STATUS OF THE FERMILAB FIXED TARGET PROGRAM

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Abstract

Fermilab is in the midst of an 800 GeV fixed target run involving ten external beam lines and the operation of the pbar source for two additional experiments. Details of the preparation are presented with an emphasis on how changes from the last run have impacted the current run. Statistics and graphical representations show the progress toward meeting the goals of the program. An overview is presented of the external (floods....) and internal (machine instabilities ...) challenges encountered during the run.

1 FIXED TARGET GOALS

The main goal of the fixed target program can be succinctly stated: we wanted to increase the intensity by 50% over what we had achieved in the last fixed target run which implied that we wanted to increase the intensity by 1E13 per pulse. In absolute intensity the goal was 3E13/pulse; historically we had trouble running reliably at 1.6E13 and the peak record was 1.80E13. Our new peak intensity record so far is 2.81E13 and we have been able to run reliably at over 2.5E13/pulse which was another goal.

A feature of this run was the presence of a neutrino experiment, E815, requiring high intensity fast spill which had not been done for 9 years. Another set of goals was to provide 20 seconds of good quality slow spill every 60 seconds at 800 GeV. In the past the fast spills had been interspersed within the slow spill and caused interference with the slow spill users. In this run all the fast spills are bunched together at the start of the flattop to provide the 20 seconds of slow spill.

Our final goal was to reliably provide 100 hours of stable running per week.

2 OVERVIEW OF THE RUN

Figure 1 provides an overview of the run. In the beginning there was a melding of three activities : during the daytime there was Main Injector construction near the Booster and 1 TeV testing in the Tevatron, beam was available during the night and part of the weekends. The first goal was to push the beam as far as possible to find out what was broken and to test new devices. As mentioned above, the fast spill was bunched at the beginning and this was made possible by an upgraded extraction system QXR, Quadrupole Extraction Regulator, [1]. There were three components to our being able to place the spill in this manner: QXR upgrade, pulser upgrade, and E815 DAQ. In order to have as long a period of slow spill as possible we wanted to shorten the time between the fast spills. However the experimental data acquisition system could not go below a half second repetition rate, but even at this rate we had to upgrade our pulsed trims in the Switchyard since this was an order of magnitude increase in repetition rate. So an important component of the early startup was the commissioning of the extraction system with the multiple fast spills.

One aspect of the early running was a dedicated 150 GeV alignment run for E815 which utilized 1/3 of the Tevatron as a beam line. This was accomplished during the night time running. After 24 hour/day operation was established on June 14,1996 we quickly got up to around 1E13 but we were plagued with numerous feeder failures in addition to a large scale flooding from a very severe storm. A period of dedicated repairs to the most vulnerable feeders reduced the failures to manageable level.

However, we were still mired at an intensity level of approximately 1.2E13 until a set of measurements and calculations [2] were done that enabled us to increase the extraction step size. This change was made in September and along with the work on dampers in the Booster, Main Ring, and Tevatron [3] enabled the steady increase in intensity up till now. Even with the decrease in losses due to the step size change there was a concern about activating the D0 collision hall which would cause background for the D0 experiment and so a shutdown was made to install additional shielding There was a long shutdown for Christmas and the final two major interruptions to the program were a TeV dipole failure and a site wide power outage.

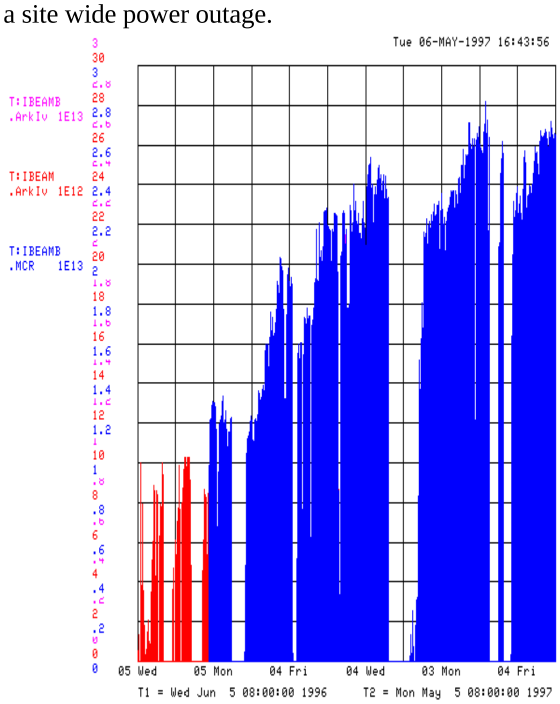

Figure 1: Overview of the Fixed Target Run. Tevatron Intensity from 6/5/96 to 5/5/97.

[1] Operated by University Research Association for the United States Department of Energy

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3 RUN SUMMARY

The run has gone well in comparison with our goals and with past runs. Figure 2 shows the integrated hours and the weekly hours and it is apparent that we are doing a reasonable job of providing 100 hours/week.

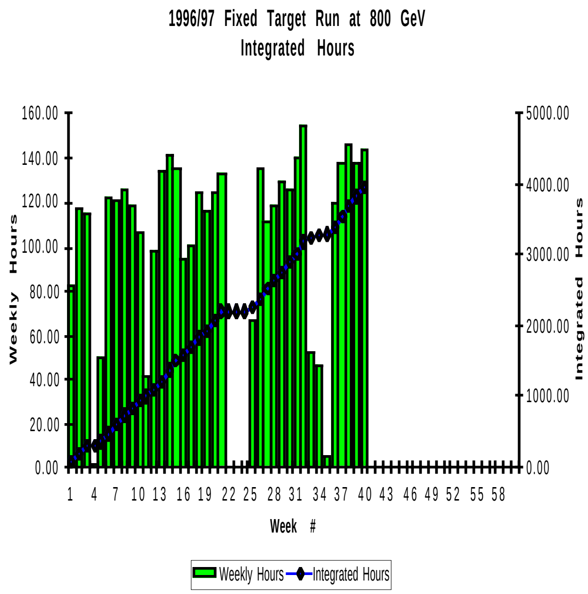


Figure 2: Integrated hours and weekly hours for the 1996/1997 Fixed Target Run.

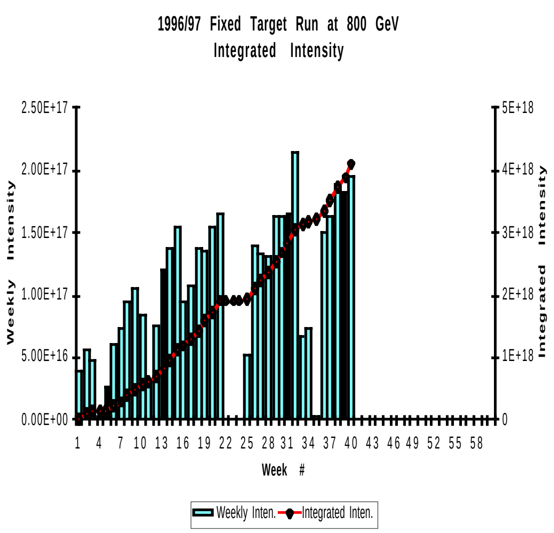


Figure 3: Integrated intensity and weekly intensity for the 1996/1997 Fixed Target Run.

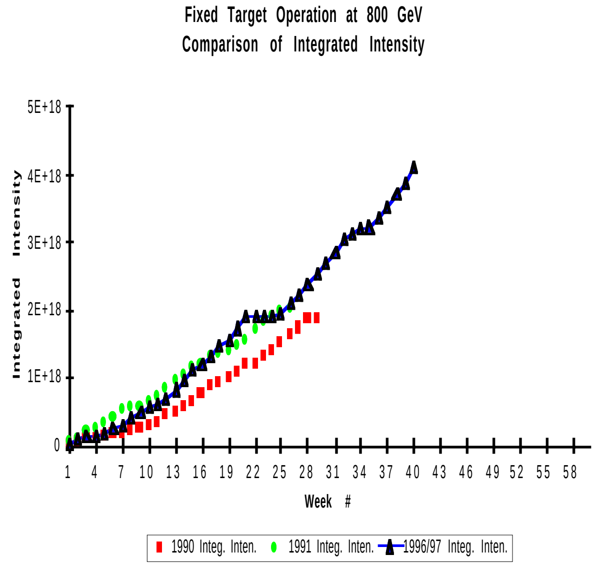


Figure 4: Comparison of integrated intensities.

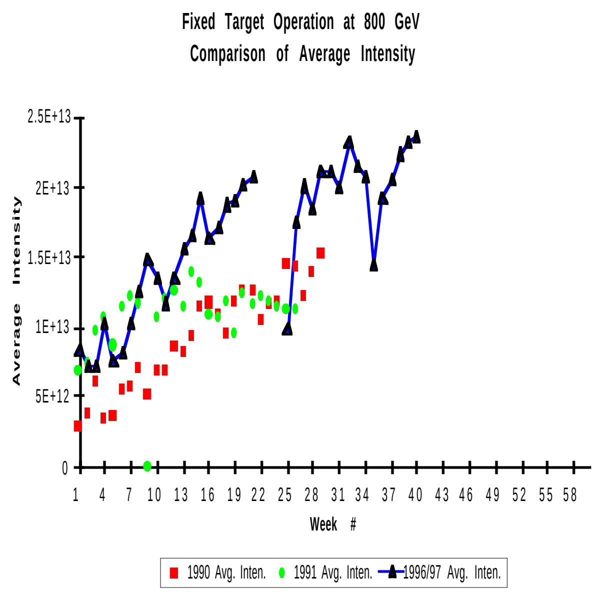


Figure 5: Comparison of average intensity

Gains have been made in the intensities delivered to the experiments. Figure 3 shows the analogous plots for the weekly intensity and the integrated intensity. Figure 4 compares the present run to the two previous runs and the fair comparison should be between the present run and the 1990 run (the 1991 run was a continuation of the 90 run with a hiatus for our shielding assessments and hence we did not make a change from collider operation). The most striking gain has been made in the intensity per pulse. Figure 5 gives a comparison between the current run and the previous runs and it is clear that we have achieved an approximately 50% increase in intensity. It should be noted that we have consistently met the users request since differing experiments have been coming on line during the course of the run.

4 CONCLUSIONS

We are doing well in this run particularly in terms of increased intensity; and we can consider four main ingredients to the success of the run: the E815 target train, the Linac upgrade, dampers, and the step size change.

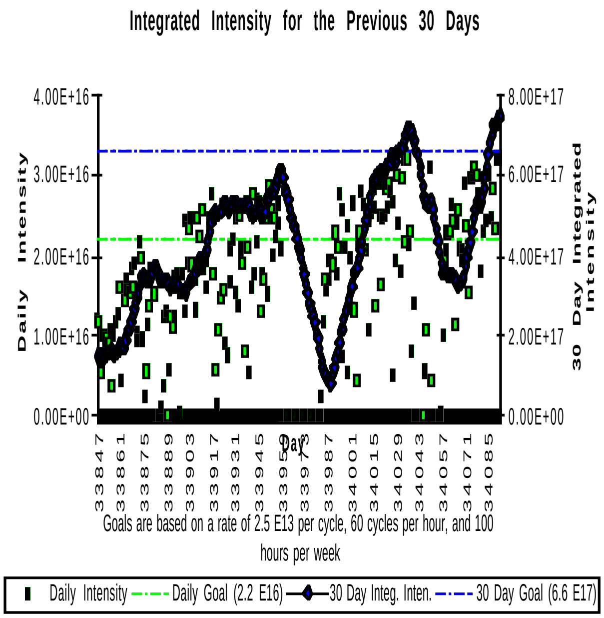
The E815 target train has several positive implications for increasing the intensity for the entire program. A very helpful use of the train is a convenient and useful place to put beam when other experiments go down. This means that there is no ratcheting of intensity and the intensity of the complex can stay high. A reason that we can have this flexibility and not disrupt the program is that we have improved (widened) the shape of the fast pulses so that operationally we can increase the intensity in each pulse (as opposed to adding pulses which would change the timing for everybody else) without greatly increasing the dead time of E815. The QXR upgrade and the Switchyard pulser upgrade imply that we can get rid of the intensity related to the fast spill in the Tevatron quickly and hence get back to the level of intensity that we had run before. However we still have to get the beam through the Main Ring and accelerate in the Tevatron.

The Linac upgrade was the reason that we had set our intensity goals for the run so much higher than previous runs had achieved. This upgrade gives us brighter beams to fit through the Main Ring and its overpasses (prior to the overpasses the Main Ring intensity record was 3.3E13). We want more intensity without increasing the size of the beam so it will fit in the available aperture (transverse, longitudinal, and dynamic), but when we make the beam brighter we increase the interaction of the particles with themselves and with their environment.

A general solution to this problem is to build dampers and of course we have done this before this run, in fact eleven dampers were used for this run that had been built previously [3] for the Booster and Main Ring. However twelve dampers were specifically built for this run [3] for the Main Ring and Tevatron, along with specific modifications [4] to the Tevatron RF to suppress some High Order Modes that had caused problems in the last fixed target run. In addition two anti-dampers were built for spill quality considerations [3].

More intensity means more extraction losses since we resonantly extract utilizing a thin wire septum. Modeling and experimental measurements which verified the modeling indicated that we could increase the step size and since the extraction losses are approximately given by the ratio of the wire diameter to the step size it was expected that the losses would go down. In fact the step size was increased by 50% and the losses in the regions of the extraction septum and the extraction Lambertsons went down by approximately 1/2. In general there was an interactive interplay between the various systems (dampers, antidampers, step size parameters), and between the various machines (Booster, Main Ring, and Tevatron)

The experimenters are interested in spill quality over varying time scales; there is a web site [5] which shows the spill on a short time scale and figure 6 shows our progress in meeting our goal of 2.5E13/pulse, 60 pulses/hour, 100 hours/week over a 30 day average.



5 ACKNOWLEDGMENTS

The success of this run has been due to the dedicated efforts of many people in the Beams Division.

6 REFERENCES

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[2] M. Martens, J. Marriner, and J. Holt, paper 2B7 in this conference.
[3] D. McGinnis, J. Steimal, private communication
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[5] Peter Kasper, private communication

http://www-focus.fnal.gov/snapshots/spill.html