Report of the High Level Trigger Group

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The objectives of the High Level Trigger Group were :

a) A comparison of the relative merits of the analogue and digital electronics for trigger implementations.

b) An examination of the implementation of specific triggers.

c) Making of estimates of the effect of detector granularity on the trigger.

d) Making of estimates of the effects of the high interaction rates at the SSC on the performance of these triggers.

Because of limited time and manpower, the group decided to restrict itself to topics b) and d) above.

The group assumed a detector which included 50,000 towers x 3 layers of calorimetry ($\Delta y = \Delta\phi \approx 0.04$), a Transition Radiation Detector (TRD)[1] for electron (or high Pt π) tracking, and a muon detector consisting of a total of 1 m U and 3 m magnetized iron, sandwiched with multiple layers of drift tubes. We also assumed the first level trigger electronics would supply the following signals:

a) 5000 Et_{EM} signals (analog, latched).

b) 5000 Et_{HAD} signals (analog, latched).

c) Electron trigger, Et > 25 GeV.

d) 1 jet trigger, Et > 80 GeV.

e) 2 jet trigger, Et > 40 GeV (per jet).

f) Missing Pt trigger, missing Pt > 50 GeV.

A specific implementation of a trigger to detect $W^+ W^- \rightarrow e \nu j j$ was then pursued. By combining the level 1 electron and jet, or electron and missing Pt triggers, a rate of 2 KHz could be achieved[2]. To reduce this rate farther, the following higher level handles were proposed:

Method	Gain
a) Track in TRD pointing to electron cluster in calorimetry.	30-100[3]
b) Isolation criteria (with < 10% of electromagnetic energy in surrounding cells).	3-10
c) Kinematic Correlations.	?

This results in a typical gain of > 300, which reduces the trigger rate to a reasonable value of < 10 Hz.

As can be seen, a major gain comes from using a TRD to correlate tracks with energy depositions. These correlations can be performed quickly by using a look-up table scheme, with response times of less than 30 ns.[4]

An alternate $W^+ W^-$ trigger can be achieved by replacing the electron signal by a muon one ($W^+ W^- \rightarrow \mu \nu j j$). It was estimated that the rates would be the same as the electron case, for $|y| < 2$. As with the TRD, a high speed look-up table method can be used to identify muon tracks.

It was the conclusion of the group that a high level trigger for $W^+ W^- \rightarrow e (\mu) \nu j j$ can be achieved with a rate of about 10 Hz. Indeed, the solutions proposed for this problem are currently being used by several existing experiments. It is clear that the difficult problem of triggering at the SSC lies in the first level electronics, which was luckily a given for this group.

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[1] Willis, LBL Workshop, 1984 ???

[2] Rates were estimated with the help of F. Paige and ISAJET.

[3] D0 (French Collaborators) ???

[4] A similar scheme, used by the VENUS collaboration at TRISTAN, is presented by T. Ohsugi elsewhere in these proceedings.

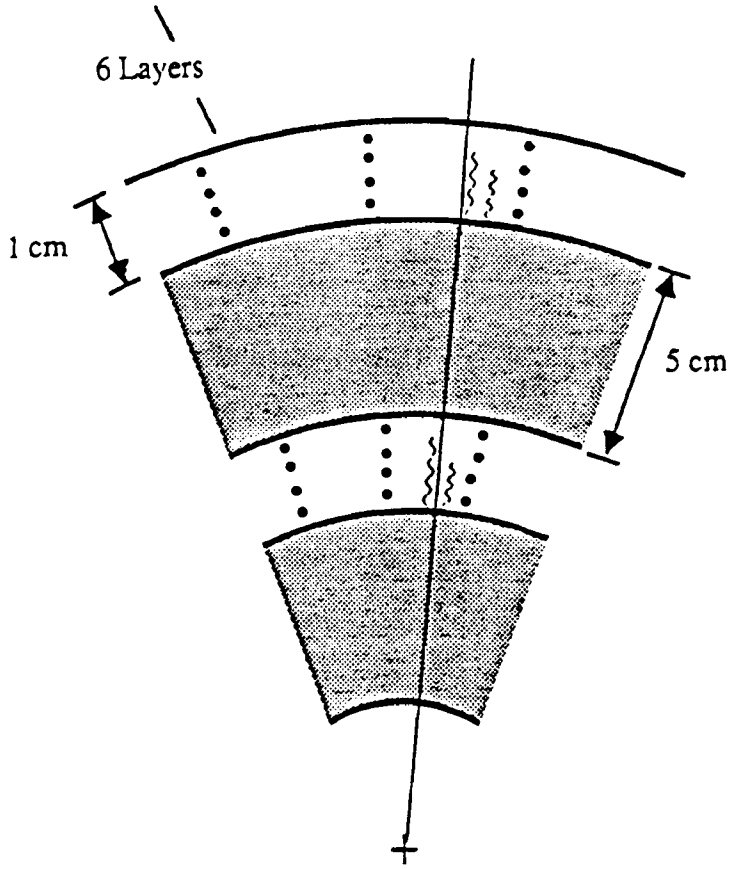

FIG. 1. Transistion Radiation Detector [1]

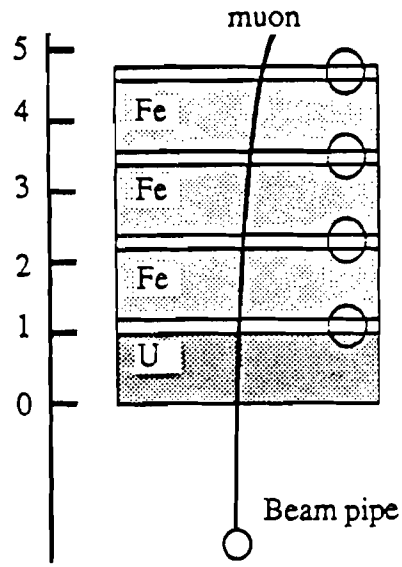

FIG. 2. Muon Detector

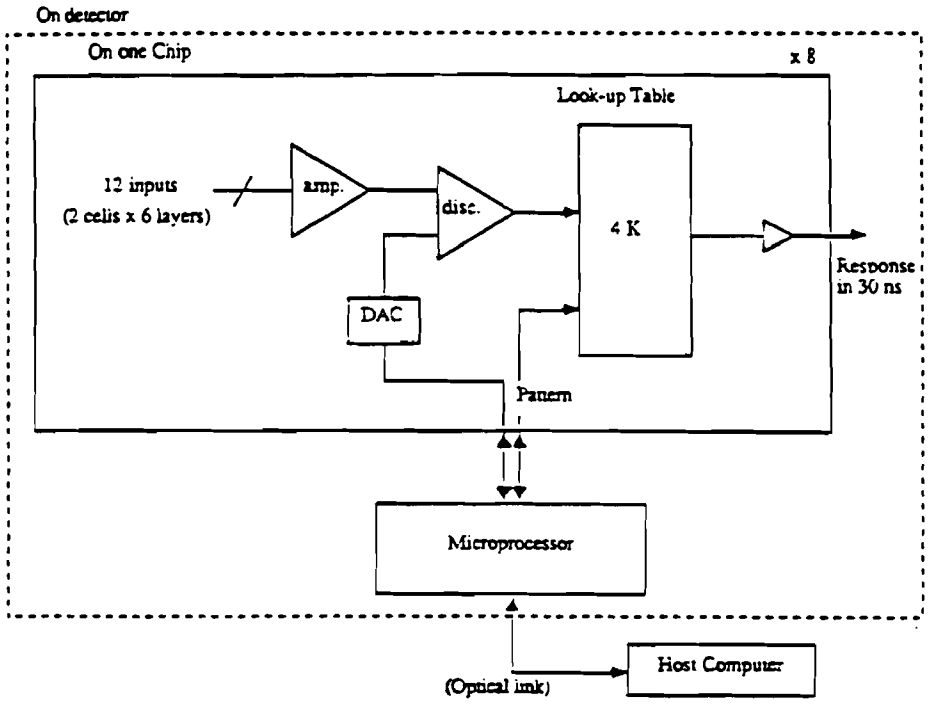

FIG. 3. TRD Track Finder