

Long-Term DCAL Analysis

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This is a summary of long-term DCAL analysis so far and a description of where it needs to go in the future. The purpose of the long-term analysis is to determine whether or not the chambers' performance varies over time. This document's purpose is to record efforts taken in analysis and to give a direction to future long-term analysis projects.

I. INTRODUCTION

The project to analyze long-term DCAL data was initiated in the summer of 2012. The original direction of the project was to analyze cosmic ray data that has been taken since the DCAL project first began. Each usable cosmic run would be individually analyzed to determine a number of hits per trigger, or a number of hits recorded per the number of cosmic rays detected by the scintillation counters.

It was immediately determined that, in order to be precise and accurate in the analysis, the data must be grouped by threshold and by chamber that took the data. If hits per trigger numbers for one chamber were graphed all at the same time, regardless of threshold, there would be a wide range of data that was directly affected by controlled variables that were not made uniform. The hits per trigger would naturally be higher for runs of a higher threshold. In much a similar way, the data will vary chamber-to-chamber, so both variables must be taken out of the equation and all of the data must be graphed per chamber and per threshold simultaneously.

The project was, after initial difficulties, expanded to noise data. The same types of graphs would be made using noise data from the different chambers.

II. ANALYSIS TO DATE

Once the project began, the search for an organized list of cosmic data began. After

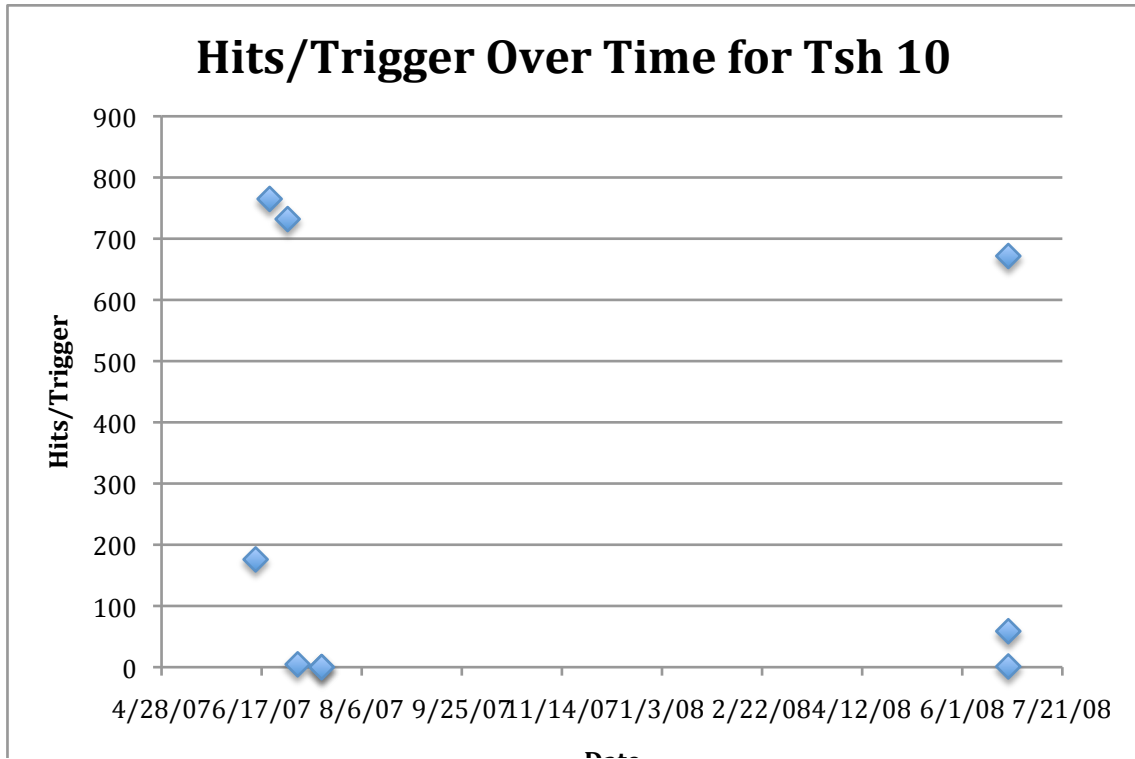
consulting many of the members of the GEM project, it was determined that the DCAL lab book would be the best source for old data. The lab book recorded the cosmic runs and their date. From there, the data was accessed in the heppc20 computer to determine hit and trigger numbers. The numbers were logged into an Excel file for reference.

There were approximately 30 usable cosmic runs found in the DCAL lab book. However, there were too many chamber switches and threshold variations to make useful graphs that were chamber and threshold independent (Here it should be noted that all of the data from one chamber could possibly be put on one graph if the different thresholds were color coded and the variety of thresholds did not put any set of data too far out of range for visual analysis).

After it was determined that there were too few cosmic runs for long-term analysis to be effective, the decision was made to move on to analysis of noise data. The same process of initial analysis was followed, and a graph was made that was not concerned with differentiating between chambers. Since there were only eight data points to graph that were found to be analyzable for hit and trigger numbers, the graph is inconclusive. The only conclusion that can be drawn is that more data is needed in order for effective analysis, the same conclusion that was drawn for the cosmic data. It should also be noted that there were a few noise runs that showed zero triggers.

The cosmic data spreadsheet and graph of noise data are shown below.

Run Number	Date	Chamber	Threshold	Triggers	Hits	Hits/Trigger
200947	6/10/11	0	36	2252	2923	1.30
200951	6/12/11	0	31	17373	37087	2.13
200951	6/12/11	1	31	17373	52965	3.05
200952	6/13/11	0	32	10457	17295	1.65
200952	6/13/11	1	32	10457	24608	2.35
200953	6/14/11	0	33	7589	10177	1.34
200953	5/14/11	1	33	7589	13079	1.72
200955	6/15/11	0	34	7849	8230	1.05
200955	6/15/11	1	34	7849	8466	1.08
200963	6/17/11	0	38	6252	8027	1.28
200963	6/17/11	1	38	6252	8513	1.36
200967	6/20/11	2	36	11849	13157	1.11
200969	6/23/11	2	37	4916	5929	1.21
200970	6/23/11	2	38	25435	29987	1.18
200971	6/25/11	2	36	22472	23819	1.06
200972	6/26/11	2	37	14363	14882	1.04
200973	6/26/11	2	38	12423	13042	1.05
200974	6/30/11	2	35	7432	10313	1.39
201137	7/17/11	0	17	9818	13379	1.36
201137	7/17/11	1	36	9818	9296	0.95
201138	7/18/11	0	17	6737	9977	1.48
201138	7/18/11	1	36	6737	7627	1.13
201147	7/19/11	0	15	10911	78721	7.21
201147	7/19/11	1	34	10911	25778	2.36
201148	7/21/11	0	14	6095	41520	6.81
201148	7/21/11	1	33	6095	41586	6.82
201160	7/21/11	0	11	4681	9718	2.08
201160	7/21/11	1	35	4681	5764	1.23
201204	7/23/11	0	18	7864	10231	1.30
201204	7/23/11	1	37	7864	10520	1.34



On Friday, August 31, a new set of data was discovered. This new set of data supposedly bridges the obvious gap in data that is in between August 2011 and July 2012 on the previous graph, and is in an Excel file in the possession of the previous head of DCAL studies. The data has not yet been analyzed, but should it prove enough data to make an effective study, the same process should be used as was previously described. Also, histograms could be created from the hits per trigger numbers. It should be noted that the chambers' ideal performance would be indicated by a histogram that is centered and precise on one hit per trigger.

III. FUTURE ANALYSIS

The first step in future analysis should be to make one comprehensive database, preferably electronic. Once all of the data is in one place, a program could potentially be written so that a series of graphs could be created as Root objects. Another program could be written to automatically create the histograms for each chamber and threshold. Then, as long as the collection of data continues and the database is kept current, the long-term analysis could be done with a simple command. Of course, the graphs and histograms should be analyzed themselves for conclusions about the DCAL system and GEM chambers' long-term behavior.

The importance of keeping the DCAL lab book current cannot be stressed enough. It is an archive of what has been done with the DCAL system. Each cosmic run and noise series should be recorded along with relevant data gathered. Notes should also be taken on problems and experiences with the system, along with the researcher's conclusions so that the ideas can be passed along to the next person in line. If all of this future analysis is done and a system for keeping everything current is established, then the DCAL team can move on to a new task for the betterment of the HEP team at Arlington.