DEAR Technical Note IR-24

Electron versus positron background measurements in the DEAR interaction region

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1) Introduction.

After the background measurement of July 2000 performed with the DEAR NTP setup when beams were colliding in KLOE, see DEAR Technical Note 23 [1], new background measurements have been performed with either only electron or only positron beams circulating in DAΦNE. The goal of the present measurements is to compare electrons versus positrons produced background in conditions of no beam-beam effect in the KLOE interaction region. Indeed this kind of measurements was extensively exploited by DEAR before the recent shutdown and reported in a paper to appear on N.I.M. [2]. They are now repeated in the new machine configuration.
The experimental results reported in this Note are referring to CCD clusters measurements (with the NTP setup) and to kaon monitor background rates.

2) CCD clusters measurements.

CCD clusters measurements have been performed in the following machine configurations:
- only positron beam circulating in DAΦNE;
- only electron beam circulating in DAΦNE.

The results of the analysis of these measurements are reported in the following sections.

2.1 CCD clusters measurements for circulating positrons.

Dedicated CCD runs (each one of 1 minute and 30 seconds) have been performed for the positron-beam of 25 July 2000. The positron beam current, as given by the DAΦNE monitor, is reported in Fig. 1.

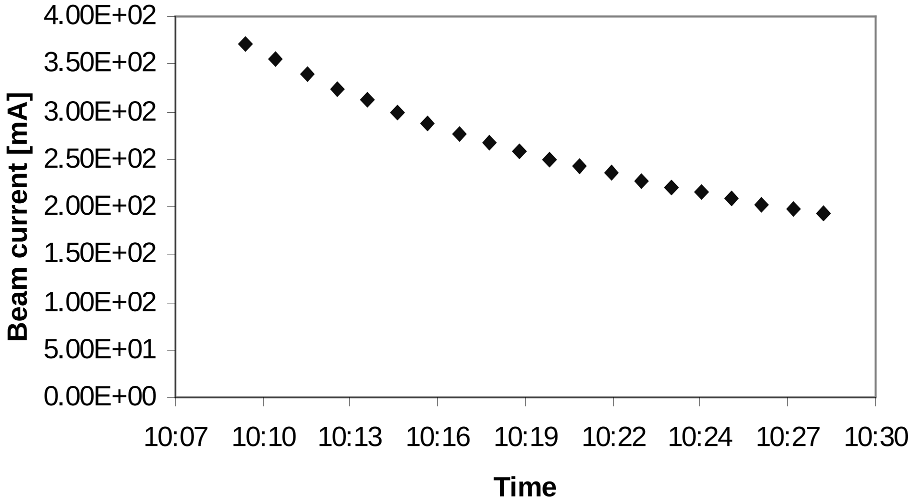

Figure 1: Positron beam intensity of 25 July 2000.

In Fig. 2 the time behaviour of the registered numbers of clusters per CCD, normalized to the beam current loss in the measurement interval, is reported.

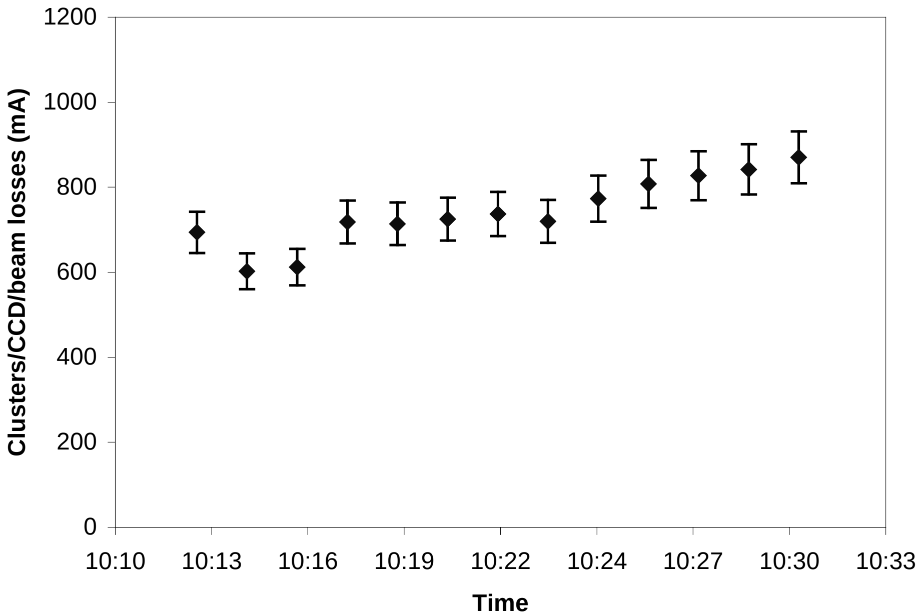

Figure 2: Positron results, as measured on July 25, 2000.
The measurement time was 1.5 minutes, allowing for occupancies smaller than 7%.

2.2 CCD clusters measurements for circulating electrons.

Dedicated CCD runs (each one of 1 minute) have been performed for the electron beam of 25 July 2000. The electron beam current, as given by the DAΦNE monitor, is reported in Fig. 3.

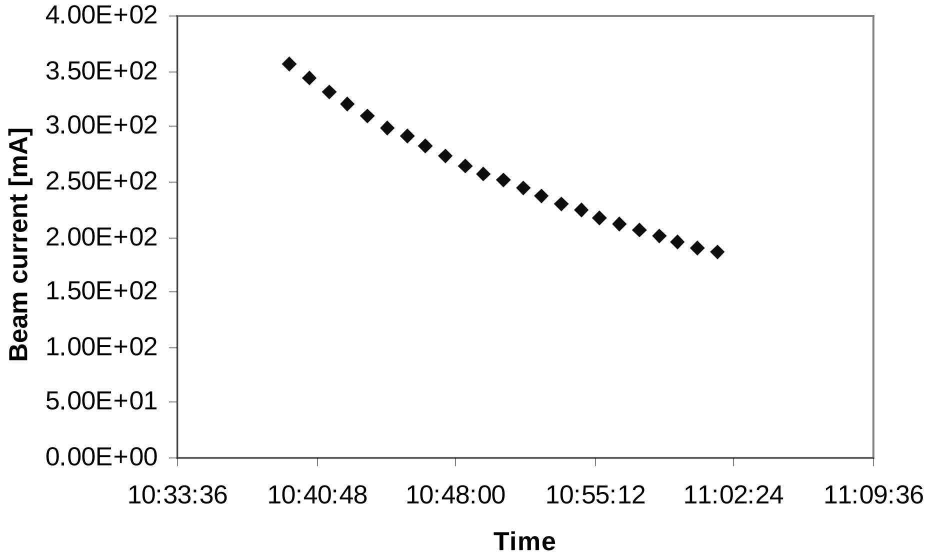

Figure 3: Electron beam intensity of 25 July 2000.

In Fig. 4 the time behaviour of the registered numbers of clusters per CCD, normalized to the beam current loss in the measurement interval, is reported.

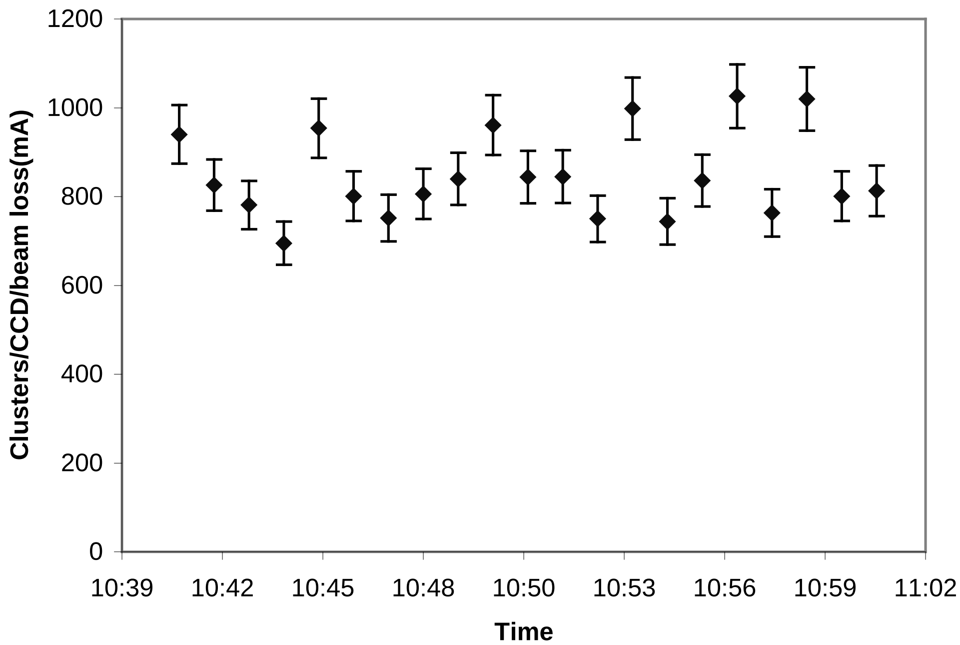

Figure 4: Electron results, as measured on July 25, 2000.
The measurement time was 1 minute, allowing for occupancies smaller than 7%.

2.3 Results of the comparison electron versus positrons induced background and with beam colliding in KLOE, as measured by CCDs.

In Table 1 the results of the background measurements with only positrons or only electrons circulating in DAΦNE on July 25, 2000 are reported. In the Table, the background measurements with beams colliding in KLOE on July 19, 2000 are as well reported.

Table 1

Background measurements performed with CCD with electrons or positrons circulating in DAΦNE.

Date	Beam	Number clusters/CCD/Beam loss (mA)
25/7/2000	e^+	770 ± 50
25/7/2000	e^-	842 ± 59
19/7/2000	$e^+ e^-$ collisions in KLOE	543 ± 40

The results allow to draw the following conclusions:

- **no difference,** within the errors, between the background produced by circulating **positrons or electrons**, measuread as numbers of clusters per CCD, normalised to the beam loss in the measurement interval, could be found;
- the background measured in the DEAR interaction region when the beams are **colliding in KLOE** is **lower** than that measured when **no beam-beam effect** is present.

2.4 Electrons versus positrons comparison using a different normalization.

A different normalization was as well checked. The number of clusters registered by CCDs was divided by the square of the beam current at the beginning of the measurement, and multiplied for a factor (0.093 for positrons and 0.135 for electrons) related to the beam dimensions, as given by the machine staff.
The results in terms of these normalizations are presented in Fig.5 and 6, an summarised in Table 2.

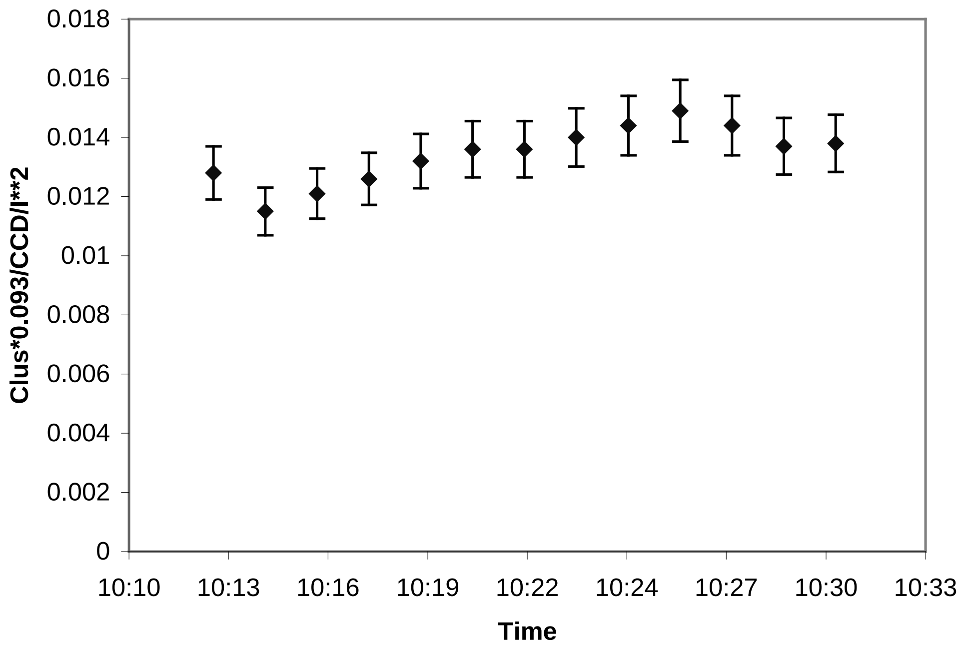

Figure 5: Positrons results, using a different normalization.

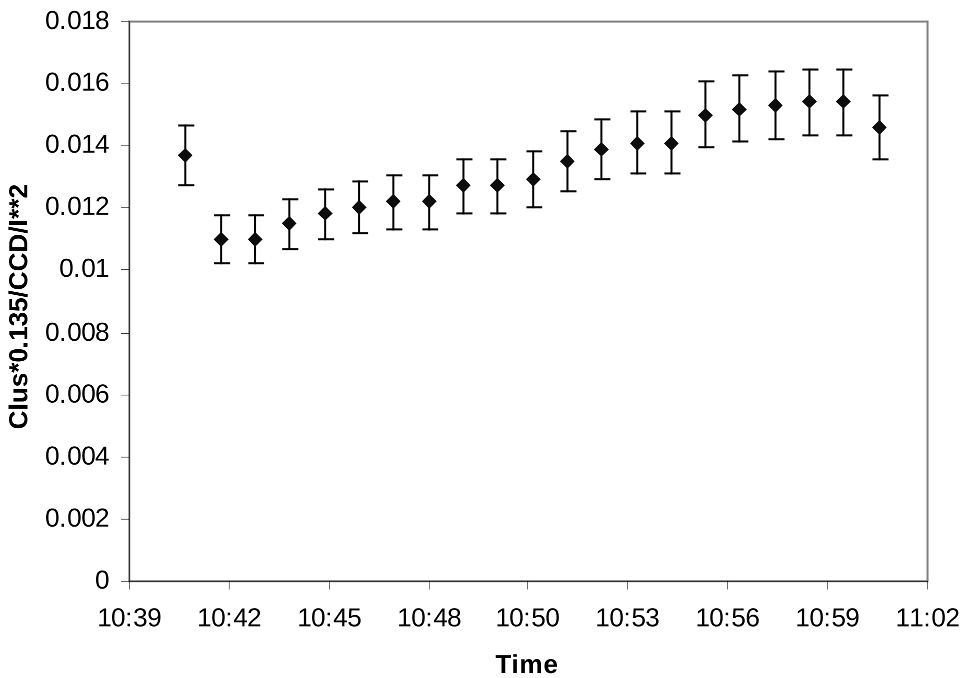

Figure 6: Electrons results, using a different normalization.

Table 2
Electrons and positrons induced background using a different normalisation.

Beam	F	Number of clusters*F/CCD/(beam current)**2
e^+	0.093	1.34 ± 0.09
e^-	0.135	1.32 ± 0.09

From Table 2, it turns out that the two **new values** of the induced background by electrons and positrons **coincide** within them, **in agreement** with the result obtained in the previous comparison, reported in Table 1.

3) Kaon monitor measurements.

Kaon monitor background rates have been measured in the following machine configurations:

- only positron beam circulating in DAΦNE;
- only electron beam circulating in DAΦNE;
- beams in collision in the KLOE interaction region.

In order not to reject any m.i.p.s, the discriminator thresholds were fixed to a very low value (30 mV), while the average pulse heigth was about 500 mV.

At the present level of background, the rates recorded by the scintillators were quite high (of the order of hundreds kHz), allowing us to perform short scans (few seconds).

The results, in terms of counting rates of a single scintillator, normalised to the beam losses during the measurement interval, are shown in Figures 7-10.

3.1 Kaon monitor results for circulating positrons.

A dedicated run with 10 second scans was performed with the positron currents reported in Fig.1.
In Fig.7, the background rates measured by one scintillator (both have the same rate), normalised to the beam losses, are reported. A constant behaviour with time is clearely seen.

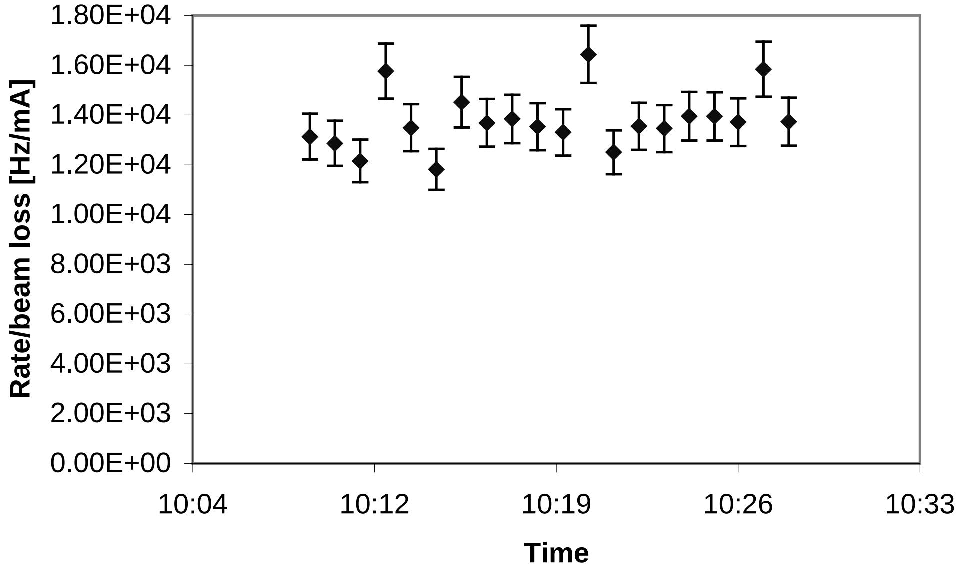

Figure 7: Positron counting rates normalised to the beam loss in the measurement interval.

3.2 Kaon monitor results for circulating electrons.

A dedicated run with 10 second scans was performed with the electron currents reported in Fig.3. In Fig.8, the background rates measured by one scintillator (both have the same rate), normalised to the beam losses, are reported. A constant behaviour with time is clearely seen.

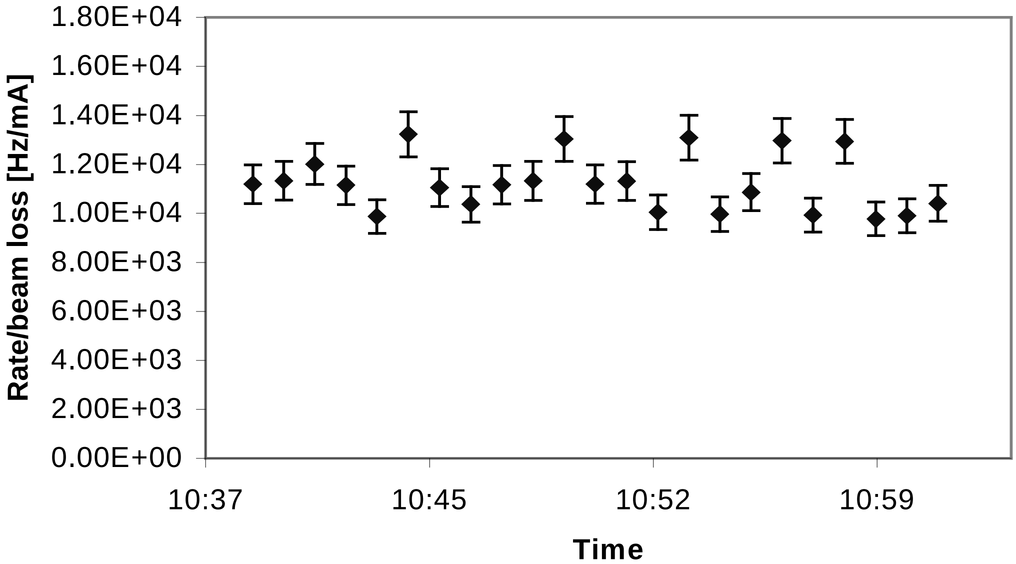

Figure 8: Electron counting rates normalised to the beam loss in the measurement interval.

3.3 Kaon monitor results for interacting beams in KLOE.

The counting rates of scintillators when beams collide in KLOE were recorded. The currents reported for this run are plotted in the Fig. 9.

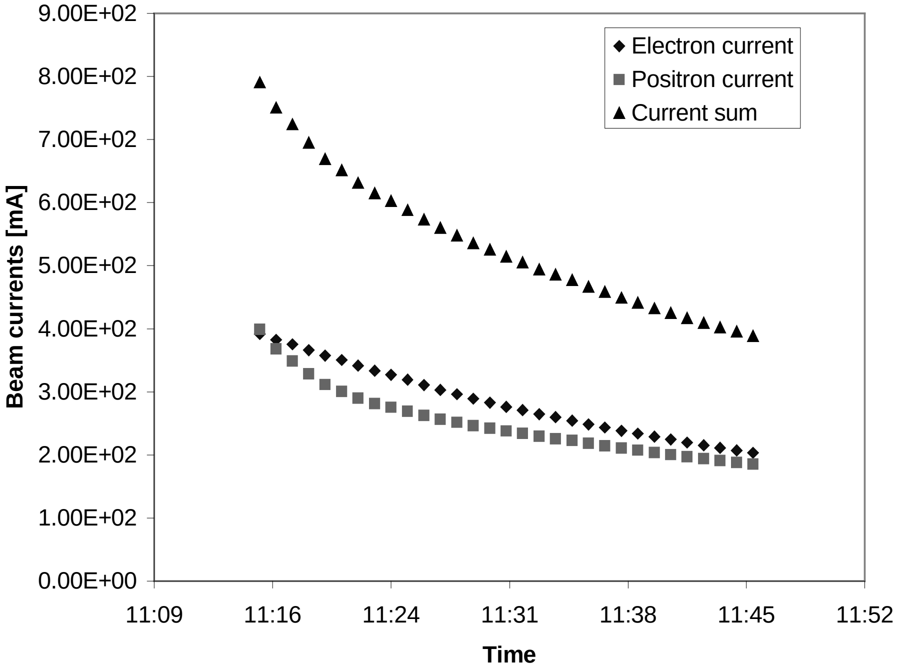

Figure 9: Positron, electron and sum of currents for two beams colliding in KLOE on 25/7/2000.

In Fig.10, the background rates measured by one scintillator (both have the same rate), normalised to the beam loss, are reported. At the beginning of the measurements period, the high background level put the PMs in conditions near the saturation regime. After that, a stable response with time of the normalised rates with respect to beam loss was again observed.

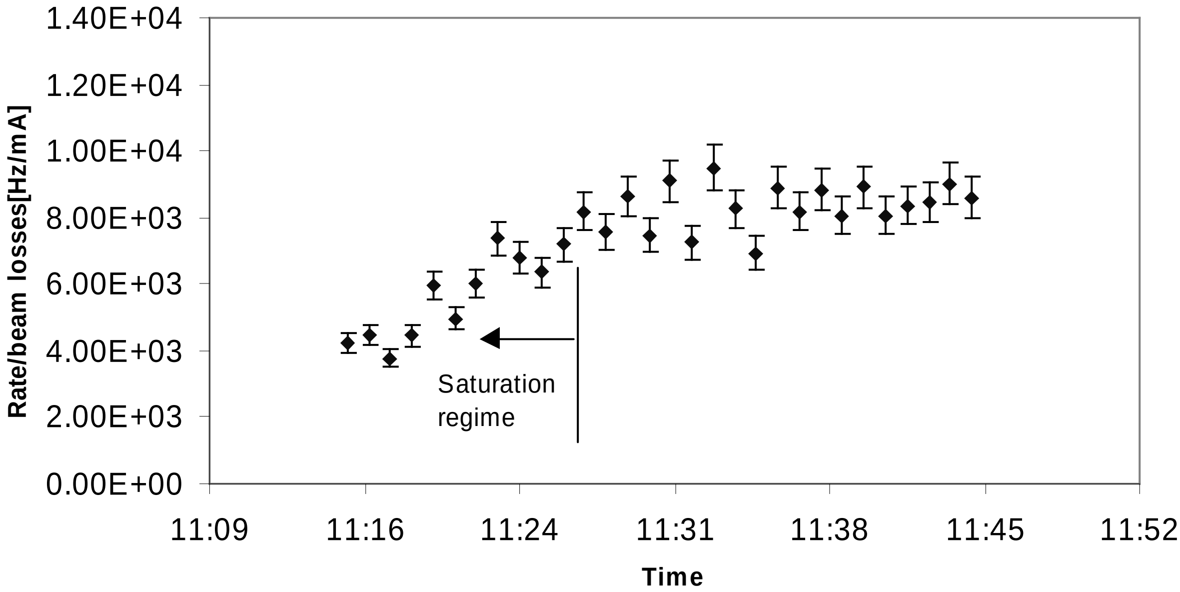

Figure 10: Counting rates normalised to the beam loss in the measurement interval for two beams colliding in KLOE.

3.4 Results of the comparison electrons versus positrons induced background, and with beams colliding in KLOE, as measured by the kaon monitor.

In Table 3 the results of the background rates measured by the scintillators of the kaon monitor on July 25, 2000, with only electrons or only positrons and for beam colliding in DAΦNE, are reported.

Table 3

Background measurements performed with the kaon monitor with electrons or positrons circulating in DAΦNE.

Date	Beam	Counting rates/beam loss
25/07/2000	e^+	13761 ± 1164
25/07/2000	e^-	11226 ± 1153
25/07/2000	e^+e^- collisions in KLOE	8192 ± 662

The results allow the following conclusions:

- **no difference,** within the errors, between the background rates, normalised to the beam loss, induced by circulating **positrons or electrons** could be checked;
- the rates are **lower** when the beams are **colliding** in KLOE.

References:

[1] B.Lauss, C.Petrascu, "Comparison of background measurements in the DEAR interaction region for collisions in KLOE in December 1999 and July 2000", DEAR Note-IR 23

[2] M.Ausburger 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.