An Estimate of the Counting Rates for the Downstream Detectors in the New Dirac Geometry.

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March 2005

According to the Addendum to the DIRAC Proposal some modifications of the current DIRAC setup need to be performed for the new data collection period. Acceptance of the Vertical Hodoscope, Horizontal Hodoscope, Preshower Muon Detector will be increased, including the area near the beam line. In addition, a new set of threshold Cherenkov detectors will be added for the π and *K* identification. Importantly, it has also been proposed to increase the beam intensity by a factor of nearly 2. Thus, it becomes indispensable to estimate detector counting rates for the new conditions. The following is such an estimate for some of the downstream detectors.

Figure 1 shows a schematic view of the downstream part of the DIRAC setup.

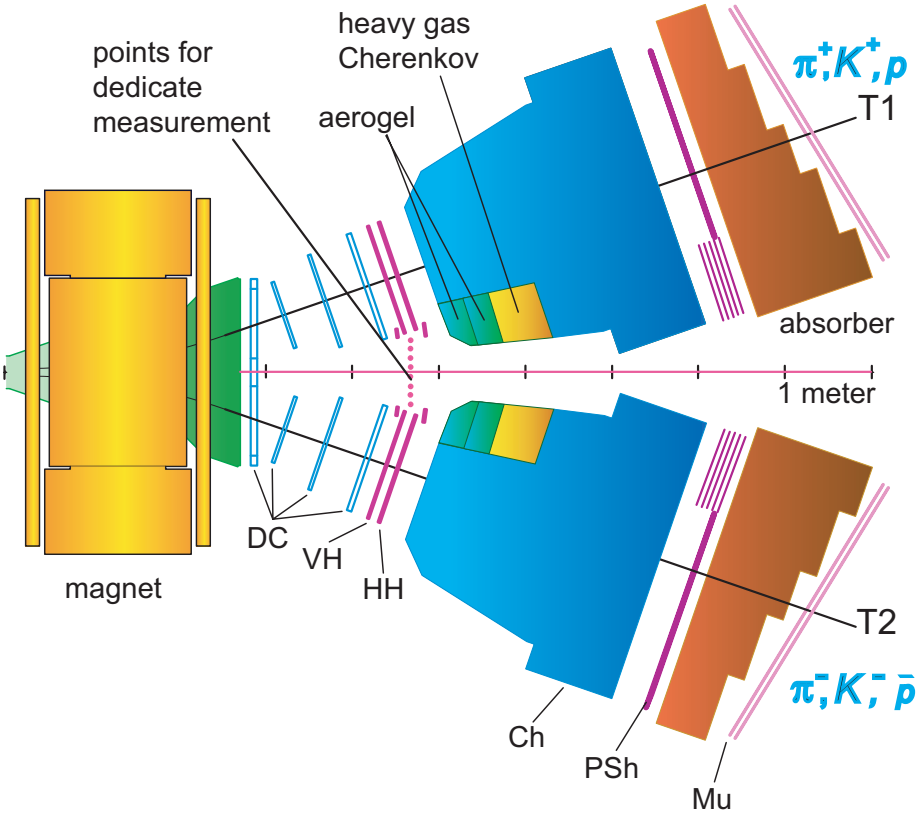

Figure 1: A schematic view of the DIRAC setup (downstream part).

We use the slabs of the left and the right arm of Vertical Hodoscope (VH) to calculate the counting rates on the base of 2002 data and results of a dedicated measurement performed in 2004 in order to get an impression of the counting rates near the central axis of the setup. For this measurement one single slab was used. This slab was placed at several different positions, starting from the right edge of left arm of the

vertical hodoscope and ending at the left edge of right arm, as shown schematically in Figure 1.

The resulting distribution is presented in Figure 2. Bin width is equivalent to one vertical hodoscope slab width (~ 7 cm). Bins 1 to 18 corresponds to the slabs in the left arm, bins 33 to 50 - slabs in the right arm, and bins 19 to 32: results of a scan with one dedicated slab. Yellow color – measured distribution, brown color – "real" distribution assuming the absence of drift chambers support and other materials near the beam line which are absorbing and scattering beam particles.

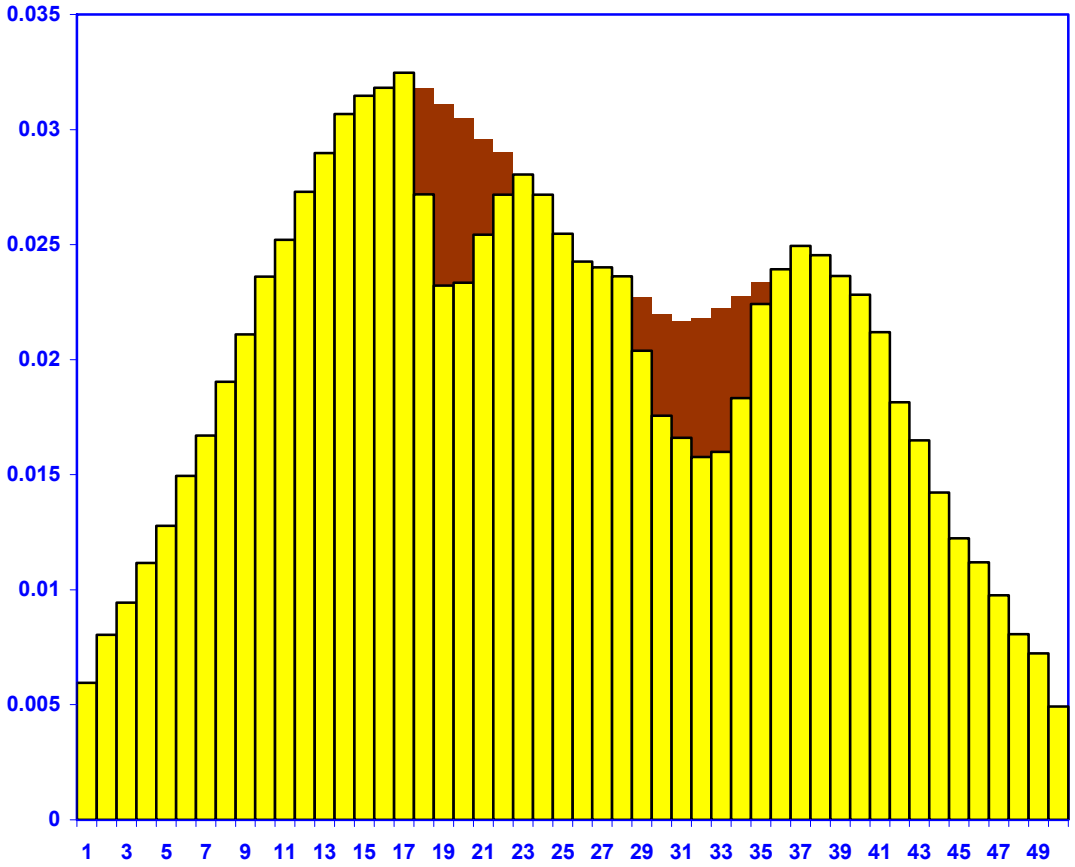

Figure 2: Distribution of the secondary particle hits in the vertical hodoscope.

The following procedure was used to reconstruct this distribution. A hit distribution for vertical hodoscope was reconstructed for a "typical" data of 2001 (24 GeV) with T1 trigger (bins 1-18 and 33-50 in Figure 2). Hit distribution for bins from 19 to 32 was reconstructed based on the results of a dedicated single slab measurement performed in 2004. In the course of this measurement a spare slab of vertical hodoscope was placed behind the one nearest to the beam line in the left and right arms (in order to combine the results of different measurements) and also at several intermediate points between them, Figure 1.

As was mentioned at the beginning, according to the Addendum to the DIRAC Proposal some modifications of the current DIRAC setup will be performed for new data collection. The list of modifications includes extending the vertical, horizontal hodoscopes and preshower detectors. Another important item in this list is the installation of new Cherenkov counters for π, K and p identification.

It is possible to estimate counting rates in the downstream detectors taking into account the distribution presented in Figure 2 and the data collected previously.

All counting rates were calculated for the proposed beam intensity – $1.6 \cdot 10^{11}$ protons per spill and normalised to 1 second. The addition of extra two slabs in each arm of the vertical hodoscope, the increase of the length of the horizontal hodoscope by about 20 cm, and the prospective transverse cross-section of the new threshold Cherenkov detectors to 400×400 mm^2 was taken into account. The results of these calculations are presented in Table 1. Counting rates for Muon Detector are low enough so it's absent in this table. There are three rows for each detector. First raw for each detector – old counting rates for 2001 year. Second raw – new counting rates under the assumption of beam intensity $1.6 \cdot 10^{11}$ and new acceptance of detectors. Third raw – estimation of a lower limit of dead time for detectors. For calculation of this dead time private communication of M. Zhabitsky about dead time measurement for present DIRAC setup was used. Method of this measurement explained in [1].

Table 1: Counting rates per one second for some of the downstream detectors.

		Left arm	Right arm	Maximal occupancy per one channel
Vertical Hodoscope	OLD	$1.5 \cdot 10^6$	$1.0 \cdot 10^6$	$0.13 \cdot 10^6$
	NEW	$2.9 \cdot 10^6$	$1.8 \cdot 10^6$	$0.25 \cdot 10^6$
	Ineff.	> 6%		
Horizontal Hodoscope	OLD	$1.4 \cdot 10^6$	$0.9 \cdot 10^6$	$0.12 \cdot 10^6$
	NEW	$3.0 \cdot 10^6$	$1.9 \cdot 10^6$	$0.27 \cdot 10^6$
	Ineff.	> 8%		
Preshower	OLD	$1.7 \cdot 10^6$	$1.0 \cdot 10^6$	$0.30 \cdot 10^6$
	NEW	$3.4 \cdot 10^6$	$2.1 \cdot 10^6$	$0.60 \cdot 10^6$
		> 16%		
Aerogel and heavy gas Cherenkov detectors	OLD	–	–	–
	NEW	$1.3 \cdot 10^6$	$0.8 \cdot 10^6$	$1.3 \cdot 10^6$
	Ineff.			

It is evident from this table that the occupancy per channel of the Cherenkov counters is very high, but taking into account a wider signal in preshower, the maximal occupancy of the last one is in the same conditions.

References

1. A. Kulikov and M. Zhabitsky, "Dead time losses and their measurement in DIRAC", Nucl. Instr. Meth. A527 (2004) 591.

Comments, suggestions and criticism are welcome.

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