

CDF Excerpt from April 2002 PAC Recommendations

Run I Ib Upgrades P-924 CDF (Bedeschi/Goshaw) P-925 D0 (Weerts/Womersley)

Overall Comments

The Committee was impressed with the progress made by CDF and D0 since the November PAC meeting. The dialogue between the collaborations and the recently formed Technical Review Committee (TRC) provided a forum to explore the most urgent cost, schedule, manpower, and technical issues. The report of the committee offered numerous recommendations, to which the collaborations have recently provided written responses, and as a result of which some design changes have been adopted. Despite these encouraging signs, the Committee remains seriously concerned by the scope of challenges that remain and the difficulty posed by the as-yet unresolved tension between the simultaneous demands of physics performance, resource limitations, and schedule. The Laboratory and the two collaborations *must work hand-in-hand* to maximize the combined potential for discovery of new physics in Run I Ib by optimizing the use of constrained Laboratory resources, both manpower and financial.

At the Aspen meeting in June, the Committee will reconvene to consider a recommendation for Stage I approval of the upgrade projects. This process will require new or refined information on various aspects of the proposed upgrades, which will be noted in the paragraphs that follow. More broadly, in presentations at the Aspen meeting, the Committee would like to hear from each collaboration a critical evaluation of progress with respect to plans that were presented at the November 2001 PAC. In the case of the additional CDF upgrade components whose inclusion in the scope is most in question, this discussion should include latest feasible dates for a decision on implementation. Above all, the Committee will be looking to see the Laboratory and the collaborations converge on a baseline plan that is shown quantitatively to be consistent with the primary physics goals.

The Committee is encouraged that the projects are moving toward Stage I approval and baselining this summer. The Committee would appreciate an overview of the high-level project milestones for all items of the upgrade projects at the Aspen meeting.

The Silicon Upgrades

For both CDF and D0, the silicon tracker upgrades are essential to the ultimate success of the physics program and are the schedule and cost drivers for the Run I Ib upgrade projects. Both experiments have made significant progress in optimizing the design of their silicon trackers since the November PAC meeting.

CDF

Following the TRC review, the CDF collaboration has made a number of changes to their silicon detector design, specifically the elimination of 90-degree

stereo layers and the adoption of the outer-layer stave design for Layer 1. These have resulted in significant simplifications for the project, improved pattern recognition, and very clear benefits to the cost and schedule. They have also altered their sensor specification to reduce sensor costs by 15-20%, streamlined the mechanical design, and transferred more QC/QA steps to the vendor to reduce assembly time. The Committee strongly commends these positive steps.

Both

The collaborations have assessed a number of descoping options. For example, the effect of eliminating a silicon layer was presented by both collaborations in terms of b-tagging efficiency, which directly impacts Higgs sensitivity. The CDF upgrade TDR showed that elimination of an outer layer, which would result in a significant reduction of 27-30% in the number of staves, would reduce b-tagging efficiency by 4% relative to the efficiency with all layers. This increases to 13% if the inner COT layers are dead*. The D0 presentation showed that eliminating Layer 4, which would result in a significant cost reduction of \$1.15M, would reduce double b-tag efficiency by 12-14% relative to the efficiency with all layers.

In light of remaining shortfalls in resources and the extremely tight construction schedule, and in order to retain nearly the full scope of their proposed upgrades, the collaborations should continue to search for cost reductions and for simplifications that would shorten construction time. Estimates of potential cost savings, time savings, and effects on Higgs sensitivity should be quantitative. The justifications to retain scope may include redundancy arguments; however, these arguments should be quantitative, in terms of the usual Higgs metric.

The Committee notes the delay incurred in the submission of the first prototype SVX4 chip, and will look forward to an update on the status of this part of the project at Aspen. The Committee also notes that both collaborations have rejected the TRC's suggestion to use edge alignment during ladder production; the Committee accepts this conclusion.

Non-silicon Upgrades

In anticipation of higher rates and occupancies in the Run IIb era, both experiments are proposing upgrades to their Trigger and Data Acquisition systems, and CDF has introduced for consideration some further detector upgrades.

CDF

The Committee was shown a number of new requests for upgrades in CDF, including EM calorimeter timing, Level 1 and Level 2 Trigger upgrades, and DAQ upgrades. Quantitative evaluation of the impact of these proposed upgrades on Higgs sensitivity and SUSY searches should be presented at Aspen. In addition,

* The CDF study was performed using the Run I silicon geometry.

the collaboration should specify for each upgrade component the latest date for a decision on whether or not to implement that upgrade.

1. *EM Calorimeter Timing.* This would allow suppression of out-of-time hits that can contribute to backgrounds in exotics searches involving photons, and rough estimates suggest the suppression could be as much as an order of magnitude. Caution is warranted in making changes to the phototube bases, but the Committee was pleased to hear that the bases have been handled recently without any damage. Options such as splitting anode signals are still being evaluated and might provide an even less invasive course of action. Overall cost of this upgrade is modest, and the Committee notes that the funds are proposed to come from university grants and INFN. Possibilities for further simplification through ganging of channels should be investigated.
2. *3D XFT.* Inclusion of stereo information in the Level 1 tracking trigger may allow the Level 1 trigger to be more selective and more robust with respect to chamber occupancy. The project is relatively non-invasive, but is the most expensive of the new proposals. The Committee looks forward to seeing a quantitative assessment of impact on Higgs sensitivity presented at the Aspen meeting.
3. *Level 2 Speed.* The Level 2 trigger has a number of vulnerabilities that could be addressed in a modestly priced upgrade. These include remaining problems with the Magic Bus, obsolete processors, and maintenance and possible unreliability of interface boards. It is not clear yet if any of these will be a limiting factor, but there may well exist a need for greater bandwidth, selectivity, or both. The collaboration plans more studies to clarify the needs and the options.
4. *TDC Bandwidth.* Inadequate bandwidth in the TDCs may be a DAQ bottleneck limiting readout rate to 300Hz. Operational experience will be important in evaluating the need for partial TDC replacement, and the Committee requests the collaboration to provide a specific plan and proposed timetable for this upgrade at the Aspen meeting.

Beyond these additions, the Committee was reminded of the proposals for the Central PreRadiator upgrade and the Event Builder upgrade. Slow response in the current gas chamber preradiator will integrate over four beam crossings in Run IIb, severely degrading its performance. The replacement device would use scintillator and optical fiber with phototube readout, with about half the cost proposed to be borne by collaborators. In the case of the Event Builder, a new ATM switch is proposed to increase the throughput from 16MB/s to 64MB/s.

Committee requests to CDF and D0

1. Overview of high-level project milestones.
2. Progress with respect to plans and milestones presented at November 2001 PAC.

3. Dates for decision to implement/descope trigger modifications.
4. Report on cost-reduction/simplification efforts for silicon detectors.
5. CDF: Quantitative evaluation of trigger modifications, individually and in combination, in terms of Higgs sensitivity. Studies of options to reduce the cost of the EM Timing project.