# Response to the Aspen Meeting of the Fermilab PAC

The DØ Collaboration

*June 13, 2003*

In this document we respond to the request from the laboratory:

***In light of the luminosity profiles that are being submitted with the accelerator plan in June, please submit a brief document that addresses the following issues. We understand that the tight time constraint precludes new detailed studies. We are looking for answers based on studies already done plus your experience and judgment.***

***Question 1: What is currently your best understanding of how the performance of the silicon detector will diminish with increasing integrated luminosity? What is the impact of this degradation in performance on the most important physics analyses? Which physics topics suffer the most from this effect and which least?***

We know that the silicon detector performance will degrade because of radiation damage. There is also a significant risk of deterioration over time simply because of age and component failures. We have prepared reports on both of these subjects and they are available on the web (Ref. [1] and [2]). To briefly summarise here:

**Radiation Damage**

Our estimate of the lifetime is based on

- The locations and types of detectors installed in DØ
- Our measurement-based knowledge of the phenomenology of radiation damage
- The actual measured dose received in the Tevatron environment.

We expect that the lifetime of the SMT will be limited by micro-discharge breakdown of the junction in the Micron-supplied detectors in the inner four barrels. This will begin to occur at bias values of ~150 volts and all channels will fail at bias values of ~200 volts. This means that we will start to lose significant numbers of channels at an integrated luminosity of $3.6 \pm 1.8$ $fb^{-1}$ and that 100% of the channels on the inner layer will be dead by $4.9 \pm 2.5$ $fb^{-1}$. The uncertainties reflect how well we can estimate the micro-discharge formation and dose accumulation.

## Detector Deterioration

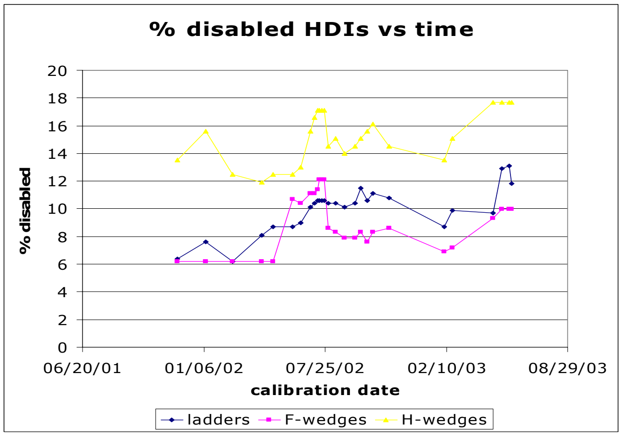


Figure 1. Percentage of disabled (barrel) ladders, F-wedges, and H-wedges as a function of time in the DØ Run IIa Silicon detector.

The silicon detector was never designed to operate indefinitely. Failures of inaccessible device elements are not repairable: this includes silicon sensors, the high density interconnects (HDI's) which carry the chips, and the low mass cables. The fraction of disabled ladders in the readout was about 6% at the end of 2001 and is a bit more than 10% now (Fig.1). We do not believe any of these failures are due to radiation damage. It is unclear how to extrapolate this into the future.

## Impact of degraded performance

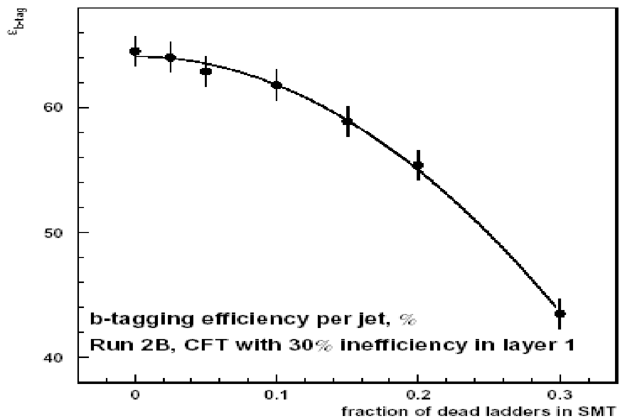


Figure 2. b-tagging efficiency per jet as a function of the fraction of dead silicon ladders, for the DØ Run IIb upgrade detector.

Radiation damage will affect the innermost silicon layers first. Loss of these layers most directly affects b-tagging performance. As noted in the laboratory's preamble, we did not specifically study the effect of radiation damage on current detector's tracking or b-tagging capabilities, but we have studied the effect of random loss of silicon ladders on the Run IIb (upgraded) detector. Figure 2 shows the dependence of the b-tagging efficiency per jet on the silicon inefficiency. Anything more than about 10% dead ladders starts to have a serious impact.

As well as reducing the b-tagging efficiency, the performance of the system as a tracker will be affected. Although we do not have quantitative studies it is clear that we will lose track efficiency and resolution and we will suffer increased fake rates. We also expect to have greater difficulty isolating the correct primary vertex location of the high-$p_T$ collision which will in turn worsen the missing-$E_T$ and jet resolutions.

Obviously, physics which requires multiple b-tags will suffer the most. Unfortunately this encompasses much of the flagship program of the Tevatron (the reason motivating the upgrades in the first place):

- Top quark physics, including precision mass measurements
- Standard Model Higgs Searches
- Supersymmetry searches involving light stop and sbottom
- Supersymmetry searches involving cascade decays of squarks or gluinos to heavy flavor
- Supersymmetric Higgs searches in 4b and bbττ modes
- Technicolor searches
- The entire B-physics program

The DØ silicon tracker is an integral part of the tracking system. It is essential for pattern recognition and sagitta measurements. Since our entire physics program depends on precision tracking and good primary vertex determination, it will all be affected by silicon degradation, though arguably to a lesser extent than the processes above. As a reminder, this includes:

- W mass and electroweak physics
- Supersymmetry searches in trileptons
- Supersymmetry searches with taus
- Extra dimensions
- Jets and missing $E_T$

***Question 2: How much time is needed to install and commission the new silicon detectors?***

We have put together a detailed installation and commissioning plan (see Ref. [3] and [4]). This plan is a fully resource loaded project plan which includes opening the DØ detector, installing the Run IIb upgraded silicon detector and trigger elements, and the technical commissioning of all the pieces. The installation includes all required preparatory and infrastructure work. Technical commissioning includes testing all connections and data protocols possible without beam. The installation and technical commissioning of the silicon detector drives the duration of the shutdown; we therefore focus on this component in the discussion below. We note that we have designed the silicon detector in such a way that it can be installed while the DØ detector remains in the Collision Hall: we do not have to roll the detector out of the Hall to replace the silicon, which greatly simplifies the process.

As seen in the attached schedule, installation of the silicon detector includes uncabling the old detector and removing its associated electronics, installing the new detector and its associated electronics, installing new high and low voltage systems, cabling the new detector and installing the new beam pipe. The design and fabrication of much of the infrastructure for the silicon installation begins one year before the actual shutdown is scheduled so that we are ready to open the detector and begin the necessary preparatory work in the Collision Hall for the silicon installation immediately after the beginning of the shutdown. The beginning of the shutdown proper – that is, the time at which the Tevatron would be turned off to allow access to the Collision Hall – occurs approximately eight weeks prior to the completion of the silicon detector and its move from the silicon facility to the DØ Assembly Building. This time is required in order to remove the Run IIa silicon detector and to prepare the calorimeter bore, faces, and other infrastructure for the installation of the upgraded device. The silicon installation takes 4.5 months, and is followed immediately by, and is dovetailed wherever possible with, the technical commissioning.

After the installation of the silicon detector, technical commissioning proceeds by testing all of the electrical connections for the silicon detector. Testing proceeds on a quadrant-by-quadrant basis. For each adapter card in a quadrant, before the twisted-pair cable is connected to the adapter cards, the full chain of twisted-pair cable, junction card, digital cable and sensor is tested. Next the downstream chain of adapter card, 80-conductor cable and interface board is tested. Then the radiation and temperature monitoring cables are connected, and finally the twisted-pair cable is connected to the adapter card and the full readout chain is tested. The full technical commissioning takes ten weeks of one and a half shifts per day, using two teams (north and south face) of two people per shift.

The new silicon online readout software can begin commissioning as soon as a readout crate is fully supported (i.e., when one quadrant of the detector is commissioned) and continues in parallel with the technical commissioning. The online software includes download and calibration software, data unpacking software, online monitoring software and mapping software. The software is heavily derived from existing Run IIa tools and is being overseen as an integrated portion of the detector construction project. Initial testing, debugging and verification will be done at SiDet using a 10% test setup, which we successfully did in Run IIa. After the detector moves to DØ, we have allowed 1.5 months for online software commissioning.

The total time for silicon detector technical commissioning is 2.5 months. The DØ detector is then closed and the silicon detector is ready for beam. The full installation and technical commissioning from the beginning of the shutdown is 7 months. The baseline completion date for the silicon construction, which contains some schedule contingency, is May 25, 2006. This leads to a shutdown that begins on March 30, 2006, with the upgraded DØ detector ready for first beam on October 25, 2006.

We believe that this is a conservative estimate of the shutdown duration. With appropriate implementation of additional shifts and further streamlining the work in both the trigger and silicon installation, we could gain one or two months. This is in the process of being studied more completely.

***Question 3: At what time after the end of the shutdown period would the full experiment be able to record physics-quality data with good efficiency?***

The installation and commissioning plan outlined above contains a detailed installation and commissioning plan for the both the silicon and trigger upgrades. In order for the Run IIb upgrade to be useful, DØ must come up from a long shutdown with all upgraded elements in good data taking shape. The collaboration understands that an extended commissioning period after the installation will directly impact the physics reach of the detector and negate the intense effort of upgrading the detector. As a result, not only have we made a detailed plan for the upgrade installation and technical commissioning, but we are in the process of making the same level of plan for the final commissioning of the detector with beam in order to collect physics quality data as soon as possible.

Plans for commissioning with cosmic rays (if the shutdown lasts longer than needed for our upgrade installation) are being developed, as are plans for commissioning the full upgraded detector with beam using lessons learned from Run IIa. We note that the Run IIb upgrade is very significantly less ambitious than the Run IIa upgrade and overall commissioning will proceed much faster.

For the silicon detector, many of the problems encountered in Run IIa were due to the downstream electronics and low voltage supplies. The system issues have been solved and these electronics will not change. In addition, the low voltage supplies will be migrated to the Movable Counting House and thus be accessible without an access. There were also many bad connections or problems with interface boards that had to wait until the detector could be opened up to be resolved. This is why we plan an intense technical commissioning time to shake down these problems before we close the detector. In addition, with the larger number of layers and simpler design, the Run IIb silicon detector will outperform the IIa silicon detector it replaces very soon after installation even with holes in the coverage.

The alignment technique used in Run IIa resulted in a detector that was aligned to within 20 microns in r-$\phi$ at installation, which is good enough for physics with minimal additional alignment work.

The trigger upgrades are also simpler in scope. Many of the problems encountered with the Level 1 Calorimeter Trigger in Run IIa were caused by readout electronics feeding the trigger boards. These problems were diagnosed and fixed early in Run IIa and, since the electronics will not change, these problems will not recur. We will use the same trigger framework and only minor modifications will be needed for the online monitoring software.

It will be necessary to debug the new electronics and verify the algorithms in FPGA's. However, we have built a 'splitter' board that allows us to feed Run IIa calorimeter data into the Run IIb trigger boards parasitically while taking data. We installed this board last winter and checked the signals. A trigger testing area has been installed for detailed integration of prototype boards using these signals beginning this summer. Using this technique, as well as a hardware data emulator that will download test patterns into the FPGA's most of the trigger will be verified and debugged before its final installation in the experiment. Beam testing with the trigger should also proceed quickly after the shutdown: in Run IIa, one of the first comprehensive studies of L1 calorimeter turn-on curves and efficiencies was done with ~5 $pb^{-1}$ of data. Such a sample takes less than a week to collect.  The analysis of the data for Run IIa then took a month. We should therefore be able to repeat such a study including data taking and analysis in roughly 6 weeks.

To summarize, the commissioning plan shows us ready to record physics quality data after three months of beam time following the shutdown, making a total of ten months of downtime. If our installation is completed before the shutdown ends, for whatever reason, we will use the additional time to debug with cosmic rays, which will allow us to come up faster with beam. We will continue to refine this beam commissioning plan into a fully resource loaded schedule, with appropriate lead personnel and institutions identified, in order to facilitate the evolution toward a physics-capable detector.

***Question 4: What strategy would the collaboration prefer for the detector upgrades and what are the most important drivers of this position? What should be the conditions for beginning the extended shutdown to install the silicon detector upgrades? What is the minimum time of operation after the shutdown needed to justify installing the silicon detector?***

The collaboration's preferred strategy is outlined in the attached letters from the Spokespersons and the Institutional Board.

We wish to see a wholehearted effort to get the most physics out of the Tevatron while it remains a unique facility in the world. This means that we should not back down from ambitious luminosity goals, but should work to put them on a firmer basis by addressing the technical and human issues that currently call them into question. We note that the Laboratory's plan is anyway to study and understand the recycler and electron-cooling issues in much more detail between now and end of the year.

The schedule is such that we cannot ask the detector upgrades to take a holiday while this happens. We have to plan for success in the accelerator and we should not do anything that precludes taking full advantage of that success. This means we have to continue to proceed at full pace with the upgrades while we get our arms round the accelerator situation.

The most important driver of this position is the potential payoff in physics. When we started these upgrades, we fully understood that we were embarking on a project that contained significant risk. We did so because the physics is compelling and unequalled. If Run IIb delivers all the physics we originally envisioned, we will be delighted. If not, we will be disappointed, but as long as we gave it our best shot, we will have no regrets. We do not want is to see the opportunity lost by backing away from ambitious goals to avoid the possibility of defeat.

We cannot state hard-and-fast conditions for beginning the silicon installation shutdown. The decision will be a complicated optimization exercise, including a good measure of technical and physics judgment. It will need to consider:

- The state of readiness of the detector upgrades (both DØ and CDF)
- The performance of the existing tracking system including radiation damage (if any), further component losses (if any), and pattern recognition performance in the high occupancy environment
- Accelerator performance up to that date and projections for the following two years
- The state of the LHC accelerator and detectors at that time
- Any discoveries or hints of new physics in the Run II data.

It is important to note that the upgraded DØ silicon detector offers increased performance over the current device. It has six layers rather than four, yielding better pattern recognition, and the inner layers are closer to the beam pipe, giving improved b-tagging. The tracking and b-tagging efficiencies are robust against overlaid minimum bias events.

The new device is not a spare part, it is a higher performance detector. A very rough figure of merit is that the double b-tagging efficiency with the new detector is 1.7 times higher than the existing device, even in the absence of radiation damage to the latter. (This is based on a full GEANT simulation for ZH $\rightarrow$ $\nu\nu bb$ events in both IIa and IIb detector geometries. A poisson average of 7.5 minimum bias events per crossing were overlaid, which corresponds to a luminosity of $2\times10^{32}$ $cm^{-2}$ $s^{-1}$ . The double-tagging probability increases from 0.19 in the IIa detector to 0.32 in the new device).

The minimum length of running time we believe would be needed to justify replacement of the silicon detector depends strongly on the predictions of the accelerator performance. The Beams Division's stretch (base) plan anticipates delivery of approximately 2.4 (1.2) $fb^{-1}$ per year in the latter years. We believe that in either case, following roughly a year of downtime, a physics running period also of a year or so at high luminosity would justify installing the new detector. With improved performance from the new device, each inverse picobarn recorded after the upgrade would be worth much more for physics. Of course, running for longer than a year would only increase the physics payoff of the Tevatron and the RunIIb upgrades.

***Question 5: Please review the motivation for each of the nonsilicon detector upgrades and comment on any substantial changes that might occur due to the new luminosity profiles*.**

The primary motivation for the DØ non-silicon upgrades (trigger, data acquisition and online) is the need to be able to trigger, filter and log data efficiently at higher instantaneous luminosities. The upgrades to the level 1 trigger system – the replacement of the L1 calorimeter trigger, the enhancement of the L1 track trigger, and the new L1 calorimeter-track matching trigger – are needed to increase rejection at Level 1 in order to fit comfortably into the ~5 kHz bandwidth from Level 1 to Level 2. We concluded that a core trigger menu for high-$p_T$ physics would be seriously compromised at high luminosity without a trigger upgrade, as shown in table 1 below. We designed these upgrades to handle a luminosity of $2\times10^{32}$ $cm^{-2}s^{-1}$ at a bunch spacing of 396 ns with enough headroom to handle peak luminosities up to $4\times10^{32}$ $cm^{-2}s^{-1}$. We had also preserved the option of running at 132 ns bunch spacing. These parameters correspond to the guidelines we received from the Laboratory when the upgrades were baselined in September 2002. Details of the technical approach and the justifications can be found in the documentation from previous PAC and DOE reviews, and in our Technical Design Report.

The "stretch" plan of the new luminosity profile indicates instantaneous luminosity first reaching $2\times10^{32}$ $cm^{-2}s^{-1}$ some time in FY06, and approaching $3\times10^{32}$ $cm^{-2}s^{-1}$ in FY08, while in the new "base" plan, the threshold of $1\times10^{32}cm^{-2}s^{-1}$ is first exceeded in FY07, and eventually reaches about $1.7\times10^{32}cm^{-2}s^{-1}$. In either case, our original rationale for the non-silicon upgrades – triggers, data acquisition, and online systems - still holds. (These upgrades could perhaps occur one year later under the "base" plan, but we would benefit from the upgrades as soon as we can install them.)

The Level 1 calorimeter trigger upgrade consists of an ADC+digital filter ("ADF") system to digitize the calorimeter tower signals, and a trigger algorithm board ("TAB") system which forms jet, EM and tau clusters with a sliding window algorithm. The digital filtering in the Level 1 Cal trigger would be necessary in order to run at 132 ns. With an accelerator plan that does not include 132 ns running, we could in principle simplify the filtering, but at this point there would be little savings in cost (~$40k) or complexity, and the filtering can still be useful for pile-up rejection. Most of the features of the ADF system are needed in any case to feed digitized signals to the algorithm boards, which in turn provide the upgraded rejection.

The need for the L1 track trigger (L1CTT) upgrade is driven by larger numbers of interactions per crossing. The upgrade compensates for the higher occupancy by using individual fibers in place of the OR of fiber doublets that is currently implemented. This upgrade is more important at 396 ns since, for a given luminosity, there are more interactions per crossing than at 132 ns. The 396 ns specification was used for baselining the CTT since it was already known that 132 ns would not be implemented at the beginning of Run IIb. Thus, the strategy for the L1CTT upgrade is unchanged.

The upgrade to the Level 2 "beta" processor system is also motivated by increased rate, and the need to apply more sophisticated algorithms to the events coming from the upgraded Level 1 system. This motivation is also unchanged.
The upgrade to the Level 2 Silicon Track Trigger is required to take advantage of the additional layers in the Run IIb silicon detector. Studies of rates for displaced vertex triggers at $2\times10^{32}$ $cm^{-2}s^{-1}$ showed substantial gains in rejection by instrumenting five layers in the STT, compared to the current four-layer system. While the STT upgrade strategy of course depends on the upgrade strategy for the silicon tracker, it should be noted that additional processors would be needed in any event. They are required to handle significantly increased hit multiplicities per road at high luminosity, independent of whether the detector is upgraded or not.

Upgrades to the data acquisition system, which consist primarily of additional farm nodes offering more processing power, address the need for enhanced filtering capability on a generally richer input data set. The upgrades to the online system will provide the capability for higher bandwidth data-logging in the high rate Run IIb environment.

| Trigger | Example Physics | Rate (kHz) No Upgrade L=1x10^32 | Rate (kHz) No Upgrade L=2x10^32 | Rate (kHz) With Upgrade L=2x10^32 |
|---|---|---|---|---|
| EM<br>(1 EM TT>10GeV) | $W \rightarrow e\nu$<br>$WH \rightarrow e\nu$<br>$Susy$<br>$M_W$<br>$W\gamma$ | 0.65 | 1.3 | 0.7 |
| Di-EM<br>(1EM TT>7 GeV,<br>2 EM TT>5 GeV) | $Z \rightarrow ee$<br>$ZH \rightarrow eejj$<br>$Susy$<br>$Z'$<br>$Z\gamma$ | 0.25 | 0.5 | 0.1 |
| Muon<br>(muon $p_T$>11GeV + CFT Track) | $W \rightarrow \mu\nu$<br>$WH \rightarrow \mu\nu jj$<br>$Susy$<br>$M_W$<br>$W\gamma$ | 3 | 6 | 0.4 |
| Di-Muons<br>(2 Muons $p_T$>3 GeV<br>+ CFT Tracks) | $Z \rightarrow \mu\mu$<br>$J/\Psi \rightarrow \mu\mu$<br>$ZH \rightarrow \mu\mu jj$<br>$Z'$<br>$Z\gamma$ | 0.2 | 0.4 | <0.1 |
| Electron + Jets<br>(1 EM TT>7GeV,<br>2Had TT>5GeV) | $WH \rightarrow e\nu + jets$<br>$tt \rightarrow e\nu + jets$<br>$Susy$<br>$M_t$<br>$Single\ Top$ | 0.4 | 0.8 | 0.2 |
| Muon + Jet<br>(muon $p_T$>3GeV,<br>1 Had TT>5GeV) | $WH \rightarrow \mu\nu + jets$<br>$tt \rightarrow \mu\nu + jets$<br>$Susy$<br>$M_t$<br>$Single\ Top$ | <0.1 | <0.1 | <0.1 |
| Jet+MET<br>(2TT>5GeV, Missing $E_T$>10GeV) | $ZH \rightarrow \nu\bar{\nu}b\bar{b}$<br>$Susy$ | 1.1 | 2.1 | 0.8 |
| Muon + EM<br>(muon $p_T$>3GeV + CFT track +1EM TT >5GeV) | $H \rightarrow WW$<br>$H \rightarrow ZZ$ | <0.1 | <0.1 | <0.1 |
| Single Isolated Track<br>(1 Isolated CFT track $p_T$>10GeV) | $H \rightarrow \tau\tau$<br>$W \rightarrow \mu\nu$<br>$Susy$ | 8.5 | 17 | 1.0 |
| Di-Track<br>(1 isolated track $p_T$>10GeV, 2 tracks $p_T$>5 GeV, 1 matched with EM energy) | $H \rightarrow \tau\tau$<br>$Susy$ | 0.6 | 0.6 | <0.1 |
| **Total Rate** | | **~15kHz** | **~30kHz** | **3.2kHz** |

**Table 1**: Level 1 accept rates with and without the DØ Trigger Upgrades.

**Attachments**

- Letter from the DØ Spokespersons to the Fermilab Director, June 2003
- Letter from the DØ Institutional Board, June 12, 2003

**References**


1. Silicon radiation damage document
   http://d0server1.fnal.gov/projects/run2b/meetings/pac/june03/smtlifetime.pdf
2. Silicon longevity document
   http://d0server1.fnal.gov/projects/run2b/meetings/pac/june03/smtlongevity.pdf
3. Installation and commissioning milestones
   http://d0server1.fnal.gov/projects/run2b/meetings/pac/june03/installation_milestones.pdf
4. Installation and commissioning plan
   http://d0server1.fnal.gov/projects/run2b/meetings/pac/june03/installation_schedule.pdf

*Letter from the DØ Spokespersons to the Fermilab Director, June 2003*

Dear Mike,

Thank you for the frank and open conversation last Thursday concerning the future of Run II. Although we understand the budgetary and schedule pressures facing the Laboratory, we believe the plan presented is not in the best interest of the collider experiments, the Laboratory, or high energy physics – either at home or abroad. With discoveries of fundamental scientific relevance in the balance and the window of opportunity for exploiting them sharply defined, we believe that only one choice is available for the Laboratory's base plan for Run II: support of the full suite of upgrades to the Tevatron and the Run IIb detector upgrades. This plan places the Lab's priorities where they need to be: on the science available to the HEP community during the coming years when Fermilab is the world's frontier facility.

We greatly prefer a strategy with high reward to a strategy of low risk. While we fully appreciate that there is strong political pressure on you to minimize risk, we believe that this choice does not do justice to the physics opportunities before us. The conservative plan or base goal as presented at last Thursday's PMG will result in the termination of the detector upgrades before determination of the technical viability of the recycler and electron cooling has occurred. The justification for pursuing the collider upgrades will then inevitably be called into question. Should the performance of the silicon detectors degrade significantly at any point, without replacements having been built, the necessity of continuing to invest in further luminosity upgrades will be seriously questioned. In the end, there is a very real possibility that the base scenario will result in termination of the entire collider program, years before the availability of LHC physics data. Upgrading either the machine or the detectors, but not both, does not permit our field to capitalize on the vast investment already made in the Laboratory scientific and technical infrastructure and in the Run II physics program.

We would prefer to maximize the physics potential of Run II, fully recognizing that we are pursuing a relatively high-risk course. The plan may not succeed, but if it does – with or without a Higgs, SUSY, or other major discovery – we will have pursued science that is without question the best our field has to offer. The plan also permits a full exploration of the top quark and electroweak scales, still more avenues to unexpected physics. To forego such discovery opportunities would be a decision that is likely to have far-reaching negative ramifications.

We would argue that clearly demonstrating the ability and willingness of U.S. HEP leadership to garner the resources and apply them toward such a potential payoff is reason enough to pursue such a plan. The message must be sent, and the program pursued, that indicates that the science itself is worth the risk. Our entire field is founded on this underlying tenet. Like any investment, resources must be devoted to pursue such a project. But as long as the necessary resources can be identified, the potential payoff is so large that we believe the investment is fully justified. We would urge you to put whatever effort is required into the search for the necessary resources to realize this plan.

The stretch accelerator plan presented last week contains all the elements needed to potentially deliver ~ 10 $fb^{-1}$ of luminosity to the experiments. We understand that it is an audacious plan, intrinsically high risk, and that it will present many managerial and technical challenges to the laboratory. We are ready and eager to work with you to help achieve it. We believe this is the only plan that makes sense, and is consistent with the Laboratory's physics program: full support of both the accelerator upgrade, including the recycler and electron cooling, and the detector upgrades.

The DØ Collaboration has enthusiastically pursued the Run IIb upgrade with the understanding that we are involved in a project that contains significant risk. We did so nonetheless, because the physics is compelling and unequalled. If Run IIb delivers all the physics we originally envisioned, we will be delighted. If not, we will be disappointed, but as long as we gave it our best shot, we will have no regrets. We do not want to see the opportunity lost by backing away from ambitious goals to avoid the possibility of defeat. This is an historic moment when a measure of boldness is required. While we understand the risks associated with pursuing such a course of action at this time, you can depend on our unremitting support in realization of this plan.

With best regards

Gerald Blazey
DØ Co-spokesperson

John Womersley
DØ Co-spokesperson

*Letter from the DØ Institutional Board, June 12, 2003*

To: Mike Witherell: Director of Fermilab
Abe Seiden: P5 Chair
Jim Alexander: PAC Chair

From: Nick Hadley: DØ Institutional Board Deputy Chair
Terry Wyatt: DØ Institutional Board Chair

Dear Mike, Abe, and Jim:

We are writing to you as members of the DØ Collaboration at Fermilab in light of the recently released plan of the laboratory for the Tevatron collider. The fact that plans for an integrated luminosity for Run II as low as 5 $fb^{-1}$ are now being considered is a source of serious concern, because of the implications for

- the physics achievable during Run II,
- the Run IIb upgrade programme of DØ,
- the ability of the non-US institutes to maintain their long-term commitments to DØ

The physics potential of Run II remains absolutely compelling and the Tevatron provides incomparable opportunities for major discovery. With regard both to the detectors and the accelerator we believe that a determined and aggressive approach by all concerned offers the best chance for success.

With regard to the detector, our collaboration must ensure that the trigger and event reconstruction capability of DØ is maintained to the end of the decade. Indeed, we need to increase the efficiency in crucial areas such as tracking and b-tagging in order to maximise the signal samples expected for a given integrated luminosity. Our Run IIb upgrades are on schedule, and significant funds have already been spent on them, including those from two NSF MRI awards. The upgrades have passed numerous external reviews, and are being well managed. We expect neither major schedule changes, nor cost over-runs. We wish to reaffirm our very strong support for the Run IIb upgrades, as discussed in our letter to Abe on March 17, 2003.

We intend to operate the detector to the end of the decade and to extract the maximum possible breadth and quality of physics results from the collected data. In order to achieve this we need to maintain a large and active collaboration, extending into the period when, for example, the LHC experiments will be installing, commissioning and starting to take physics data. In order to meet the many challenges of Run II, the DØ collaboration has grown substantially over the past years, with the addition of many non-US groups. The non-US groups are committed to the long-term future of DØ. Indeed, at the moment they continue to grow. However, these groups continually have to defend their financial and manpower commitments to DØ and the Run IIb upgrade; ultimately it is the fantastic physics expected for Run II that allows them to do this.

With regard to the accelerator complex, the Run II physics reach clearly depends strongly on the total integrated luminosity. We urge the laboratory to reaffirm the aim of delivering around $9fb^{-1}$ by FY 2009 and to restate its commitment to taking all possible steps and making available all necessary resources in order to achieve this ambitious aim.

We recognise the need to redouble our efforts as a collaboration to be well-informed regarding the challenges facing the accelerator complex. If it becomes clear that manpower from the collaboration might make a useful contribution we are ready and willing to help in any way we can. We understand that Fermilab expects to conduct in-depth reviews of the accelerator complex over the next two months, and that the possibility of electron cooling in the Recycler will not be fully clarified until the end of 2003. As the PAC and P5 reevaluate the Tevatron collider programme over the coming weeks, we urge that the future physics potential not be jeopardised by any premature decisions regarding, for example, the detector upgrades for Run IIb, before the future capabilities of the Tevatron are fully understood.

These matters have been discussed very widely and seriously within the collaboration. This letter represents the overwhelming consensus of opinion within the DØ institutes.

On behalf of the D0 Collaboration,

Nick Hadley and Terry Wyatt.