

Level 2 Trigger Upgrade Review Report

The Trigger Upgrade Review Committee was appointed by the Spokespersons, Rob Roser and Jaco Konigsberg, in June 2006. The members of the committee are:

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The committee was charged with addressing:

- 1) the feasibility of projects and any correlations between projects (resources)
- 2) the impact on Physics
- 3) whether CDF should proceed with the projects
- 4) if there is sufficient information or is more R&D needed.

The Trigger Upgrade Review Committee had three meetings: a preliminary phone/video discussion to clarify issues; a one-day meeting at Fermilab on July 27th, where we heard presentations from the proponents; and a phone meeting to discuss conclusions, August 2nd.

All of the presentations can be found at http://www-cdf.fnal.gov/internal/WebTalks/Archive/0607/060727_trigger_upgrade_review/

On July 27th, the morning was dedicated to the new cluster finding proposal. The documentation provided can be found in CDFNOTE-8415.

David Waters set the stage by summarizing the status of the TDSWG. This was followed by presentations by the proponents: Mary Convery (motivation), Gene Flanagan (detailed studies presented by Mary), Laura Sartori (hardware) and Ted Liu.

The committee met over the lunch break and offered initial thoughts to Ted Liu and Paola Giannetti concerning the L2 Cluster Proposal.

In the afternoon, we heard from:

- 1) Matthew Jones on the Phi Trigger Upgrade
- 2) Kevin Lannon (for Ben Kilminster) on 3-layer XFT tracks
- 3) Laura Sartori on hardware for SVT Standalone
- 4) Paola Giannetti on SVT standalone
- 5) Marco Rescigno on New SVT Patterns
- 6) Rick St. Denis on Higgs \rightarrow WW

Preamble:

The committee appreciates all the hard work and effort by the proponents that preceded the review. The presentations were excellent and were extremely important in helping the committee understand the issues.

The committee was shown convincing evidence that the trigger cross sections are growing and will continue to grow over this coming year and that the overall physics program of CDF will be adversely affected if we cannot reduce the rate of growth. CDF has invested heavily in the stereo track trigger upgrades to control rates and has installed a new event builder to help handle higher rates. The remaining option to control rates will be upgrading the calorimetry triggers. The Level-2 trigger clustering algorithm, as implemented, will tend to merge jets at very high luminosities. This is not happening yet, but studies indicate this will happen soon. The proponents propose a hardware upgrade that allows a new implementation of fixed cone algorithm running in a PC. Gene Flanagan from Purdue has been extensively studying these issues and his work is the partial basis of our conclusions.

The committee was not convinced that sufficiently strong arguments had been presented to make a compelling physics case for the upgrade beyond not losing ground because of higher trigger cross sections. In particular, the missing E_T used in the Higgs search HZ already employs a significant cut beyond the trigger cutoff. However, the committee did think that it would be wise for the spokespersons to pursue the issue of whether a lower missing E_T cut is possible in the Higgs search. The importance of this mode for the Higgs search cannot be overstated, and the committee thinks every effort must be made by the CDF spokespersons to maximize the potential discovery of the Higgs.

The committee was convinced of the technical feasibility of the project. CDF has a very good understanding of the pulsar performance and needs. However, there were concerns that a careful study of the cable layout, cable connections and performance is needed. The number of replacement pulsars must be studied carefully since this is a significant part of the cost. In addition, concern was expressed by the committee about the amount of diagnostics and the possible long time to read out, incurring deadtime.

The project must be completed in a time critical manner. In the committee's view, the upgrade must be complete by next summer. The estimate from the proponents is six months of hardware development and three months of commissioning. We have no reason to believe this cannot be met with the appropriate experienced leadership and team in place.

Ted Liu is the leader of the L2-cluster upgrade proposal. Ted was the founder of the entire pulsar trigger program in CDF and has a tremendous track record of success in working with the Level 2 trigger. He was a strong and effective leader. Ted, however, does not wish to lead the present Level-2 cluster upgrade although he is willing to be a major player. We note that Ted has been a very effective proponent of this important project. This was a surprise to the committee and was discussed extensively. The committee believes that the L2-cluster upgrade will clearly benefit from Ted's expertise in whatever degree he can afford.

The committee believes that the project must have clear leadership and a well defined organization before it can go forward. We suggest that candidates for playing an important leadership role are Gene Flanagan (Purdue) and Laura Sartori (Pisa), who are familiar with pulsars, the CDF trigger system, and are technically strong. We suggest the overall leadership be a more senior person. He or she must be located at Fermilab due to the time critical nature of the project. The committee thinks this is an extremely important project; as such, this project would be ideal for the right individual. The project encompasses trigger

hardware, software, firmware and is also tightly coupled to CDF's most important physics.

Support staff for the project, postdocs and students seem to be adequate to get started. There are three postdocs that can start immediately and at least two graduate students. More are likely to be attracted to the project. However, a very significant effort will be needed in the area of trigger studies and ensuring that everything is working. In addition, it will be necessary to identify human resources who will pursue possible improvements to the Higgs search from lowering missing energy thresholds.

One concern was continuity of responsibility for the trigger once the project is complete. The spokespersons should ensure that postdocs in the project now, or entering on the scale of six months, should be committed to the trigger program at CDF for at least two years.

The SVT standalone project was found to be attractive. The possibility of extending forward lepton coverage by combining the so called "bypass" SVT tracks with the BMU or showers would add about (unclear but we estimate about 10-15%) in coverage. Initial studies of the phi resolution have been started, and the work thus far is encouraging but not complete. The committee considered this upgrade to give potentially a greater muon acceptance than the 3-layer upgrade, which covers about half the BMU acceptance. However, the main issue with this upgrade is the human resources. Laura Sartori is the main postdoc on SVT standalone and the L2 cluster upgrade project. The group, led by Paola Gianetti, has suggested that their prioritized interest for upgrades is the L2-cluster upgrade followed by the SVT standalone. Completion of studies and a clear signal from the physics groups would be needed before CDF could consider moving forward with the SVT standalone.

Conclusions:

1. Cluster Finder:

Overall Recommendation: The committee recommends moving forward quickly with this project but a number of resource issues need to be addressed. This recommendation is predicated on the assumption that luminosity will increase substantially over this next year. If this is not the case, the upgrade is not needed. The committee is forward looking and anticipates such an increase, but it is not guaranteed.

- a) A strong technical leader of the project must be found before the project can move forward. That person must be resident at Fermilab and have familiarity with the trigger and pulsars.
- b) Due to the time critical nature of the project, the project should rapidly move forward once a leader is found. Ted Liu is willing to help initially to keep the process moving forward. Close support from Henry Frisch and the University of Chicago is important.
- c) A few individuals who will develop online software to utilize the new diagnostic information from the trigger and monitor the performance of the trigger should be identified immediately.
- d) A local engineer who can do a detailed layout of the new cable plant should be identified.

e) The spokespersons should in parallel launch a physics effort in the relevant physics areas/groups to ensure that CDF fully exploits the potential benefits of the L2-trigger upgrade. This should be done in conjunction with the project leader and may be part of the charge to that individual if he or she has the appropriate skill set. The human resources needed to do studies of possible physics analysis benefits have not been identified.

2. The phi trigger:

We recommend not proceeding with the project at this time. Some of the proponents of this project have expressed a desire to be players (GF) in the L2 cluster upgrade project and have agreed to continue after the project is complete with helping maintain the trigger system. The proponents agreed that the physics motivation for the phi trigger was good but not overwhelming and decided not to proceed with the trigger upgrade at this time. This project could be revisited at a later date.

3. 3-layer tracks:

We recommend not proceeding with this upgrade at this time. Again, it could be revisited in the future if human resources were available.

4. New SVT Patterns:

Since this project requires no new hardware, and the proponents are still evaluating the possibilities for the improvements on their physics program, we recommend allowing this upgrade to proceed under the guidance of the TDSWG and trigger subproject leaders.

5. SVT Standalone:

The proponents expressed a desire to contribute to the L2 Cluster project as a higher priority than SVT standalone. We support the combining of resources of the groups to focus on the high priority cluster project.

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