Responses to the June 2002 PAC Recommendations

The DØ Collaboration
August 8, 2002

Overview

We thank the committee for their report from the June 2002 meeting. We appreciate the committee's enthusiastic endorsement of the physics potential and importance of Run IIb and we are very gratified to have received Stage I approval for the DØ Run IIb upgrade (E925). We also thank the committee for its thorough survey of the state of the various upgrade components and for its suggestions on how to proceed in each case. We have attempted to follow this advice. In this document we respond both to the specific questions and also the more general issues raised by the PAC and describe what we have done to develop the project since the PAC review.

Run IIb Silicon Upgrade Recommendations

The committee identified five recommendations for the silicon upgrade that were to be addressed in preparation of the joint TDR/DRC review. We provide our responses to these recommendations below:

1. Move expeditiously towards prototype stave testing.

We agree that the construction and testing of a prototype stave is an important milestone for the project. We are making good progress in designing the required assembly fixtures (discussed in the mechanical key issue below) and expect to fabricate a full mechanical prototype this fall. This mechanical prototype will include prototypes of all components except for the sensors, where we will use inactive silicon pieces of the correct dimensions. This mechanical prototype stave will allow us to make a comprehensive set of measurements of the mechanical and thermal properties of the staves. Electrical tests of stave components will occur in parallel, and are already far advanced. We have already demonstrated that a Layer 1 module assembly consisting of two prototype sensors wire-bonded to a prototype hybrid with the first SVX4 chips can be readout through a prototype digital jumper cable. The final testing of an electrically active stave will take place early next year when sensors are available. This will be preceded by thorough tests of electrical prototype modules.

2. Plan and perform appropriate radiation tests on electrically working prototype staves and/or individual components.

Several critical electrical components have been irradiated to address the radiation damage issues. These irradiations were performed at the KSU 10 MeV proton source.

1. The AVX 50-pin connector used on all DØ hybrids was irradiated to 5 MRad in the fall 2001, no changes were observed.

2. The tantalum capacitors used on all DØ Junction Cards were irradiated to 5 MRad in the fall 2001, no changes were observed. See also NASA document regarding the same type of capacitors: http://www.phys.ksu.edu/hep/dzero/nasa_rad_tests_tantalum.pdf.

3. AWG34 twisted pair cable with Tefzel insulation was irradiated to 5 Mrad in July 2002, no visual changes to the insulation were observed. Conclusions await electrical measurements with the irradiated piece. See also CERN documentation regarding radiation damage of insulators:
http://preprints.cern.ch/cgi-bin/tiff2pdf?/archive/cernrep/1982/82-10/p1.tif.

We are also planning to irradiate stuffed DØ hybrids to 5-10 MRad to ensure that there are no radiation damage issues with the hybrid.

The SVX4 chip itself will be tested for radiation resistance:

1. SEU – Single Event Upset, i.e. the failure of the on-chip memory (configuration register composed of Flip-Flops) due to the passage of a highly ionizing particle through a memory cell. Tests will be performed at the UC Davis Cyclotron during the second week of September 2002. The chip has been designed to be SEU tolerant and we expect to see no significant problems.

2. Bulk radiation damage. The process used to build the SVX4 is intrinsically radiation resistant due to its small feature size. Tests with a Cobalt-60 source (i.e. gamma ray irradiation) to approximately 10 Mrad on a test version of the analog portion of the chip were performed last spring and this test chip survived. A similar test for the prototype SVX4 chip is planned during the same period, possibly in Sacramento.

While most of the mechanical components are materials that are known to be radiation tolerant at the expected doses, we have undertaken studies of a few components that are of particular concern: adhesives and elastomer tubing.

We fully expect all of the adhesives we intend to use to be radiation hard, including the resins in the composite structures, but we felt that the impact of a failure was too great not to proceed with these tests. We have irradiated overlap shear test samples of several epoxies, bonded to G10 substrates, to 18 Mrad and observed no degradation of the adhesive joints. In addition, we prepared similar samples of our carbon fiber prepreg; again in an overlap shear test configuration, but using only the prepreg resin to bond the samples. Again we saw no degradation of the samples. In all cases, control samples were built at the same time, as well as pull-tested at the same time as the irradiated samples. We have recently procured additional carbon fiber with a different resin system (Bryte EX-1515). While we have not tested this material ourselves, the vendor has data on irradiation tests of this resin to 1000 Mrad, followed by many thermal cycles to liquid nitrogen temperatures with no degradation observed.

We have also tested several samples of elastomer tubing that are candidates for the connections from the stave ends to the cooling manifolds a few inches away. In Run IIa, both CDF and DØ used a product called Cilran. The attractive properties of this product are very high elongation and a strong resistance to taking a set or hardening with time. However, this tube was used at large radius (~140mm) in the past and was not thought to be a viable choice in the higher radiation environment at small radius and high luminosity. We identified alternative materials, the most promising being Tygothane. The test in this case was a pressure burst test, again with control samples assembled and tested concurrently with the irradiated samples. In addition to the final burst strength, the qualitative behavior of the tubing was identical between the control samples and those irradiated to 20 Mrad, both for the Cilran and the Tygothane. While we feel that these tests have identified suitable materials, we intend to conduct further tubing irradiation tests to 30 Mrad for tubing intended for use in L0 and L1 (r<3cm) to ensure a sufficient safety margin.

3. Address the issue of short-pulse radiation damage as recently observed by CDF, and modify designs to reduce or eliminate susceptibility.

The failure observed at CDF is not yet understood. It may be that this failure is due to the SVX3 (used at CDF and not at DØ) or some other feature intrinsic to the way the CDF devices were built, but again this is hard to tell since the DØ detector has not suffered any large instantaneous dose incidents. We have been in communication with CDF on this issue, and it is our understanding that the problem could not be reproduced in tests at the Booster Radiation Area. These tests subjected CDF SVX3 devices to large instantaneous beam blasts, and no failures were observed. In any case, we will expose the SVX4 to similar beam blasts at the Booster just to explore the possibility of such failures. These tests have not been scheduled yet but will probably take place sometime in late September to November 2002.

4. Develop detailed plans and schedule for full system testing prior to installation.

We have developed plans and a schedule for the testing of each main component of the system as well as a full system test. We have plans for 3 test stands, each addressed to test different levels of the system.

1. Stand-alone sequencer test stand – operational now. Can simultaneously read out up to 6 hybrids. It addresses the following issues:
    a. Single hybrid and module debugging, tests and burn-in
    b. Stave tests and burn-in
    c. L0 & L1 sector tests and burn-in
2. 1% full chain stand – scheduled to be operational in October 2002. This test setup is planned to be located in the burn-in area SiDet This is a minimal full vertical slice of the real system readout with up to 8 connected hybrids. It addresses the following issues:

    a. Test of all components of the full readout chain
    b. Full chain readout of up to 2 staves
    c. Full chain readout of one L0 sector and up to two L1 sectors
3. 10% full chain stand – scheduled to be operational in spring 2003. This setup will be located in the cleanroom where the actual modules will be assembled. The goal of this stand is to integrate as many readout channels as possible (up to 10%), including components of the final HV and LV system. Three sector tests are foreseen with this test stand. First, a sector of the Layer 0 detector will be tested, mainly to study the noise performance. Second, a sector of the Layer 1 detector will be tested. The third test planned is to readout a series of at least 5 staves.

We are also planning to modify the Run IIa Low Voltage test stand to test the Low Voltage system. The High Voltage system will use the same type of power supplies as Run IIa. The test stand for this system is already built and will be used to test the additional supplies.

5. Develop detailed plans and schedule for installation so that the shutdown time can be minimized.

Following the April Director's Review, we added an installation task (WBS Level 2) to the project. Rich Smith is the Installation Project Manager and has begun pulling together the detailed plans and schedule for the installation. Level 3 managers for the Silicon Installation and Trigger Installation tasks are now in place and are helping Rich with this task.

We have prepared an installation schedule using Microsoft Project® that describes the tasks required to remove the RunIIa silicon detector and related infrastructure, and replace it with the new RunIIb silicon detector and related new infrastructure. This schedule also contains the installation-related tasks required by the L1 and L2 trigger upgrades. This schedule is fully integrated in the RunIIb WBS management structure, and it accepts as input the completion date of the RunIIb silicon. It predicts both the start of the shutdown and the date the detector is once again ready for beam. We have loaded the schedule with effort and costs and find it already sufficiently mature to enable us to plan the timing of critical sub-activities in order to assign our effort resources, especially supervisory, technician, and physicist, in a credible manner. Within these constraints, and those imposed by tight working conditions within the detector (to save time the detector will remain in the collision hall during the shutdown) this schedule carefully interleaves tasks that can proceed in parallel to yield substantial compression of the elapsed installation time. This schedule presently calculates a shutdown duration of seven months.

Run IIb Silicon Key Issues

In addition to the questions, the committee also identified a number of key issues associated with the silicon upgrade. We would like to take this opportunity to update our progress on those issues that were not addressed above.

a) Procurement

DØ has experienced delay in obtaining sensors, apparently due in part to procurement delays at Fermilab and production delay at Hamamatsu. Delays in sensor procurement will delay the critical milestone of building and testing the first full stave.

We have had discussions with Purchasing in order to identify ways that procurement bottlenecks can be eliminated. We have jointly performed "post-mortems" on a few problematic purchase orders. We have also requested that the lab assign an expediter to track DØ Run IIb requisitions through the procurement process. We strongly agree that procurement is a key issue, and will continue to work with purchasing to minimize procurement delays.

b) Mechanical

CDF and DØ do not yet have assembly fixtures in hand and DØ is investigating the possibility of using CDF fixtures. The Committee commends this simplifying approach and urges rapid convergence to a decision on this issue and start up of prototype assembly.

Due to the differences in hybrid placement, straddling sensors in the center of the modules in DØ versus at the ends of the modules in CDF, the fixtures must differ. The DØ fixtures, while not identical, have drawn on many of the features of the CDF design. The engineers and physicists designing the tooling for the two projects are exchanging concepts regularly and are freely plagiarizing one another's designs as appropriate. The initial module fixture designs are 90% complete at this time and we intend to initiate fabrication this month. The fixtures for mounting modules on staves are about 50% designed and we intend to submit those for fabrication by the middle of September. We feel confident that we are on track with our milestones of initial mechanical modules in October and a mechanical stave in November and are pushing to get this work done ahead of schedule if possible.

c) Design Issues and Pending Studies

The design of cooling tubes is not advanced and basic questions remain unanswered. The Committee notes the need for rapid convergence on this issue. Design options that require long-term studies, such as of the aging properties of potential materials, appear to be inconsistent with this requirement.

The two tube materials under consideration at the time of the PAC meeting were formed PEEK and molded carbon fiber. The DØ group has adopted carbon fiber cooling tubes as the baseline design. The main concerns with carbon fiber are fabrication and possible long-term interaction with the cooling fluid (ethylene glycol and water). We have successfully fabricated several tubes that are He leak tight at 10^{-8}-10^{-9} torr-liter/min using a high modulus fiber (M46J, 60Msi). Attempts to fabricate tubes with very high modulus fiber (K1392U, 110 Msi) have proven to be difficult and the benefits of using very high modulus fibers are marginal. We are, instead, planning on using intermediate modulus, high strength fibers (IM7) that should perform even better than the M46J we are currently using in prototypes. We anticipate ordering IM7 prepreg by the end of August. We have chosen a cyanate ester resin system (Bryte EX1515) that has extremely low moisture absorption (0.04%) and is radiation resistant. We have a high degree of confidence that there will be no adverse interactions between this resin system and the cooling fluid. However, we have begun an accelerated aging study to verify this. These tests are being conducted jointly with CDF to study possible aging effects in carbon fiber and PEEK tubing, the latter being the CDF baseline. The test stand is currently running with two carbon fiber tube samples and five PEEK tube samples. Additional samples will be added to the system as they become available. In particular, it is critical that we install samples with the final resin system. These tests are being conducted at room temperature under flow and pressure conditions very close to those expected in the experiments: dP=3psi across the samples, P=-2 psig at the inlet. The elevated temperature, 30-35 degrees above the expected operating temperature, should accelerate aging so that 6 months of testing will be sufficient to verify that there are in fact no concerns.

e) Schedule

The DRC emphasized the tightness of the schedule and noted that the plan lacked sufficient contingency. They also called attention to specific issues such as the lack of an adequate installation plan and schedule and the need to plan for a period in 2003-2004 when SiDet facilities will be at saturation. The importance of adhering to schedule cannot be overemphasized.

We strongly agree that schedule is a key issues, and have put significant effort into developing a sound approach to scheduling this project. Our baseline schedule, which we will use to internally track the project, is designed to be aggressive but achievable. We have then added substantial contingency onto the end of the schedule. We believe this approach is the best way of minimizing the time required to complete the upgrades, while retaining adequate schedule contingency to deal with unforeseen problems.

We have also taken steps to address the issues of installation and SiDet resource planning. As discussed in our response to recommendation 5 above, we have recently developed a detailed plan for installation of the upgrades. We will continue our efforts to further understand the installation choreography and integrate installation activities into the project planning process. A plan has been developed for allocating SiDet physical resources (wire-bonders, CMMs, testing space, etc.) during the silicon detector construction period that we believe meets our needs. We are concerned about the ramp-up and training of the technical staff that will be required during the construction period, and are working with the laboratory to address this issue.

Non-Silicon Upgrades

The findings, comments, and conclusions of the Committee regarding the proposed non-silicon upgrades of DØ were summarized in two tables, together with a suggested course of action in each case. These were:

Level 1 Track Trigger and the Level 1 Calorimeter-Track Match

The committee requested that answers to the following questions should be prepared for the upcoming joint TRC/DRC review. If this work cannot be completed in time for the review, then a conservative technical solution that is guaranteed to meet requirements should be specified as the baseline. Meanwhile, studies should be continued until an appropriate technical solution is validated and subsequently launched.

In order to evaluate what upgrades to the Level-1 tracking triggers are required to cope with increased occupancy, it is necessary to understand what requirements are placed upon Level-1 tracking triggers by the principal physics goals of Run IIb, such as the Higgs search.

- **What are the quantitative requirements on efficiency, fake rate, and p_T and ϕ resolutions? These requirements should be quantitatively justified in terms of Higgs sensitivity. They should include requirements derived from the requirements of Level-2 silicon triggers for tracks found by Level-1.**

In our view the major requirement-setting goal for our Level 1 track trigger is that it must permit a high efficiency single electron and muon trigger for transverse momenta above about 10 GeV/c. There is no rate requirement for the track trigger as such; the requirement is on the electron and muon triggers. The electron trigger requires a calorimeter trigger tower to fire, together with the proposed calorimeter-track match at Level 1. The muon trigger requires a muon candidate in the muon system in phi coincidence with the central track. The physics justification for such triggers is the need to accumulate inclusive W samples, both for the W mass measurement (indirect constraints on the Higgs mass) and also to obtain the greatest efficiency for the WH Higgs discovery process. In the latter case, there are of course two additional jets in the event, but to maximize efficiency it is preferable to trigger on the lepton alone. Fig. 44 in the Trigger section of the TDR shows that even with the upgraded calorimeter trigger, requiring jets at level 1 introduces a 10-20% inefficiency per jet (the Higgs decays to jets with an E_T ranging down to 20 or 30 GeV). For the $ZH \rightarrow \nu\nu bb$ process there is no choice but to trigger on jets.

- **Do the proposed Level-1 tracking trigger upgrades satisfy these requirements? Can alternative trigger criteria (*e.g.*, higher track p_T threshold, higher lepton p_T threshold, tighter spatial match, shower-shape cuts) be used to satisfy the trigger requirements?**

Table 1 (p205) in the Trigger section of the TDR shows that the proposed tracking trigger upgrades do indeed satisfy the rate requirements. The tracking trigger upgrade reduces the single muon L1 rate by a factor of 3 (from 6kHz to 2kHz), while the single electron rate is reduced by a factor of 18 (from 9kHz to 0.5 kHz). This factor stems from a combination of the track trigger upgrade (factor ~3), calorimeter-track match (factor 2-3), and improved calorimeter isolation from the calorimeter upgrade (factor 2-3). Table 2 (p219) shows that the requirement of high efficiency for electrons and muons is also met: efficiency > 98% is attained for tracks with p_T above 10 GeV/c.

If we tried to reduce the electron rate by the same factor through raising the calorimeter threshold alone, the level 1 threshold would need to be increased from 10 to roughly 18 GeV (assuming a p_T^{-5} dependence of the QCD cross section). This would in turn raise the transverse energy at which full offline efficiency was reached from roughly 20 to 35 GeV. This is not acceptable for W decays. If we assumed the calorimeter L1 upgrade was built, but no tracking upgrade or track-calorimeter match, then the electron threshold would still need to be raised to 15 GeV at L1 (roughly 30 GeV offline). Again, this is not acceptable.

Given the spatial granularity of the fiber doublets that feed the present level 1 track trigger, there is no way to raise the muon p_T threshold - a 10 GeV track is essentially a straight track. If one wished to raise the track p_T threshold it would be possible with the upgrade, though we have not taken advantage of this possibility. The phi match granularity is set by the 80-fold electronics sectors of the trigger and cannot be changed.

- **How does the performance of the existing tracking triggers and the proposed tracking triggers compare to the requirements, as a function of the number of multiple interactions per crossing? How well do simulated occupancies compare with data?**

We share the concern of the committee that one of the big uncertainties in the tracking trigger upgrade is how much faith one can have in the simulations at high occupancy. We have therefore directed our major effort since the last review not at new simulations, but at understanding the occupancy in minimum bias events in Run II data and comparing against our simulation.

While the L1 track trigger for Run I is still being commissioned, the fiber tracker electronics has begun to function at close to the expected signal-to-noise performance. This makes the occupancy meaningful. We have therefore been able to compare the occupancy observed in data (minimum bias events after noise subtraction) with that in the simulations we have been using (PYTHIA). The results are shown in Fig. 1. The discrepancy at low radii may indicate a material modelling shortfall in the simulation and we are investigating this. Overall the agreement is quite good.

Our simulations of the fake track candidate rate as a function of luminosity are shown in Fig. 2. As can be seen, the upgraded trigger performs very stably up to 15 or more interactions per crossing. This is a factor of two higher than expected, either for 5×10^{32} cm^{-2} s^{-1} at 132ns or for 2×10^{32} cm^{-2} s^{-1} at 396ns. Its performance is therefore robust against a possible underestimation of the occupancy per event by up to a factor of two, certainly much greater than is indicated by Fig.1. (Note that the same cannot be said for the current, non-upgraded trigger).

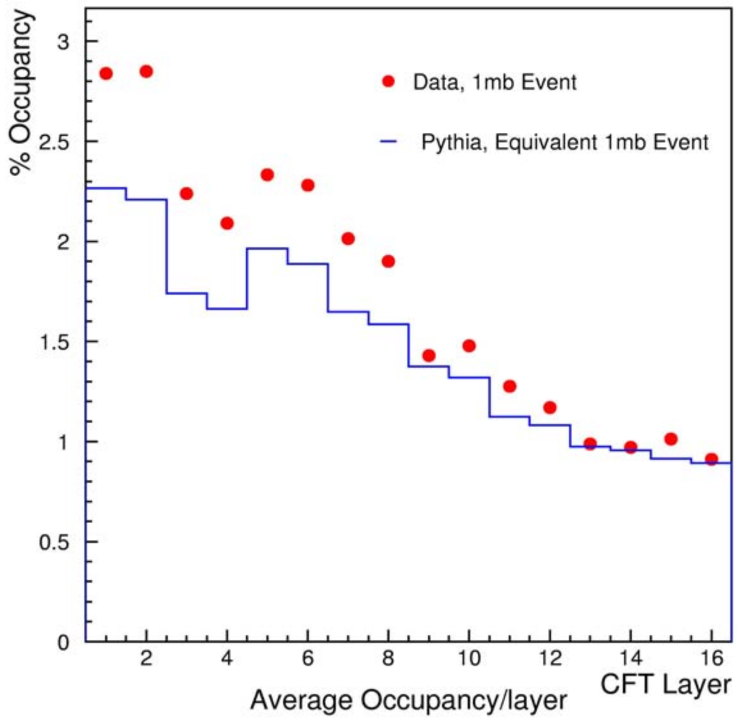

Figure 1. A comparison of the CFT occupancy by layer (the order is XUXV…) for minimum bias events in collider data and those generated by the Pythia Monte Carlo.

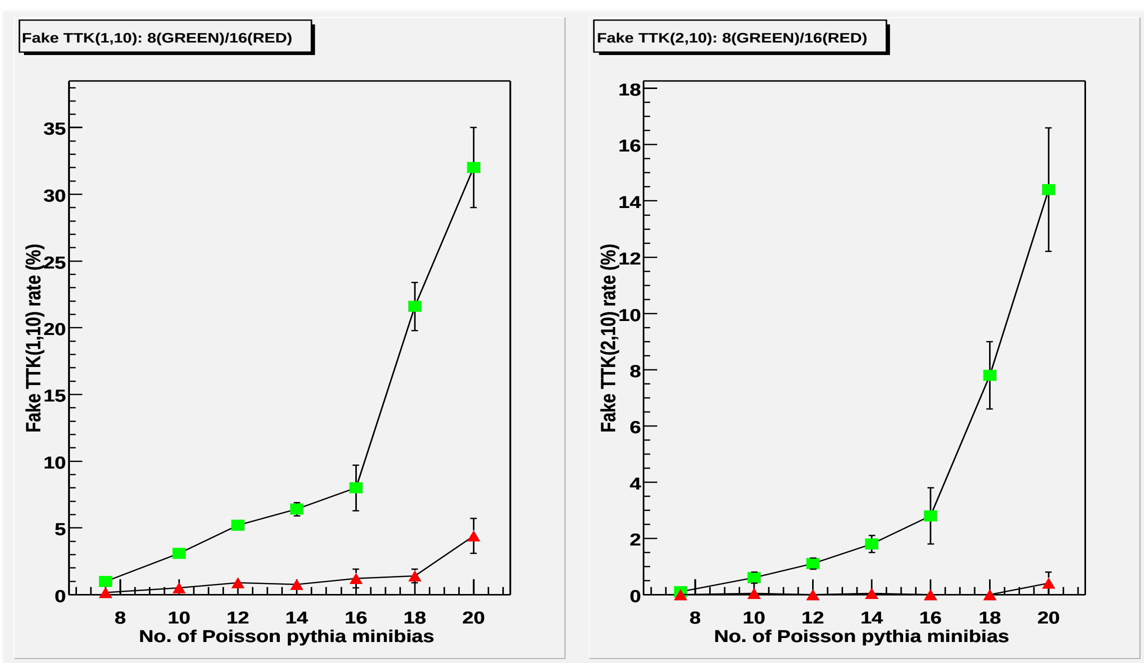

Figure 2. Rate for fake single 10 GeV tracks (left) and pairs of fake 10 GeV tracks (right) as a function of the number of overlaid minimum bias events. Upper curves show the existing trigger, lower curves show the upgrade performance.

We have not gone through the exercise of repeating the full rate simulation that is presented in Table 1 in the TDR (p205). We can, however, attempt to connect the single muon rate with what we have observed (albeit at much lower luminosities) in Run II and verify whether the performance indicated in Fig. 2 is sufficient. We observe the muon-system-only Level 1 rates which are shown in Fig. 3 over the luminosities recorded so far. The highest measured point gives some indication that the cross section increases with luminosity (certainly we cannot assume it remains constant). We therefore assumed a quadratic growth of trigger rate with luminosity (a linear growth of cross section). This functional form is to be expected since the muon trigger is generally based on twofold coincidences between scintillator layers, and is therefore quadratically dependent on the occupancy. An estimate for the sum of the central and forward rates was extracted as a function of luminosity from Fig. 3. Folding in the fake rate of the existing and upgraded track triggers taken from Fig.2, leads to the rate estimates given in Table 1.

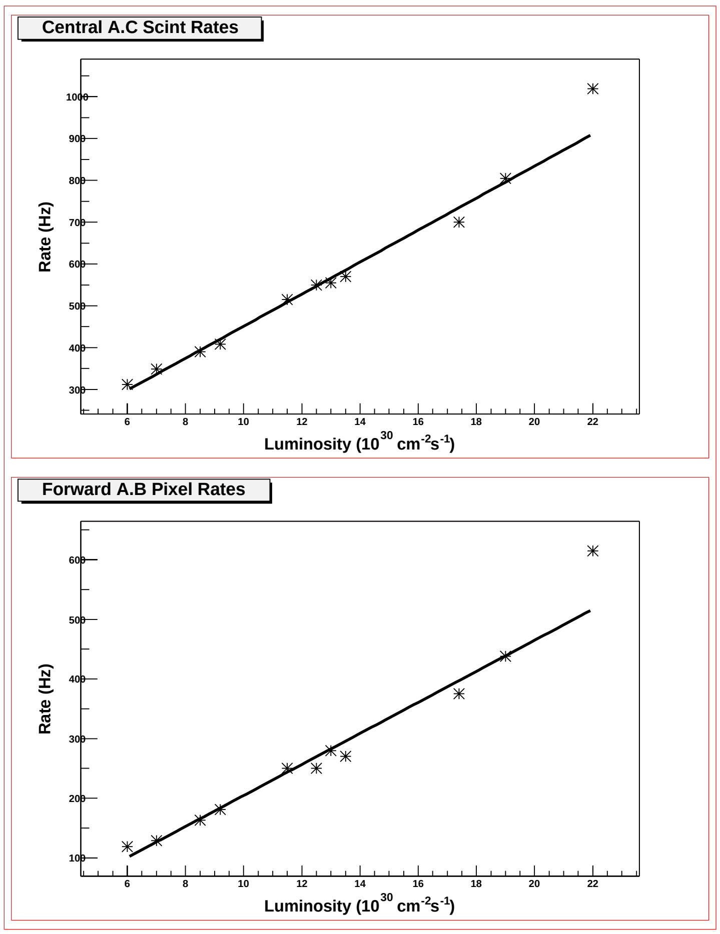

Figure 3: Measured Run II trigger rates for single muons in the muon system alone, for central and forward muons.

Luminosity and bunch spacing	Single high-p_T muon rate Existing track trigger	Single high-p_T muon rate Upgraded track trigger
5×10^{32} cm^{-2} s^{-1} at 132 ns	4.9 kHz (cf. 6 kHz in TDR)	1.0 kHz (cf. 2 kHz in TDR)
2×10^{32} cm^{-2} s^{-1} at 396 ns	1.0 kHz	0.2 kHz
4×10^{32} cm^{-2} s^{-1} at 396 ns	7.1 kHz	1.0 kHz

Table 1. Estimated single high-p_T muon rates extrapolated from the observed Run II rates.

These estimates have very large uncertainties (perhaps a factor of two), but they do compare well with the numbers in Table 1 of the TDR, as can be seen. A rate less than 1 or 2 kHz for the muon triggers is required to fit within the overall L1 bandwidth. This requirement is met with the track trigger upgrade, but not by the existing trigger. The existing trigger can run up to about 2×10^{32} cm^{-2} s^{-1} before it starts to fail. This "sanity check" based on Run II data gives us increased confidence that our rate simulations are reasonable.

Level 1 Calorimeter Trigger

We thank the committee for their assessment that the DØ Level-1 Calorimeter Trigger is ready to proceed to baseline review. We have continued to refine and develop our proposal and the TDR has been updated.

Level 2 Beta Upgrade

The PAC felt that the need for increased processing power had not been justified. Such a justification should be developed in time for the TRC/DRC review.

The trigger section of the TDR, pp. 340-342, contains a description of several algorithms that are not feasible to run now in Level 2 because of the shortage of processing time, but would be possible with the upgrade. These include correction for the vertex z position and tower by tower calibration of the calorimeter. Both of these sharpen the E_T turn-on and give rejection independent of Level 1. A vertex finding calculation using tracks has been demonstrated, and requires 480 μs. This is well over the time budget with the current processors but is possible to implement in the upgrade. It will yield a factor of about two in rejection, completely independent of Level 1.

We plan to deploy twelve upgraded processors, as below:

- three global processors to apply vertex corrections to calorimeter objects and to improve b-tagging by searching for displaced vertices;
- two calorimeter processors to apply tower-by-tower corrections to improve E_T resolutions and sharpen thresholds;

- two tracker processors to handle the increase number of silicon layers and calculate the quantities needed for primary and displaced vertex finding;
- one muon processor to maintain rejection at high occupancy;
- one preshower processor to maintain rejection at high occupancy;
- one spare and one “shadow” processor for test and development work..

While we have not yet been able to demonstrate a fully simulated trigger list, we believe the solution chosen is a conservative and reasonable one given the Level 2 beta design. It would certainly be very imprudent not to plan for this upgrade given that a) faster processors will be available off the shelf and b) some of the present Level 2 rejection will be moved upstream to Level 1. It is modest in cost (~ $80,000) and extremely straightforward to implement.

Level 2 Silicon Track Trigger

No response was requested by the PAC. We have continued to refine and develop our proposal and the TDR has been updated.

Online/DAQ Upgrades

The PAC felt that the need for increased processing power had not been justified. Such a justification should be developed in time for the TRC/DRC review.

The trigger section of the TDR, pp. 370-371, now contains a quantitative justification for the planned increased processing power, based on the present performance of the Linux Level 3 farm and the increase in event reconstruction time as the number of minimum biase events per crossing grows. We believe that this adequately addresses the issue.

The committee also asked the Laboratory to decide what portion of each of these proposed upgrades is to be attributed to operations budgets and what portion is to be included in the Run IIb upgrade budget. This guidance should be provided in time for the collaborations to develop feasible baseline plans for the upcoming joint TRC/DRC Review.

The laboratory has provided such guidance. Basically upgrades that allow us to run at a higher luminosity are part of the Run IIb upgrade project and are costed as such. These on-project costs include the Level 3 farm upgrade, database and high-end DAQ server machines, upgraded disk servers and control systems. Operating costs are those recurring costs that keep the online system viable — i.e. costs we would incur if there were no planned luminosity upgrade. These include upgrade of monitoring and control room node replacements, network upgrades and modest R&D costs for disk arrays and host systems. Test stand equipment for SiDet is built from a combination of SiDet equipment funds and online spares.

132 ns vs. 396 ns

The committee also mentioned the issue of 132ns versus 396ns bunch spacing. While no action from us was requested, it is worth stating our position. We have scoped the proposed upgrade to meet our physics goals while running at 5×10^{32} cm^{-2} s^{-1} and 132 ns. Since the number of interactions per crossing is roughly the same, we do not anticipate any problems in running at 2×10^{32} cm^{-2} s^{-1} with 396ns, using luminosity levelling. Should luminosity levelling not work out, our trigger upgrades are sufficiently robust that we believe we have headroom to run at 396ns with luminosities significantly higher than 2×10^{32} cm^{-2} s^{-1}. For the track triggers, Figure 2 above supports this assertion; it can be seen that the fake rate remains low and flat up to 15 or more interactions per crossing (a factor of two above what is expected at 2×10^{32} cm^{-2} s^{-1} with 396ns). For the calorimeter triggers, the rate is primarily sensitive to luminosity (independent of bunch spacing) and is designed to run up to 5×10^{32} cm^{-2} s^{-1}.

We do not plan to take any action now that would exclude operation at 132ns in the future. Our philosophy is that we will build the upgrade we have designed, and then operate it (together with the accelerator) in whatever mode of running maximizes the physics potential of Run II.

Offline Computing

The committee has seen the report from the Director's Review of Run II Computing that was held in June. Since then, we have moved forward on the committee's recommendations. A joint DØ-CDF-CD steering committee has been established for SAM, now that it is to be used by both collaborations. Our strategy for for offsite analysis has attracted a lot of interest from our collaborators and we are setting up a task force to implement a prototype offsite analysis center this calendar year.