DIS Parity Trigger Simulation

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This is an update on my effort to simulate the PVDIS trigger using real data. I analyzed DIS data from a run in experiment e99117 which had a large number of pions ($\frac{\pi}{e} \sim 23$). I pass the leadglass and Cerenkov data through an algorithm to simulate the trigger. The Cerenkov is summed and a cut applied to identify electron candidates (fig 1). The leadglass is summed in groups using the summing modules and a cut is applied to the group (fig 2). The grouping was explained in the memos by me and by Albert and Bogdan which are on the PVDIS DAQ web page. Briefly, blocks from the same (X,Y) region are summed in groups that fit into a summing module (8 inputs), and the trigger is the "OR" of the result of these groups. The number of groups depend on whether overlaps are allowed or not.

For the leadglass portion of the trigger, two strategies were compared: I will call them the "Bob" and "Bogdan/Albert" strategies. The "Bob" strategy takes the "or" of the groups of summed leadglass (shower and preshower) as explained in my memo. The "Bogdan/Albert" strategy imposes an additional cut on the preshower to help cut out pions. This was explained in the documents prepared by Albert and Bogdan. As expected, this reduces the pion contamination and also reduces the electron efficiency, see table I.

The cuts on the summed leadglass would be applied to discriminators and determined online from ADC spectra obtained from the summing modules. To compare the strategy of overlap versus non-overlap of leadglass regions, I used both groupings in the algorithm and produced two kinds of triggers. Since the real data had 5 columns for the R-HRS leadglass, but we plan to use only 4 (by sliding the detector over), I added the 5 columns "as if" they were 4. To verify that I had the correct detector map I wrote a leadglass event display and observed 100 events.

The electron trigger requires a scintillator trigger and both the sum-of-leadglass above a cut and Cerenkov above a cut. For the "Bogdan/Albert" strategy an addition cut is required on the preshower detector sum in each group, see fig 4. This reduces the pion contamination as well as the electron efficiency, see table I. The pion requires a scintillator trigger and both the leadglass and Cerenkov *below* the cuts. The gains of the leadglass were matched in software; they would be matched in hardware for the experiment. The results of these triggers were compared to π and e^- samples obtained using an event analysis with standard cuts on Cerenkov (fig 1) and leadglass (fig 3). The electron efficiency is defined as the ratio of electrons found by the electron trigger to those found by the event analysis. The pion contamination is defined as the fraction of pions that survive the electron trigger but show leadglass information consistent with pions. The pion efficiency is defined as the ratio of pions found by the pion trigger divided by those found in the event analysis. The difference between overlap and non-overlap strategies was negligible at the present level of precision based on 500K events.

Let me know if you have some comments or improvements, then I may repeat this with $\sim 20\times$ statistics using the computer farm; the higher statistics may uncover any small differences in overlap strategy.

TABLE I: **PVDIS Trigger Performance**

	Bob Trigger	Bogdan/Albert Trigger
Electron Efficiency of Electron Trigger	100 ($\frac{-1.1\%}{+0\%}$)	89 ($\frac{-1.1\%}{+0\%}$)
Pion Contamination of Electron Trigger	$(3.3 \pm 0.2) \times 10^{-3}$	$(9 \pm 1) \times 10^{-5}$
Pion Efficiency of Pion Trigger	99.3 ± 0.2 %	99.3 ± 0.2 % (same)

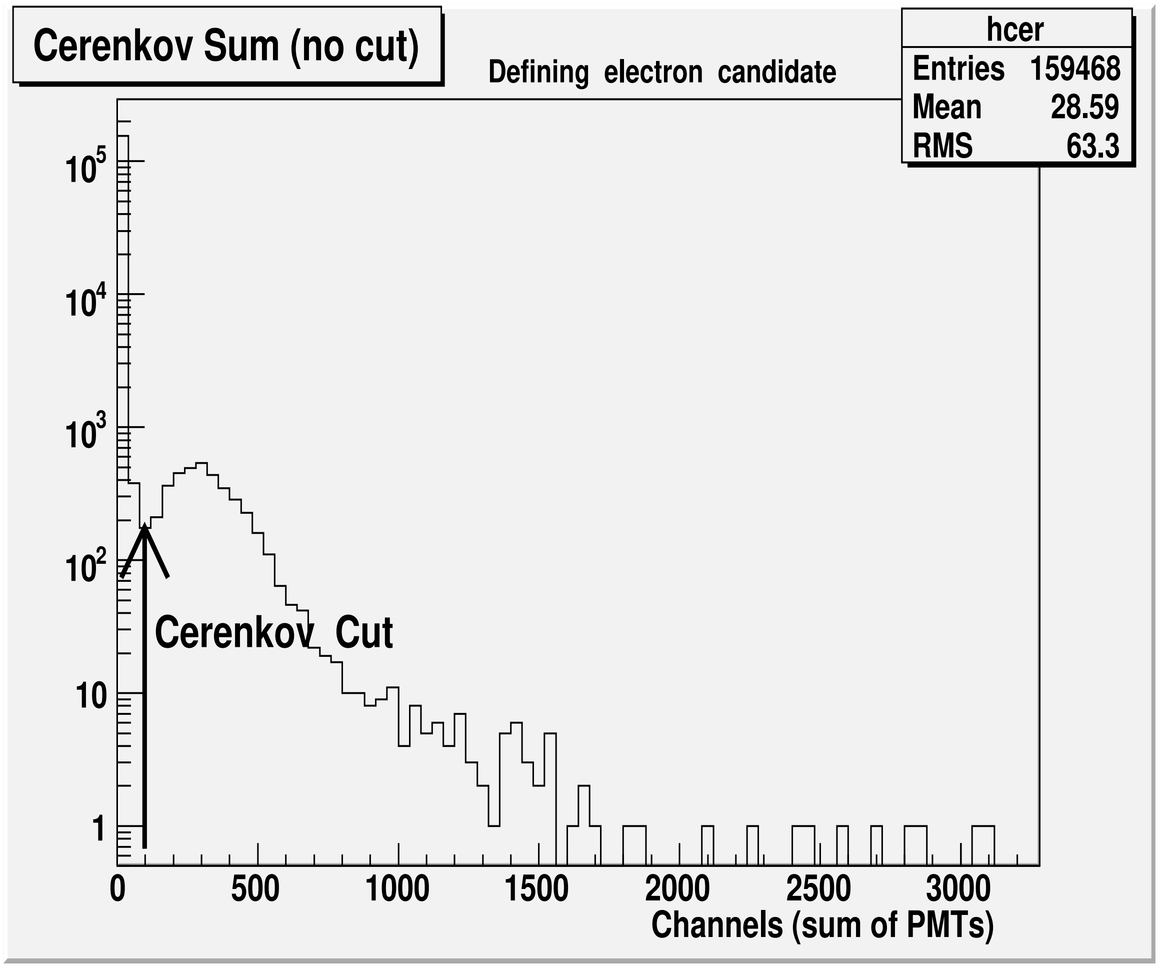

FIG. 1: Cerenkov signal showing the cut used to define electron candidates for the trigger.

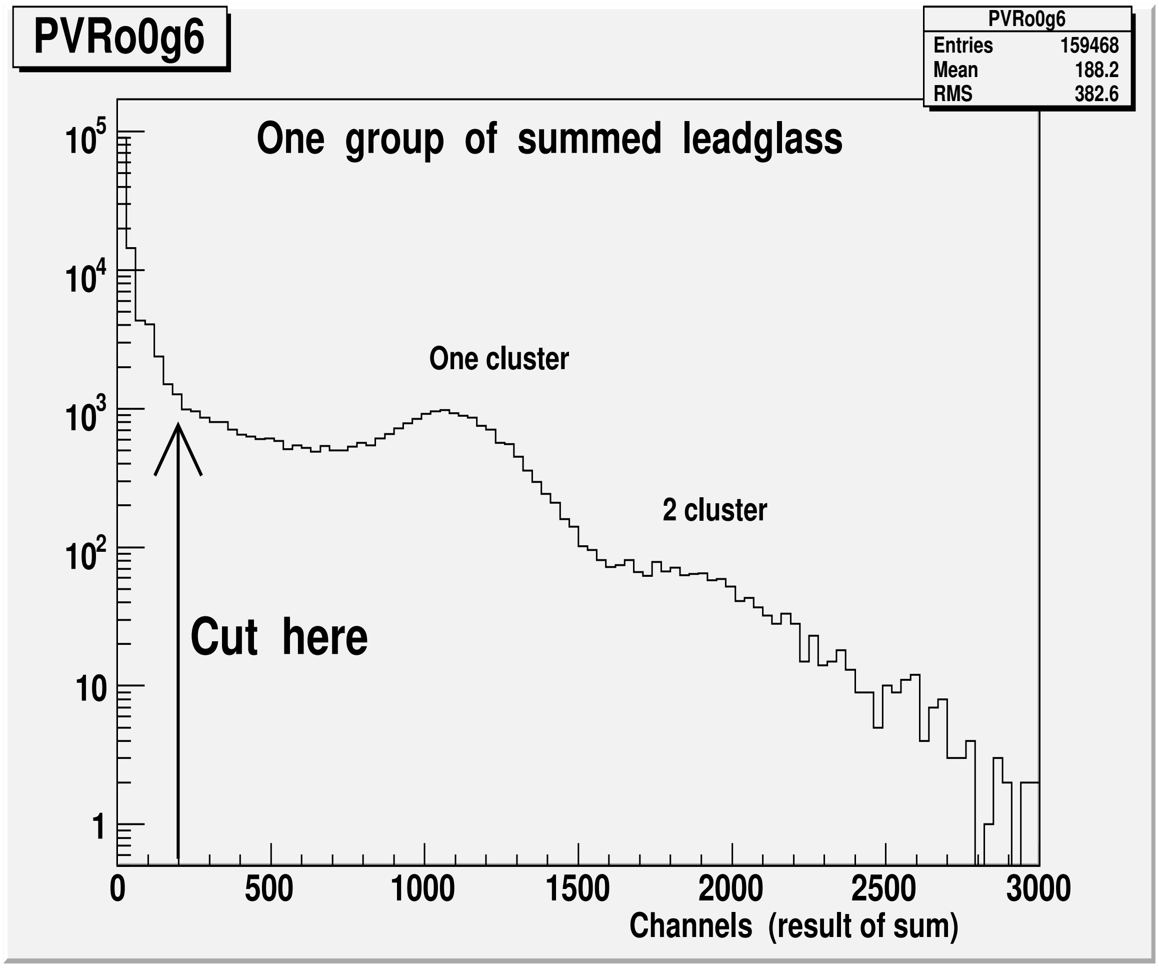

FIG. 2: Sum of leadglass from one group in the trigger. All the groups were similar because the gains were matched. The cut showing the electron candidate for the trigger simulation is shown. Data below the cut are pion trigger candidates. The Cerenkov (fig 1) is also used.

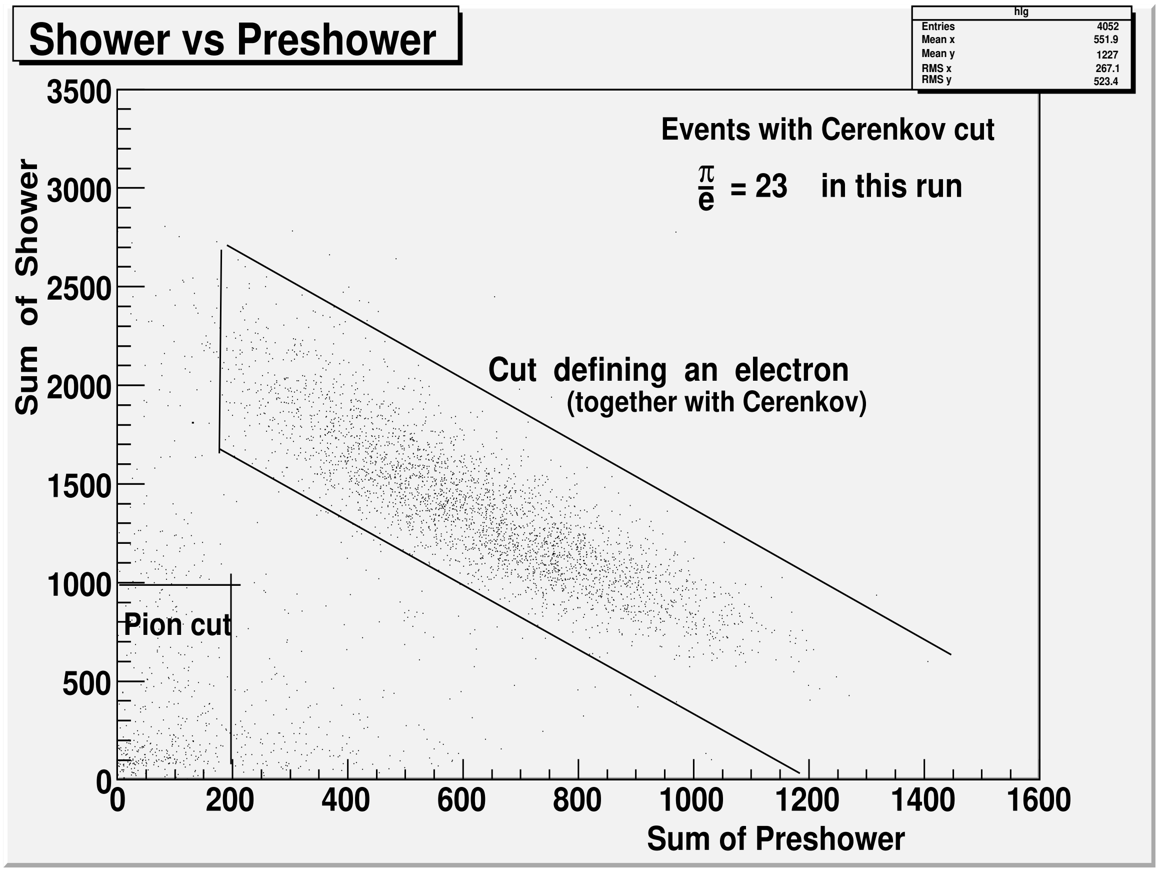

FIG. 3: Sum of shower versus sum of preshower for data with Cerenkov above a cut. The cuts showing electron and pion candidates in the event analysis are shown.

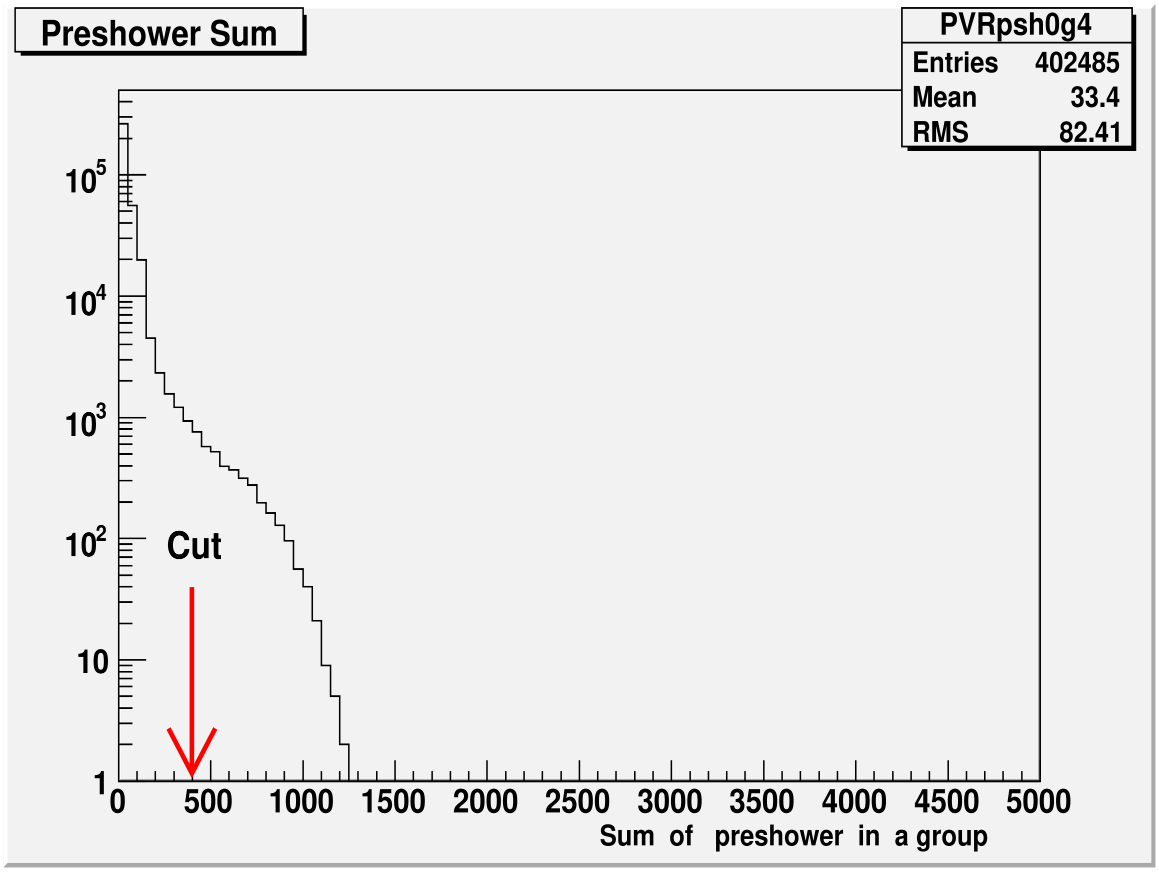

FIG. 4: Cut used on the sum of preshower blocks from a group, as used in the "Bogdan/Albert" version of the electron trigger. An electron must live above this cut in each group.