Efficiency and purity of a cut on $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})}$

David E. Jaffe
Brookhaven National Lab

Draft v1 April 6, 2006

Pre-selection criteria is cut5. Note cuts are cumulative (cutN includes cutN-1)

1. cut0 = well-defined charge and uncertainty on q/p
2. cut1 = + x,y,z fiducial cuts on vtx
3. cut2 = + |Uplane-Vplane| < 6 on vtx
4. cut3 = + fitpass && prob(chi2,ndf)>0.1
5. cut4 = + Petyt PID > 0
6. cut5 = + q/p/sigma(q/p)>0 & rnear=(0.5,2.0) m

where rnear $\equiv$ smallest radial position on the reconstructed track.

Figure 1 shows plots of $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})}$ *vs* 'signed' $P(\text{range})$ with the breakdown into CC ν_μ CC $\overline{\nu}_\mu$, NC and other. 'Signed' $P(\text{range})$ means that if the track did not stop in the detector, then $P(\text{range})$ is set negative for plotting purposes.

Figure 2 shows the same distributions as in Figure 1 for $-1 < P(\text{range}) < 10.5$ GeV/c and $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})} > -0.5$

The general features confirm the scan results that $P(\text{curvature})$ is greater than $P(\text{range})$ for ν_μ CC events when charge sign is incorrectly assigned. Similarly NC events show a tail indicating $P(\text{curvature}) > P(\text{range})$ as observed from the scan. Table 1 shows the numbers of events (just raw MC counts, not normalized to protons on target) for the three main sources as a function of a cut on $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})}$ for tracks that stop in the detector. The efficiency and purity of the cut on $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})}$ is shown in Figure 3. It seems like we could get a $\sim$90% purity for a relative loss of efficiency for $\overline{\nu}_\mu$ of $\sim$50%.

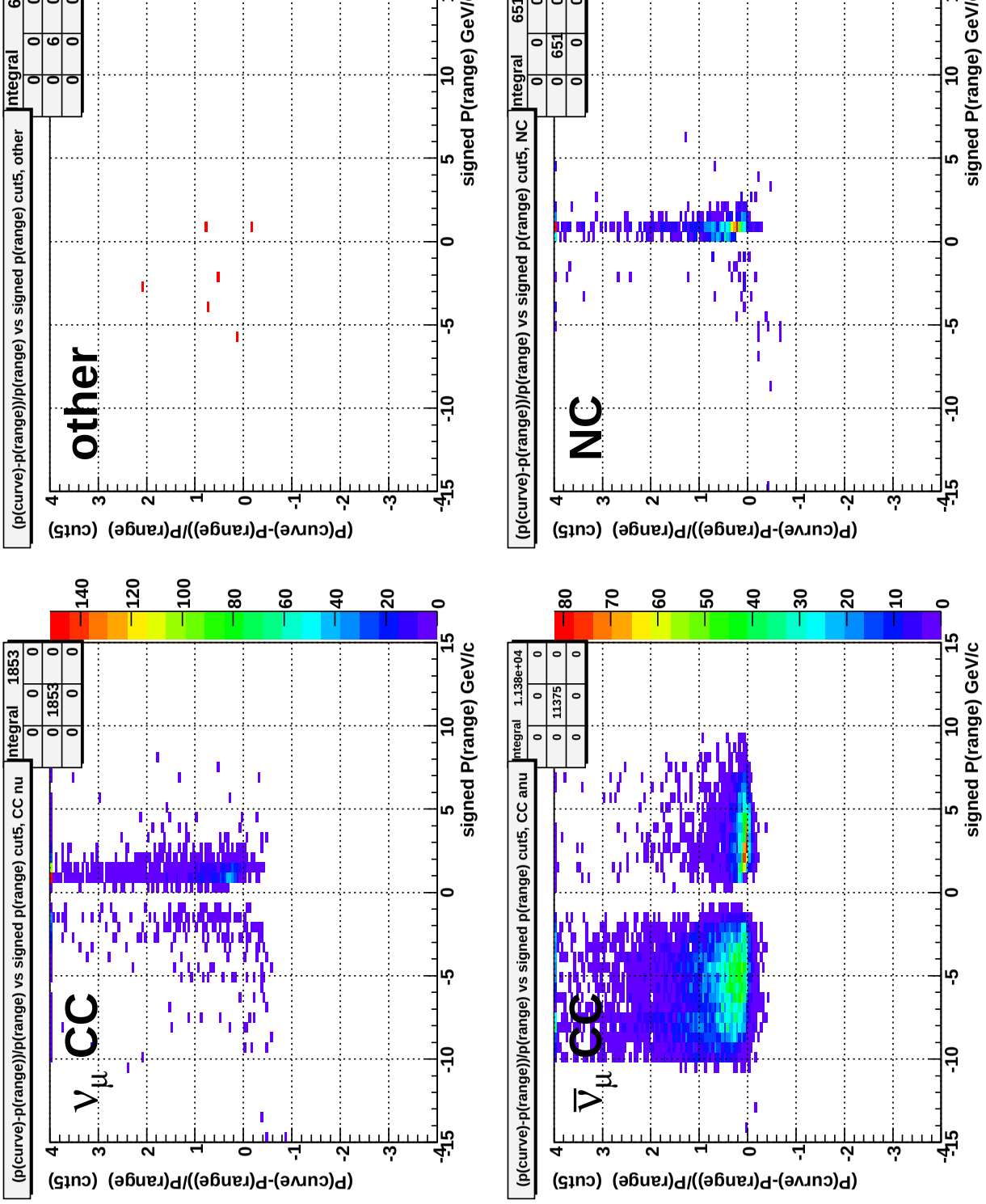

Figure 1: Plots of $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})}$ vs 'signed' $P(\text{range})$ with the breakdown into CC ν_μ , CC $\overline{\nu}_\mu$, NC and other after cut5. Overflows are put into the extreme bins.

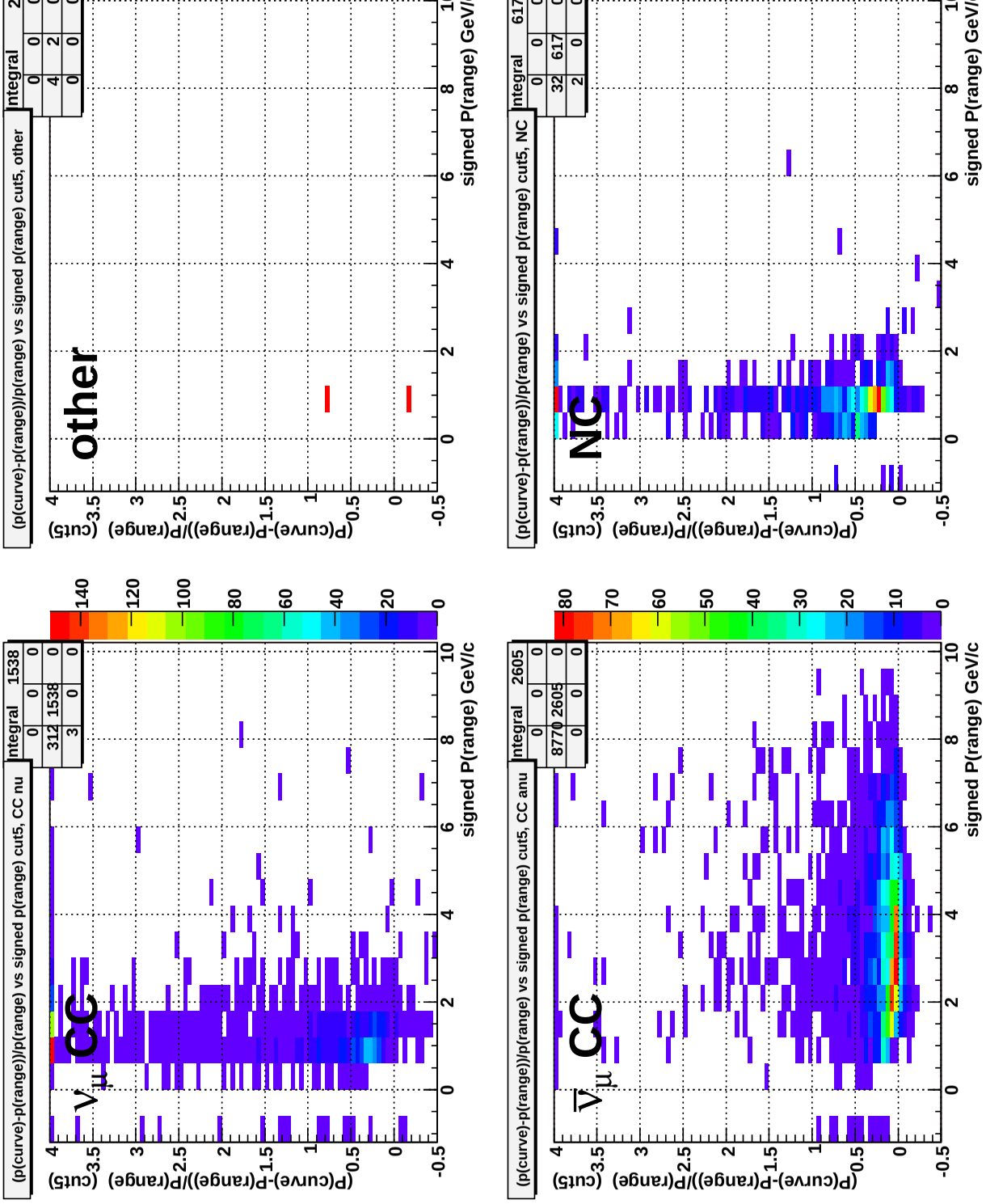

Figure 2: Same as plots in 1 for $P(\text{range}) > 0$ GeV/c and $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})} > -1.0$. Overflows are put into the extreme bins.

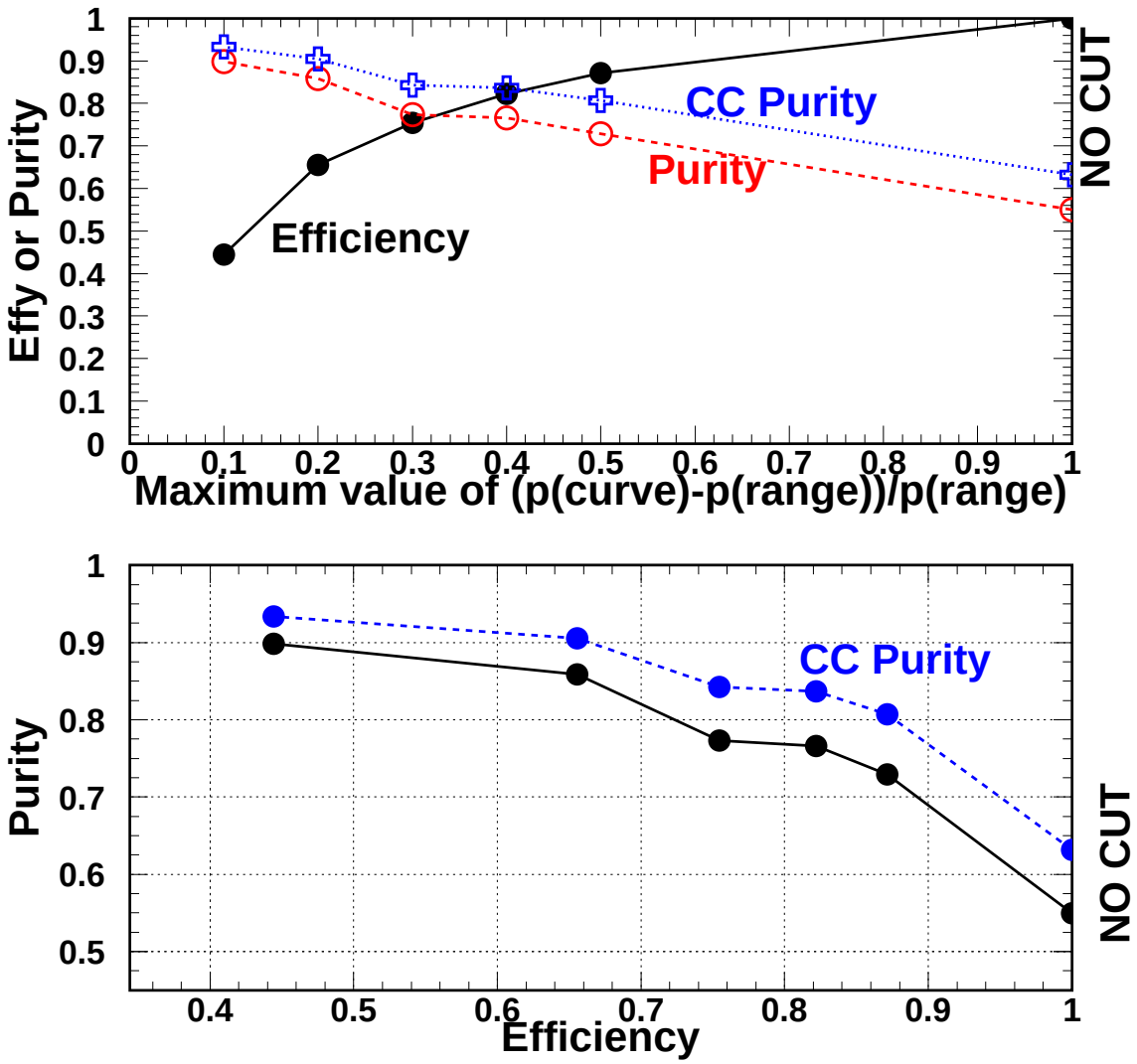

Figure 3: Efficiency and purity of a cut on $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})}$. "Purity" is $\overline{\nu}_\mu$ rate divided by the sum of the $\overline{\nu}_\mu$, ν_μ and NC rates. "CC Purity" is the $\overline{\nu}_\mu$ rate divide by the total $\overline{\nu}_\mu$ and ν_μ rates.

$\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})}$ cut	CC $\overline{\nu}_\mu$	CC ν_μ	NC
No cut	2592	1512	611
< 0.5	2259	539	300
< 0.4	2130	416	234
< 0.3	1956	366	208
< 0.2	1699	178	101
< 0.1	1151	82	48

Table 1: The number of CC $\overline{\nu}_\mu$, CC ν_μ and NC events with tracks that stop in the detector for various cuts on $\frac{P(\text{curvature})-P(\text{range})}{P(\text{range})}$ as derived from the plots in Figure 1.