# Studies of Embedding in the FTPC for 2008 p+p Runs

**Abstract**

This document describes the reactivation of the embedding procedure for the FTPCs and a study of its performance for the 2008 p+p data.

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## 1 Introduction

The embedding procedure had not been used after 2004 when the students of MPI completed their PhDs. Since then the FTPCs were extensively used for anisotropic flow measurements for which corrections are obtained from the reconstructed data directly, without the need for simulations. Now the Texas A+M group is studying correlations between the FPD and the tracks in FTPC West which covers a similar region of phase space. This work requires knowledge of tracking efficiency. The latter is obtained from embedding simulated tracks into real events and checking for their successful reconstruction. Due to the evolution of the STAR software, the embedding procedure was not working anymore. After fixing this problem, an attempt was made to optimize the procedure.

## 2 Reactivation of embedding simulation for the FTPCs

The FTPC embedding chain was last run in 2004 for AuAu data. Changes were necessary to get it running again. All changes are checked into the online/ftpc branch of the cvs repository.

## 3 Cluster simulation and reconstruction

The next step was to tune the StFtpcSlowSimMaker parameters for pp. We found that the conversion factor of charge to ADC pulseheight (adcConversion) was much too large and had to be changed from 1000 to 2100. As demonstrated in Fig. 1 the maximum ADC value in real clusters (left) now agrees well with that of simulated clusters (right).

We then checked the cluster size distributions. From the results shown in Fig. 2 we conclude that the agreement is reasonable. One notices that the clusters of the simulation are more ideal, i.e. their size fluctuates less than in the real data.

After having verified that the cluster characteristics in simulation and data are similar we proceeded to investigate the efficiency of the cluster finder. We display in Fig. 3 for a raw data FTPC event the charge recorded for a padrow in a 2d plot of pad versus timebin number. On the left you can see a clean padrow, on the right there are regions of noise. Comparison by eye

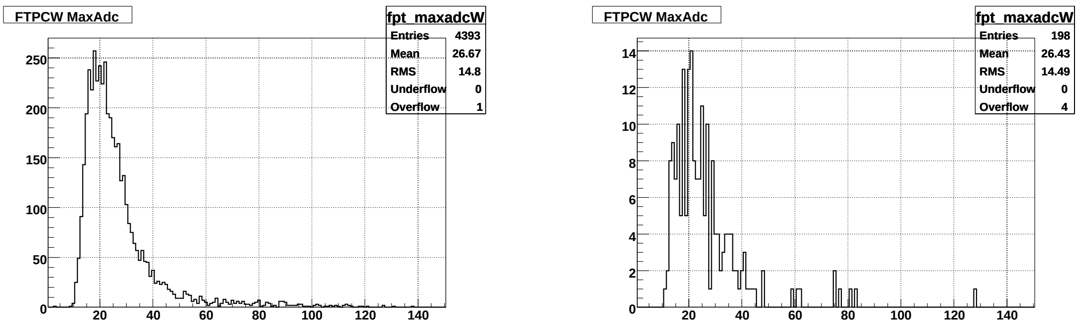



Figure 1: Distribution of maximum ADC value in clusters for data (left) and simulation (right).

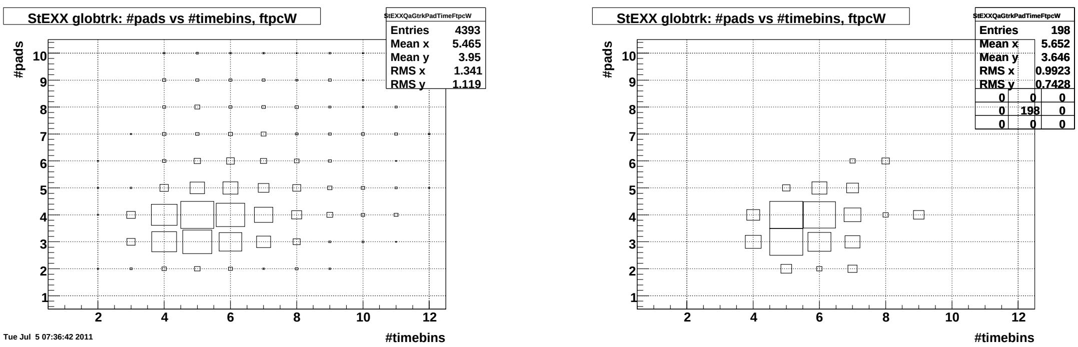
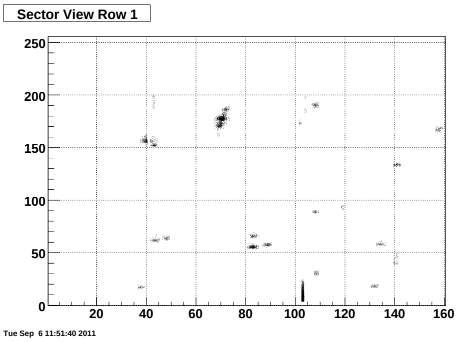



Figure 2: Distribution of number of timebins versus number of pads for clusters on track: simulation (left) and data (right).

of a couple of such plots with the list of clusters found by the cluster finder led to the conclusion that the efficiency of finding clusters is very high in low-noise regions.

So far it was our policy not to remove noisy regions in which there was still a chance of finding clusters in order to maximise the tracking efficiency. We considered this optimal for anisotropic flow analysis for which corrections are derived directly from the data. However, determination of tracking efficiencies from embedding requires stricter control of the cluster reconstruction efficiencies. We therefore excluded noisy regions in addition to dead regions of the FTPCs in the simulation by setting the gain factors for the corresponding pads to zero in 3 steps. Step 1 and 2 are illustrated in Fig. 4 in which you see the gain factors obtained from the pulser run (which injects a voltage pulse into the gating grid wires of the readout sectors and thus only test the electronic circuit) on the left and after cutting out obviously noisy pads (charge sum $> 100$) on the right.

Furthermore, we found that the charge left by tracks in the FTPCs and amplified by the



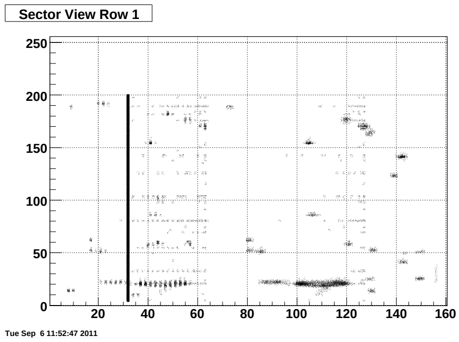




Figure 3: Raw data FTPC event: charge recorded for a padrow in a 2d plot of pad versus timebin number. Quiet padrow (left) and noisy padrow (right).

anode sense wires, is in some regions not recorded by the electronic readout. We studied this by plotting the occupancy of pads by reconstructed clusters. An example for data (the same padrow as shown in Fig. 4) can be seen in Fig. 5 left. Clearly there are additional regions where no clusters are found. We took account of this (step 3) by setting the corresponding gain factors to zero. The resulting final gain table was then used to reconstruct simulated tracks. As can be seen from Fig. 5 right the malfunctioning channels are now properly suppressed in the simulation.

# 4 Example of track reconstruction results

A typical example of the results of cluster finding and track reconstruction in a p+p collision event is depicted in Fig. 6. You see a plot of found clusters (dots), reconstructed tracks (fitted lines) with the first and last points from the fit (crosses). Track associated clusters are shown as the fatter dots. We conclude from visual inspection that reconstructed tracks are fine, but that track reconstruction efficiency could probably be improved by further work on the software. Unfortunately, the authors moved on and are not available any more. (We are grateful to Valery Fine for producing the event display)

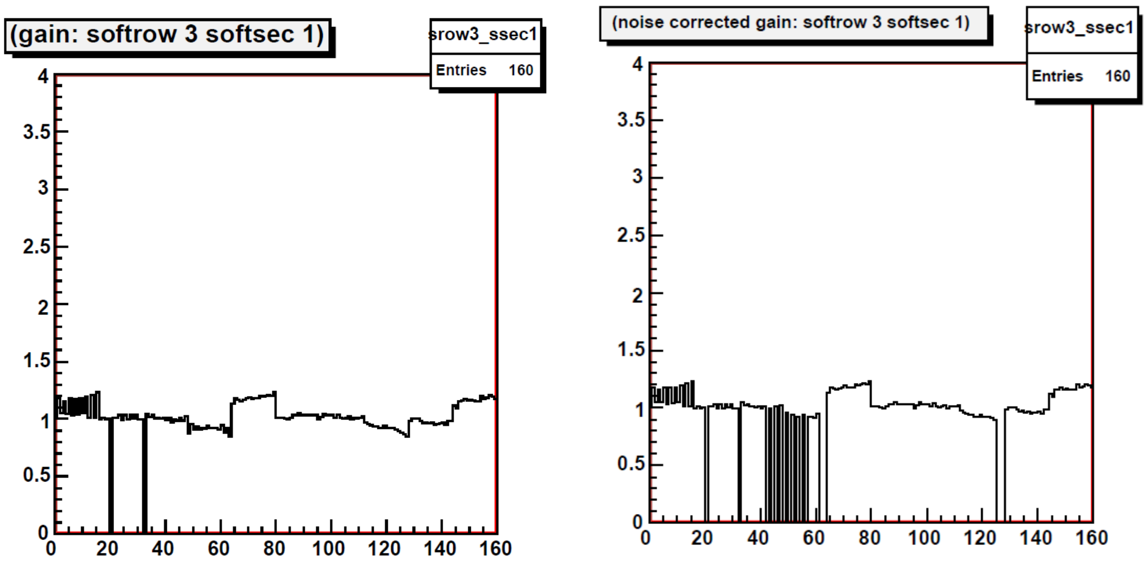



Figure 4: Gain factors versus pad number for one sector: from analysis of a pulser run (left) and with additional masking of noisy pads (right).

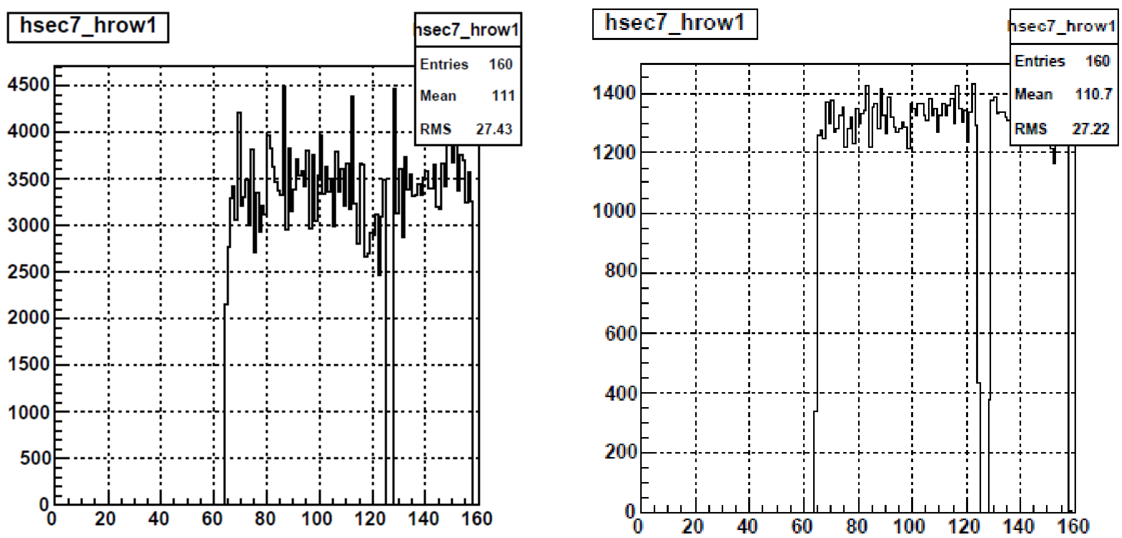



Figure 5: Occupancy by clusters versus pad number for one sector: for a p+p data run using gain table from step 2 (left) and for simulation using the final gain table from step 3 during reconstruction (right).

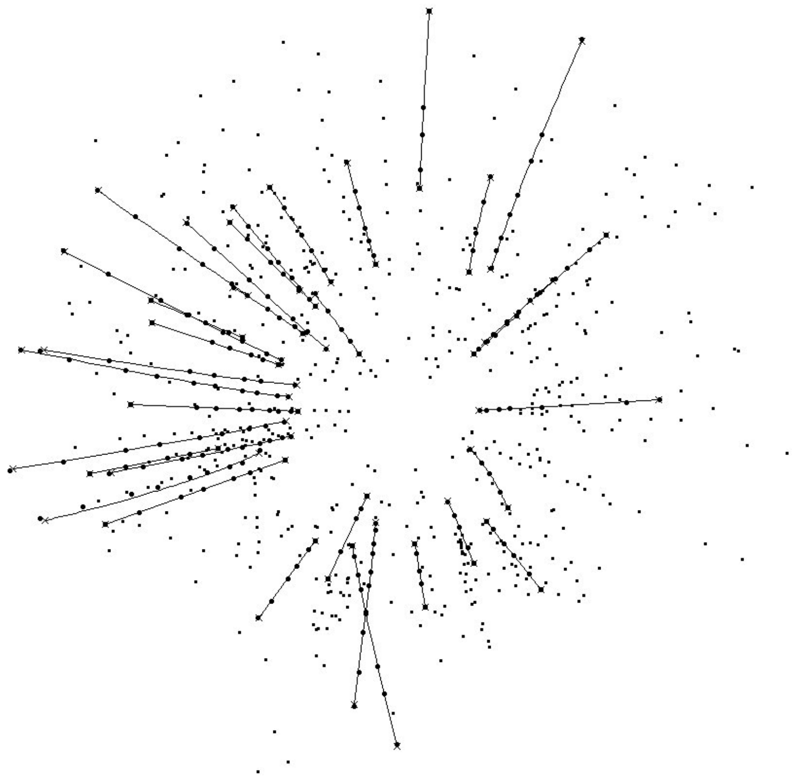


Figure 6: Event display (transverse projection, seen from West) of a typical p+p collision event at $\sqrt{s} = 200$ GeV showing clusters (dots) with reconstructed tracks (lines) superimposed. Crosses depict fitted first and last points on the tracks.