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Characterisation of the Test Beam Lines T21 and T24 at DESY II

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Abstract

In this memo the rate measurements of the testbeam 21 and 24 at DESY II synchrotron will be given. The measurements were done by a detector consisting of a 4-fold trigger system and a calorimeter.

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1 Introduction

In DESY II synchrotron, there are three testbeams, T21, T22 and T24. Electrons and protons are accelerated at DESY II synchrotron, and then injected to PETRA or DORIS. In addition DESY II generates electrons for the testbeam areas. The main properties and the geometries of the testbeams are analyzed and reported in [1].
In this project, it is aimed to measure the rates at the testbeams T21 and T24. The rates and analysis for the testbeam T22 was done before and reported in [2]. In this memo, the results of [2] will also be covered, and the rates for all three testbeams will be given.

2 The Setup

In DESY II testbeams, the electrons in the synchrotron interact with a primary carbon target and a bremsstrahlung beam is created. The photons generate electron/positron pairs in a secondary target through pair production. There are different sets of secondary targets at testbeam areas, and they are controlled from the control rooms. The electrons are selected to the required energy by controlling the current of the magnet. Figure 1 represents the setup for the beamlines.

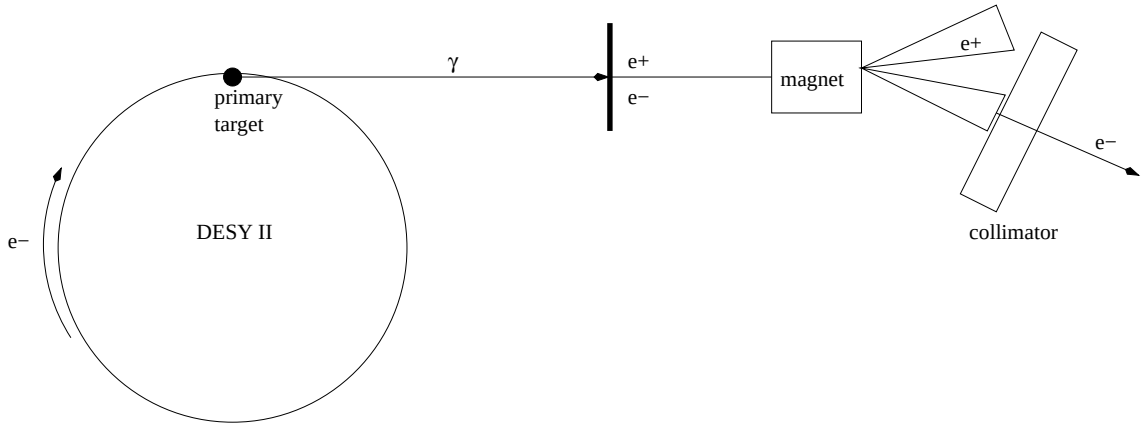

Figure 1: The schema for the beamlines[1].

In these measurements, a detector consisting of a 4-fold trigger system and a lead glass calorimeter is used. The detector called 'Bacchus', was constructed by I.-M. Gregor, H.T. Perez and P. Rahe during a summer student program. Due to a technical problem the calorimeter could not be used during these measurements. The geometry and properties of the detector is also given in [2]. The schema of the detector is given in figure 2.

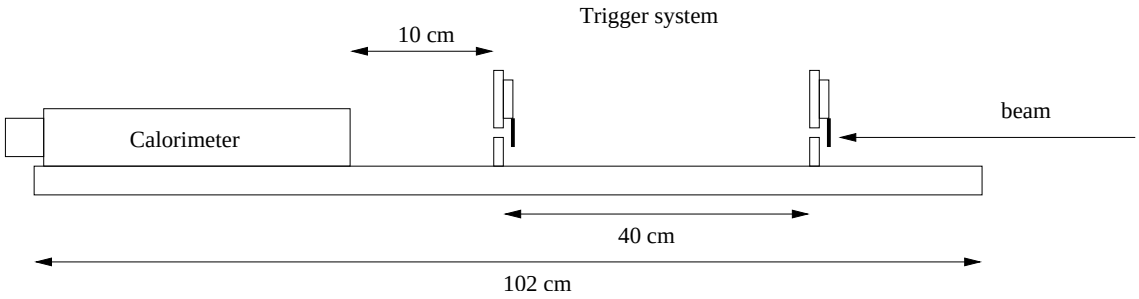

Figure 2: The schema for the detector[2].

3 Results

In this project, the rates at testbeams T21 and T24 are measured. First the beam profiles of T21 and T24 are measured, and then rates achieved with different secondary tergets are measured and compared with the results of T22. Finally, the rates against the current of the magnets at T24 are measured.

3.1 The Beam Profiles

In the project, the rates of T21 and T24 are measured. During the measurements, DESY II was running at DORIS mode with an energy of 6.97 GeV, and a current of 1.8 ± 0.2 mA . The first measurements are done for determination of the beam profile in both vertical and horizontal directions. The measured distributions are fitted by a Gaussian. The results for the beam positions at testbeams T21 and T24 are given in figures 3 and 5 for horizontal X axes and in figures 4 and 6 for vertical Y axes.

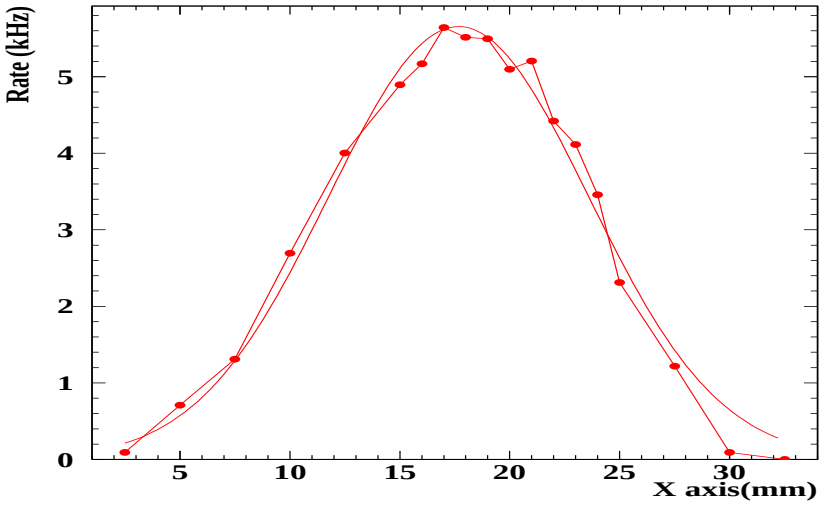

Figure 3: The position X vs rate of T21 with target Cu 3mm, and the gaussian fit with the fit parameters: constant=5.65 , mean=17.68 , sigma=5.91 . DESY II current is 1.8 ± 0.2 mA, and the electron momentum is selected to 3 GeV/c .

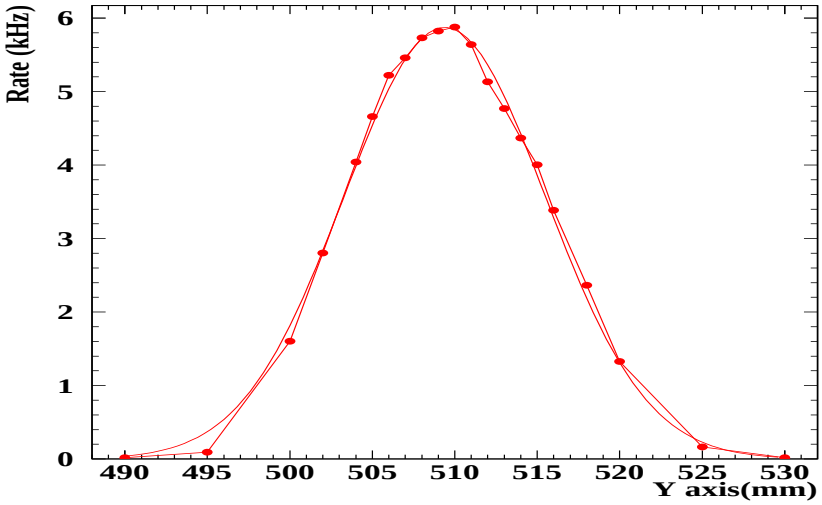

Figure 4: The position Y vs rate of T21 with target Cu 3mm, and the gaussian fit with the fit parameters: constant=5.87 , mean=509.39 , sigma=6.13. DESY II current is 1.8 ± 0.2 mA, and the electron momentum is selected to 3 GeV/c .

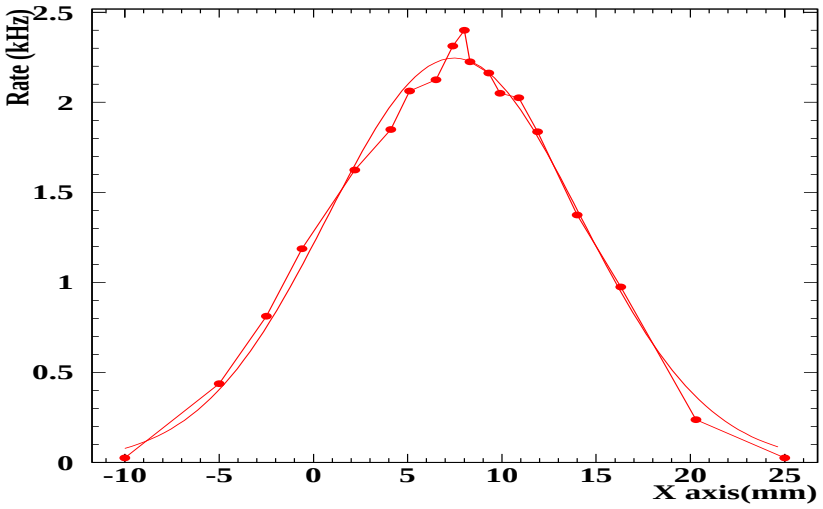

Figure 5: The position X vs rate of T24 with target Cu 3mm, and the gaussian fit with the fit parameters: constant=2.25 , mean=7.47 , sigma=6.73 . DESY II current is 1.8 ± 0.2 mA, and the electron momentum is selected to 3 GeV/c .

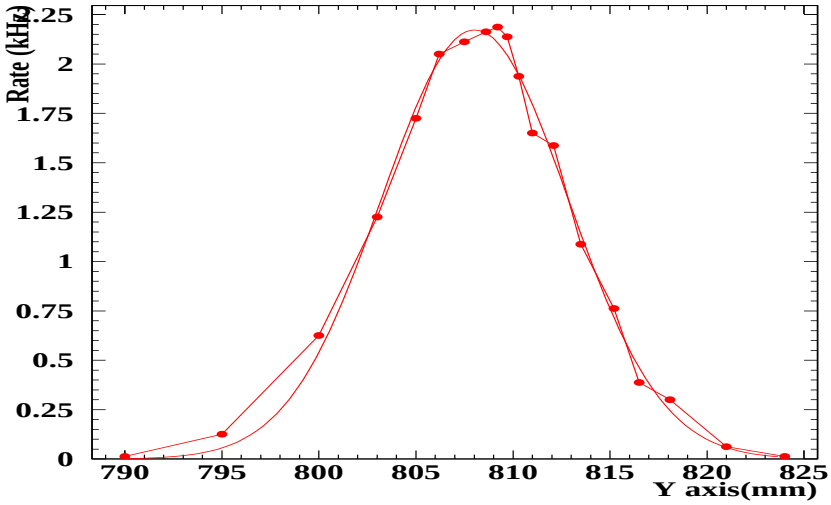

Figure 6: The position Y vs rate of T24 with target Cu 3mm, and the gaussian fit with the fit parameters: constant=2.17 , mean=808.03 , sigma=4.81 . DESY II current is 1.8 ± 0.2 mA, and the electron momentum is selected to 3 GeV/c .

3.2 Rate Measurements for Different Converter Targets

There are several targets available at testbeams T21, T22 and T24. In this part the rates achieved with all possible targets are measured in T21 and T24. The results will be given, including T22. The rate measurements for testbeam 22, was done before, and published in [2]. The measured rates for T22 are given in figure 7.

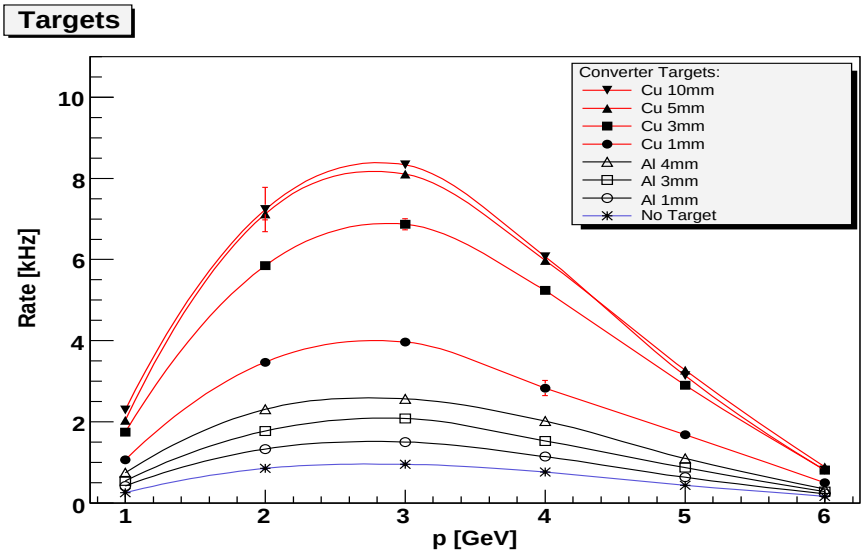

Figure 7: The graph of selected momentum vs rates with different targets at T22[2]. DESY II current is 1.8 ± 0.2 mA.

The available targets at the beam 21 are given in table 1, and they are controlled from the control room, by a motorized remote control.

	Target	Size
1	Cu 5mm	45mm×60mm
2	Cu 4mm	45mm×60mm
3	Cu 3mm	45mm×60mm
4	Al 3mm	45mm×60mm
5	Al 2mm	45mm×60mm
6	Al 1mm	45mm×60mm
7	Cu wire	1mm
8	No Target	

Table 1: Targets available at Testbeam 21

The energy of the electrons are selected by a magnet which is also controlled from the control room. The energy selection is done by changing the current in the magnet. The

rates for all available targets at different energies are measured, and the graphs for T21 are given in figure 8.

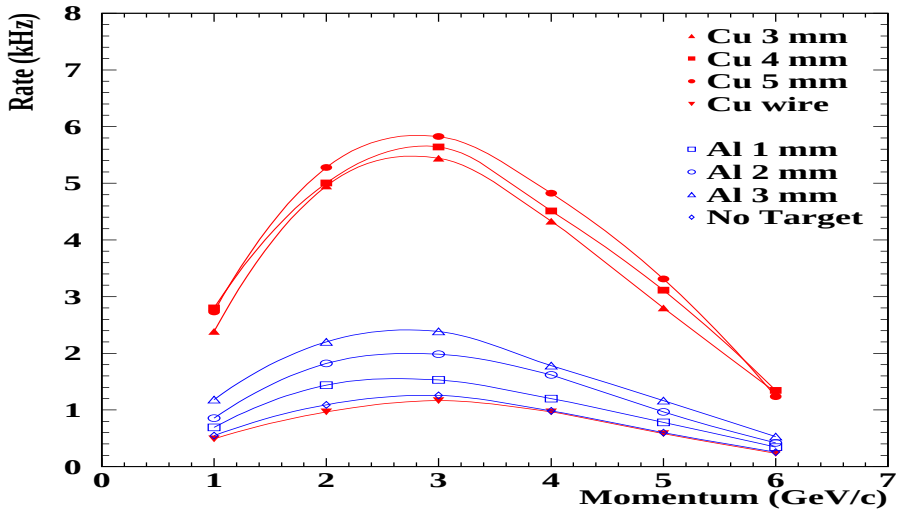

Figure 8: The graph of selected momentum vs rates with different targets at T21. DESY II current is 1.8 ± 0.2 mA.

Similarly, for testbeam 24, the available targets are given in Table 2.

	target	size
1	Cu wire	1mm
2	Cu 4mm	45mm×60mm
3	Cu 3mm	45mm×60mm
4	Al 3mm	45mm×60mm
5	Al 2mm	45mm×60mm
6	Al 1mm	45mm×60mm
7	Cu wire	1mm
8	No Target	

Table 2: Targets available at Testbeam 24

The rate measured at T24 is less then T21, so two set of measurements are done and exactly same results for rates at T24 are found, and given in figures 9 and 10.

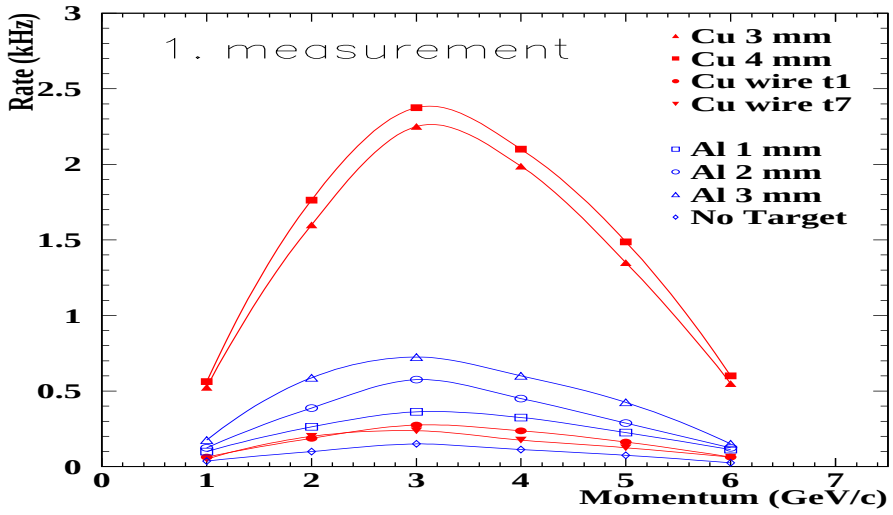

Figure 9: The graph of selected momentum vs rates with different targets T24. DESY II current is 1.8 ± 0.2 mA.

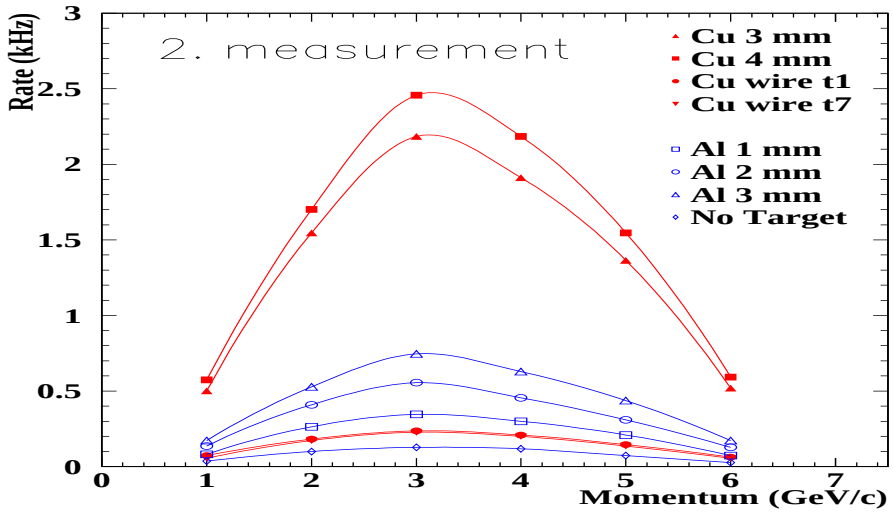

Figure 10: The graph of selected momentum vs rates with different targets at T24(second measurement). DESY II current is 1.8 ± 0.2 mA.

3.3 The Rates versus Magnet Currents at T24

It was observed in previous measurements that the rates at T24 are less then other testbeams. Also setup of testbeam T24 has a difference then the other testbeams. In testbeams the momentum of the electrons are selected by arranging the current in the magnets. In T24 there are two magnets, so these two magnets have to be arranged. The values of the currents for corresponding momentum selection were given. To select electrons with 3 GeV/c, the currents are given as 112 A in Magnet I, and 479 A in Magnet II. At this part the effects of the currents of the magnets on the rates are searched, and as a result graphs of magnet currents versus rates and the gaussian fits are given.

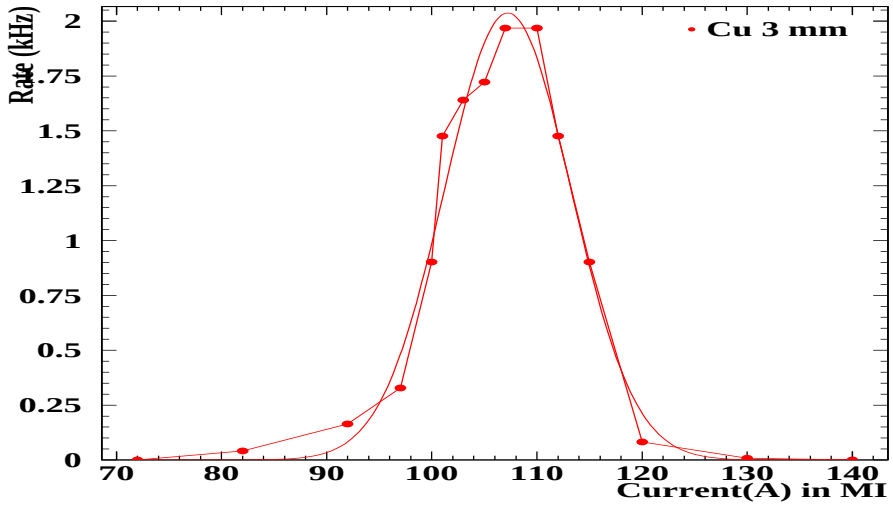

Figure 11: The graph of current in Magnet I vs. rates at T24. The current in MII is set to 480 A, and DESY II was running with a current of 1.8 ± 0.2 mA .(the fit parameters: constant=2.10 , mean=107.0, sigma=6.01)

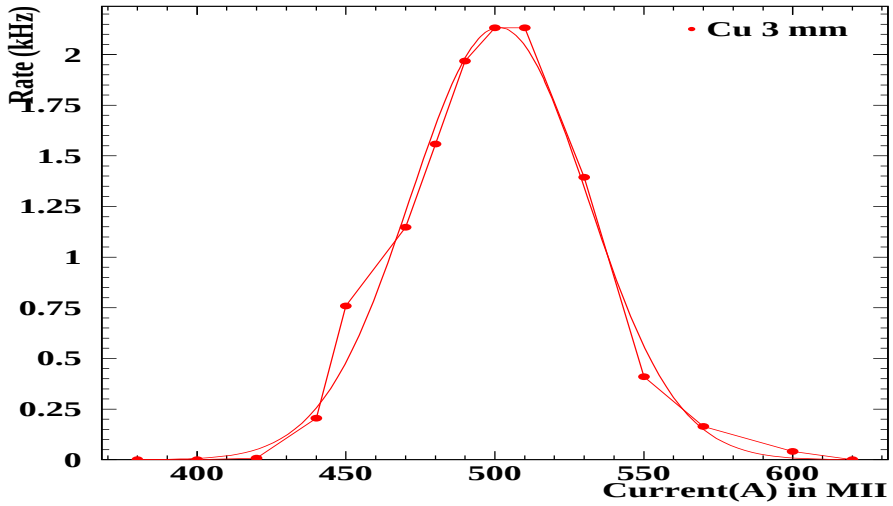

Figure 12: The graph of current in Magnet II vs. rates at T24. The current in MI is set to 112 A, and DESY II was running with a current of 1.8 ± 0.2 mA .(the fit parameters: constant=2.12 , mean=501.0, sigma=29.8)

4 Conclusion

In this project, the profiles of the testbeams T21 and T24 were determined. Beam profiles are found to be a gaussian distribution around the beam positions.
It was also measured at T21 and T24 that, the beams created at different secondary targets have more rates with cupper, increasing with the thickness of the target. The rates achieved with no target was also significant. This is due to 0.5 mm thick aluminium window at the end of the vacuum pipe.
The results for the rates are summarized at table 3.

target	T21	T22	T24
Cu 3mm	6.4	5.2	2.2
Al 3mm	2.0	2.1	0.7
No target	1.0	1.0	0.4

Table 3: The rates achieved with different targets at testbeams T21, T22 and T24 (in kHz.). The current was 1.8 ± 0.2 mA, and the electron momentums were selected to 3 GeV/c.

The results were consistent with the measurements of T22 except the maximum rates of the beams. While the maximum rates for T21 and T22 were about 6 kHz, the maximum rate at T24 was only around 2.5 kHz (%40 of T21 and T22). This is probably due to the

different geometry of testbeam T24. There is much longer distance between secondary target and beam area at T24.

Acknowledgement

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References

[1] T.Behnke, E.Garutti, I.-M.Gregor, T.Haas et al.,'Test Beams at DESY', EUDET-Memo-2007-11, 2007.

[2] H. -T. Perez, P. Rahe, I.-M.Gregor, T.Haas, U. Kotz ,'Characterization and Monte-Carlo study of the T22 Electron Test Beam Line at DESY II', EUDET-Memo-2007-XX, 2007.