

Report of the Director's Review Committee for Tevatron RunII

The Director's Review of Run II took place May 5,6,7 2003. The agendas and composition of the Committee are recorded in Appendices 1 and 2 respectively.

The Charge

The Committee is asked to review the plan under development by Fermilab for maximizing luminosity delivered from the Tevatron proton-antiproton collider over the period 2004-2009. This plan is being prepared for submission to the Department of Energy on June 1, 2003. The DoE has specifically charged Fermilab to formulate a plan that implements all required elements for achievement of the full upgraded luminosity by the end of FY2006, followed by dedicated running in this configuration for the subsequent period through the initiation of physics results from the LHC.

In particular we would like committee to offer comment, and any relevant recommendations, on the following: 1) Is the strategic approach aimed at achieving up to $3 \times 10^{32} \text{ cm}^{-2} \text{ sec}^{-1}$ by the end of FY2006 fundamentally sound? and 2) What would the committee identify as the primary technical risk factors that would cause uncertainty in meeting the luminosity goals?

The committee is invited to offer comments and/or advice in any areas it feels are relevant beyond the specific points given above. Fermilab requests that a preliminary view of the committee's comments and recommendations be presented to laboratory management at a closeout session at the end of the review. A written report is requested within approximately three weeks of the review.

The Response

General

The Committee was very pleased to see the improvements effected since last October. Attention to details has improved significantly and is showing results in the development and use of tools for better understanding of the machines. In addition, some hard decisions have been made to drop some former program elements and change some directions. This is all to the good.

The Committee was also very much impressed by the intellectual and technical power of the Fermi staff engaged in the many of the aspects of meeting the luminosity challenge. Further integration and coordination of these resources will enhance the probability of success in achieving the very worthy and ambitious goals set forth in the charge.

The Strategic Approach

The high level intermediate goals outlined in the opening talk, slip stacking, AP2+DB acceptance enlargement, stacktail cooling, rapid transfers and electron cooling are sound elements in an overall plan for luminosity increase. To these we would emphatically add "getting control of the basics" and automation of tune-up and injection procedures. By "getting control of the basics" we mean, among other things, adding significantly to the beam

instrumentation and upgrading the control system, measurement of orbits and optical functions from end to end of the luminosity producing process, stabilizing critical power supplies and rf equipment and realigning machine elements to minimize the needed corrections and thus vulnerability to their stability. The automation to which we refer, and which features prominently in all existing very high luminosity colliders, will be essential in turning peak luminosity into integrated luminosity through minimizing human error in executing the many complex processes upon which luminosity production depends.

Risk Factors

Technical Risks

The plan presented is a bold plan with high reward potential accompanied by high risk. The reward will of course be measured in the physics that gets accomplished but, very importantly, the developments in accelerator science and technology, if successful, will have a major impact on all future accelerator based science.

In the line of technical risks one must list electron cooling first. While the principle has been amply demonstrated, the parameters of the proposed system exceed those of the past in both voltage and current. Good progress has been made. Demonstration of an acceptable beam temperature–beam current combination under operating conditions and integration of this complex subsystem into the whole remain as significant challenges.

Slip stacking is another pillar of the plan. While the needed manipulations have been done at low beam current, the difficulties of controlling beam induced voltages and space charge effects have yet to be faced and mastered.

The planned increase in pbars will move the Tevatron from a strong-weak beam-beam regime into a strong-strong regime with potential for unanticipated behavior. There may be other effects as well, having to do with the higher intensity, opposite charge beam such as electron accumulation effects, etc.

The new stacktail cooling planned may encounter unanticipated phenomena.

The very fact that complete success depends on a number of factors in series is in itself an enhanced risk, making it necessary to anticipate work-arounds in the event of failure of a particular step to meet design goals.

Schedule Risks

Among these are failure of the anticipated funding profile to be realized, the challenge of integrating the recycler ring with electron cooling into the rest of the Tevatron complex, the possibility of delay in obtaining needed power tubes for the linac and the potential of the long down period to cause further unanticipated delays. Also of concern to the committee is the implied end-loading of the luminosity profile. If the planned luminosity increase is not achieved as scheduled, it could be too late to recover.

Further Comments

We are unanimous in urging that improving the basics be pursued aggressively in order to make perceptible improvements in the ratio of integrated to peak luminosity. Opening up the apertures as described in the presentations should proceed as rapidly as possible. Early attention to improving the lattice and beam models (including correctors) for the machines will also be needed. Successful modeling will be a major step towards the deep understanding of the Tevatron complex needed to achieve its maximum capabilities

While we are pleased to see the increased utilization of personnel and expertise from outside of the Beams Division, the bringing in of further help from other FNAL units as well as from outside laboratories with relevant expertise needs persistent pursuit.

The recycler together with the planned electron cooling feature need attention to obtain sufficient leadership and manpower for this exceedingly challenging project and the allocation of pbars and needed access for the urgent development work.

Conclusion

The luminosity goals presented are well worth pursuing but are very challenging. The proposed means of accomplishing them is bold and worth pursuing not only for the currently envisioned program at Fermilab but also for the future of accelerator based science in the future. The technical capabilities for addressing the technical steps needed to meet the goals are present either at FNAL itself or in the US accelerator community. The great challenge is to bring them to bear in a timely fashion.

Appendix I

Agenda Run II Director's Review

May 5, 2003

8:30 → 9:00	Executive Session
9:00 → 9:30	Introduction (project goals, scope) —Spalding
9:30 → 10:00	Introduction (technical Strategy)—McGinnis
10:00 → 10:45	Run II Operations Status—Church

10:45 → 11:00	<i>Break</i>
11:00 → 12:00	Protons on Target (technical basis, plans and status)—Kourbanis
12:00 → 13:00	Antiproton Acceptance (technical basis, plans and status)-- Werkema
13:00 → 14:00	<i>Lunch</i>
14:00 → 15:00	Antiproton Stacking and Cooling (modeling, plans and status)-- McGinnis
15:00 → 16:00	Tevatron Modeling and Upgrades (modeling, plans and status)—Lebedev
16:00 → 16:15	<i>Break</i>
16:15 → 17:00	Project Planning (RLS, milestones, phasing)—Spalding
17:00 →	Executive Session

May 6, 2003

8:30 → 12:00 Further discussions as needed

1. Tevatron Alignment

Discussion of what we know and the strategy for understanding what should be fixed, how, and when.

Lead person: Shiltsev

Other invitees: Syphers, Lebedev, Kephart

Time/place: 9:30-10:15 in the Comitium

2. Electron Cooling

Discussion of status of the effort and the plan for implementation

Lead person: Nagaitsev

Other invitees: Anyone Sergei feels he needs

Time/place: 10:15-11:00 in the Comitium

3. Instrumentation

Overview of instrumentation foreseen for supporting Run II plan and the process/plan for implementation.

Lead person: Webber

Other invitees: Anyone Bob feels he needs
Time/place: 10:15-11:00 in the Snakepit

4. Reliability

Overview of the plan to keep the complex operational over the coming decade with particular reference to the vulnerability assessment and what we are doing in response.

Lead person: Czarapata

Other invitees: Anyone Paul feels he needs

Time/place: 11:00-11:45 in the Comitium

5. Recycler

Current performance status and plan to get to integration.

Lead person: Mishra

Other invitees: Sergei and anyone else Shekhar and Roger feels is needed.

Time/place: 11:00-11:45 in the Snakepit

13:00 Executive Session

May 7, 2003

9:00 Closeout

Appendix II

Committee Members

D. Edwards FNAL ret.
P. Martin FNAL ret.
S. Milton ANL
J. Rogers Cornell
M. Ross SLAC
P. Tennenbaum SLAC
M. Tigner Cornell (Chair)
A. Tollestrup FNAL

Observers

K-J Kim ANL – FNAL liason
M. Zisman LBNL – FNAL liason