and/or edges of the target cell not covered by aluminium.

3 NTP target with lead inside

For the last two days of measurements (4 and 5 August 2000), we wanted to check the Monte Carlo result that the main part of background arrives through the entrance window inside the NTP-target.

In order to check this hypothesis we placed 2 lead-bricks inside the target - on the entrance window of the target. The lead-bricks (standard ones) were covered with a 1 cm thick layer of copper - in order to absorb the electronic X rays of lead itself.

The occupancy of the CCDs during runs was verified to be such that we could perform safely 2 minutes readout time measurements.

A series of 4 runs were performed (each one consisting of 20-30 measurements).

Then, on 5 August, a crash (due to a strong thunderstorm) of the main CPU-unit of DAΦNE occurred, and measurements were stopped. Due yo this crash we only had the values of beam currents (from the DAΦNE monitor) for the first run, which we analysed. The result, in terms of Clusters/CCD/beam loss (constant during run) was:

$$Clusters/CCD/beam\ loss\ (mA) = 126 \pm 15 \tag{1}$$

This means that background - in terms of clusters - operating this shielding - was reduced by a factor of:

$$\frac{(Clusters/CCD/beam\ loss\ (mA))^{no\ lead}}{(Clusters/CCD/beam\ loss\ (mA))^{lead}} = 4.3 \pm 0.4 \tag{2}$$

which means that about $70 - 80\%$ of the background comes from the entrance window, as expected from Monte Carlo simulations.

References

[1] B. Lauss, C. Petrascu, “Monte Carlo Calculation for the new NTP DEAR setup”, DEAR Technical Note, IR-23, July 17, 2000.

[2] M. Augsburger *et al.*, “First measurements at the DAΦNE ϕ-factory with the DEAR experimental setup”, LNF-99/32(P) (1999), accepted for publication by Nuclear Instruments and Methods in Physics Research A.