# $K^0$ FINDING EFFICIENCIES IN INCREASING LUMINOSITIES

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## 1. THE pp ENVIRONMENT

In early LHC running it is anticipated that we will obtain luminosities of $10^{32}$ cm$^{-2}$sec$^{-1}$, during which typically only one interaction per event will be obtained. But at higher luminosities, necessary for any Higgs and myriad other searches, we will have to deal with up to 50 distinct primary processes. Most will be minimum bias, and easily distinguished in terms of trigger. They can still, of course, confuse analysis of high $P_T$ events. When it comes to B events, the confusion even from minimum bias events becomes more acute, since B events are not "high $P_T$" in this environment. The need for vertex discrimination, particularly in z, is well understood; however, a collateral effect—the increasing difficulty in finding tracks at all—has received little attention. In Figure 1, we show the distribution of the $K^0$ in the Pythia[1] process $B \rightarrow J/\psi K^0$ in the space $\gamma$ vs. $\eta$. Confusion in reconstructing the $K^0$ is acute for many reasons, note least of which is the way their pions are boosted forward, and even out of acceptance. Extra luminosity merely increases the problems in finding $K^0$s, so it must not be assumed that $10^{33}$ cm$^{-2}$sec$^{-1}$ is ten times better than $10^{32}$ cm$^{-2}$sec$^{-1}$.

## 2. THE LUMINOSITY DEPENDENCE IN B $\rightarrow J/\psi K^0$

We have described the CMS trackfinder CMSTR elsewhere.[2] To illustrate the problem outlined above, we show here how it copes with increasing luminosity and the subsequent effect on finding Bs. Figure 2 shows the track finding luminosity as a function of $P_T$ for varying numbers of events overlying each other. Figure 3 shows the effect on the efficiency of finding a given number of $K^0$s in increasing track density. The $\psi$ reconstruction efficiency is barely affected, depending on isolated tracks in the muon system. The subsequent reconstruction efficiency of Bs in increasing luminosity comes from the convolution of the two daughter particle efficiencies, and as we go from 1 to 2 to 3 overlying events, resembles, therefore, the $K^0$ graphs.

## 3. CONCLUSIONS

Estimates of CP reach[3] as a function of time are fraught with danger. Track finders at future colliders must be robust.

## 4. REFERENCES


1. Pythia version 5.3 by H.U. Bengtsson, T. Söstrand, Lund Monte Carlo Programs, CERN 1989.
2. J. Hassard, S. Margetides; "Studies of CP Violation in CMS: The Case for Vertexing," Imperial College IC-HEP 93-12.
3. W. Toki, J. Hassard, "Comparing the CP reach of Different Experiments," these proceedings.


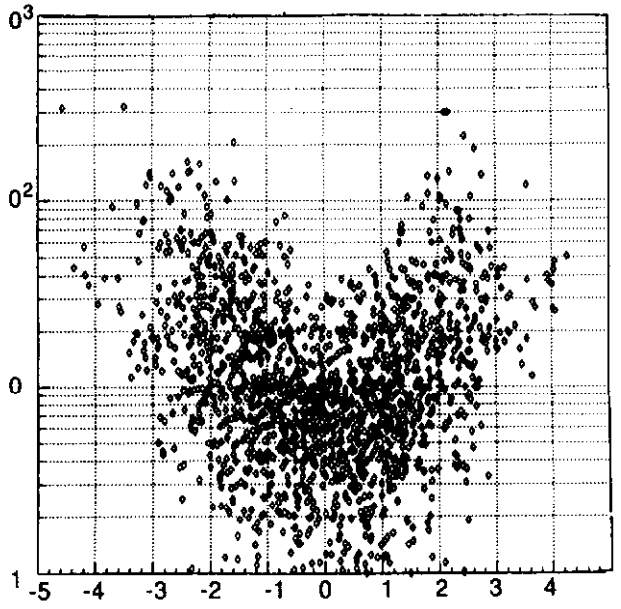


Figure 1. The distribution of $K^0$s from B decay in $\gamma$ (boost) vs. $\eta$ space.

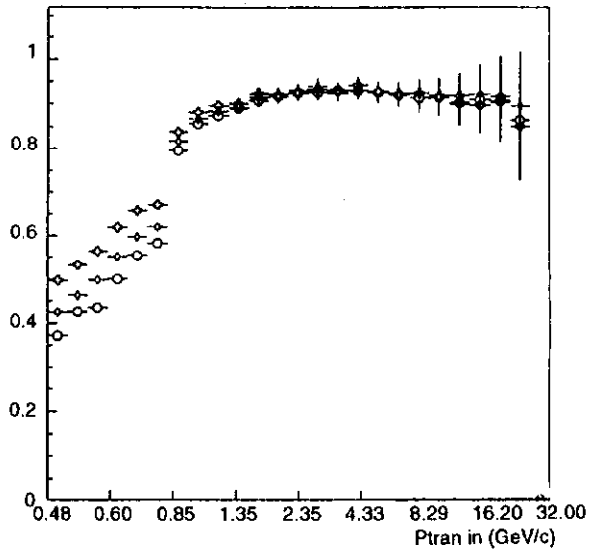


Figure 2. The trackfinding efficiency as a function of $P_T$. Different symbols refer to 1,2,3-event pile-up.

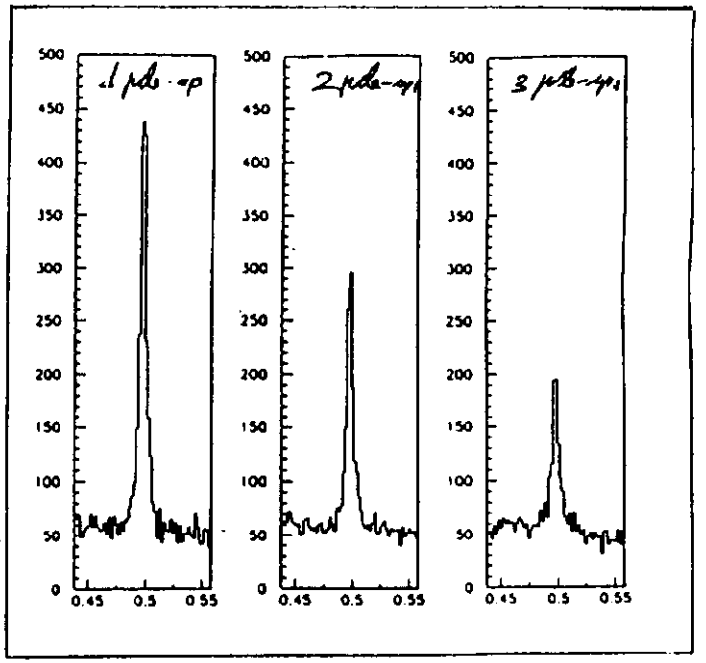


Figure 3. $K^0$ peaks in 1,2,3-event pile-up from same number of events.