FERMILAB COLLIDER RUN 1B STATISTICS

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The present Fermilab Tevatron Collider run, designated as Run 1b, started in October 1993 and will conclude in July 1995. This paper summarizes the parameters and performance of the Fermilab accelerator complex to date. Operational problems encountered during the run are described as well as the factors that limit peak and delivered luminosities.

I. INTRODUCTION

The Fermilab Tevatron is the world's highest energy superconducting proton synchrotron. It has been modified to also run as a colliding beam storage ring in order to study proton-antiproton collisions, presently at 1800 GeV in the center of mass. There have been four collider runs to date i.e., the 87 run, the 88-89 run, Run 1a and Run 1b. More details on the status of the Fermilab collider are given in reference [1].

II. TABLES AND FIGURES

Table I list some parameters for the accelerator complex for the 88-89 Run, Run 1a and Run 1b. There has been a steady improvement in all parameters.

Table II contains performance numbers for Run 1b and compares them to their values in the two previous runs. There has been a factor of ten improvement since the 88-89 Run.

Table III categorizes the stores that ended abnormally. The percentage of stores ending abnormally is smaller now and there is less sensitive to the TeV power supply system and to power glitches and lightning.

Figure 1 shows the evolution of peak luminosity during Run 1b and compares this to Run 1a. A 10X running average is applied to remove the scatter of points.

Figure 2 displays integrated luminosities. The bars represent the weekly delivered luminosity and the lines the run totals.

Figure 3 shows the antiproton stacking rate. Again there has been a steady increase in the stacking rate. The accumulator regularily stacks greater than 6 x 10^{12} antiprotons in a week, nearly twice the rate for Run 1a.

Figure 4 shows the luminosity per store hour. In the last few weeks before this conference the collider has been delivering greater than 40 nb^{-1} per hour.

[1] "Status and Future of the Tevatron", V. Bharadwaj, proceedings this conference.

Table I : Fermilab Collider Parameters

Collider Parameters	**88-89 Run**	**Run 1a**	**Run 1b**
Protons/bunch (10^{10})	7.00	12.00	22.50
Antiprotons/bunch (10^{10})	2.90	3.10	6.50
Proton emmitance (π mm-mr)	25	20	22
Antiproton emmitance (π mm-mr)	18	12	14
Beta* at interaction point (meters)	0.55	0.35	0.35
Bunch length (RMS , meters)	0.65	0.62	0.62
Typical luminosity (10^{31} $cm^{-2}sec^{-1}$)	0.16	0.54	1.89
Best luminosity (10^{31} $cm^{-2}sec^{-1}$)	0.21	0.92	2.31
Integrated Luminosity (pb^{-1}/ week)	0.32	1.09	3.82
Interactions/crossing (@ 45 mb)	0.25	0.85	2.98
Antiproton tune shift	0.025	0.009	0.015
Proton tune shift	0.014	0.004	0.007
Average luminosity lifetime (hours)	20	17	15
Typical Antiproton Stack (10^{10})	70	120	180
Antiproton stacking rate (10^{10}/hour)	1.5	3.0	4.5
Main Ring Intensity (10^{12} protons per pulse	1.5	2.0	3.2

Table II : Collider Statistics

	88-89 Run	Run 1a	Run 1b
Total Integrated Luminosity (pb^{-1})	9.59	31.70	100.80
Total store hours	4257	3373	5531
Peak luminosity ($10^{31}cm^{-2}sec^{-1}$)	0.21	0.92	2.31
Integrated luminosity rate (nb^{-1}/hour)	3.5	11.0	36.0
Max integrated luminosity in a week (pb^{-1})	0.52	2.33	4.89
Max integrated luminosity in a store (pb-1)	0.14	0.39	0.82
Max antiproton stack	97	150	221
Longest store	53	33	29
Typical shot setup time (hours)	3.5	2.5	2.5
Typical store length (hours)	21	18	16
Total number of stores	295	265	426
Abnormal store ends/total # of stores (%)	55	35	27

Table III: Store End Categories

Store end explanation	**88-89 Run**	**Run 1a**	**Run 1b**
Intentional	133	173	309
Controls	8	19	17
Quench protection system	17	15	17
TeV power supplies (TECAR)	16	5	11
Lightning & power glitches	15	5	6
TeV RF system	11	1	6
Human error	11	6	8
Cryogenics	9	7	8
Experimental areas operations	7	1	1
Correction systems	12	8	5
Vacuum	4	1	3
Low beta quads	4	6	15
Utilities	3	6	7
Instrumentation	0	1	1
Abort kicker prefire	31	0	1
Miscellaneous	14	11	11

Figure 1: Average Peak Luminosity ($cm^{-2}sec^{-1}$) vs. Day

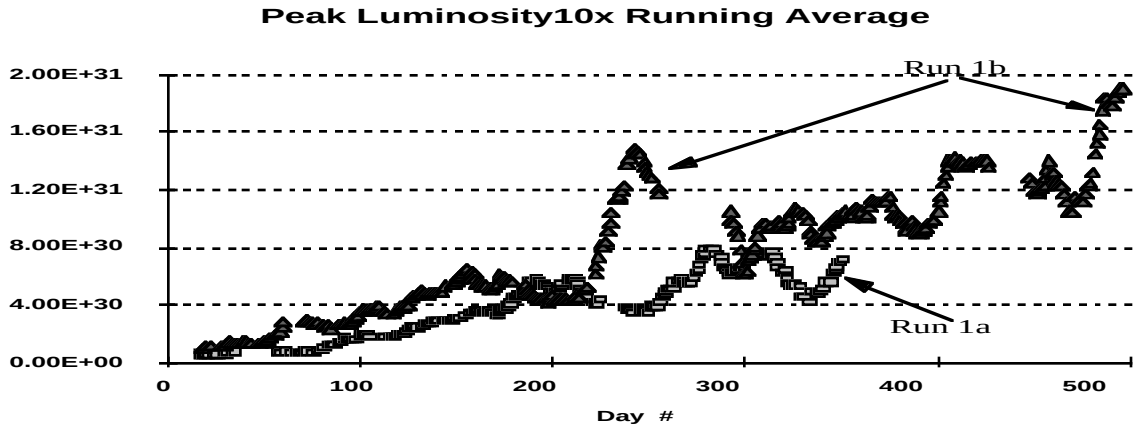

Figure 2: Weekly and Run Integrated Luminosities (nb^{-1})

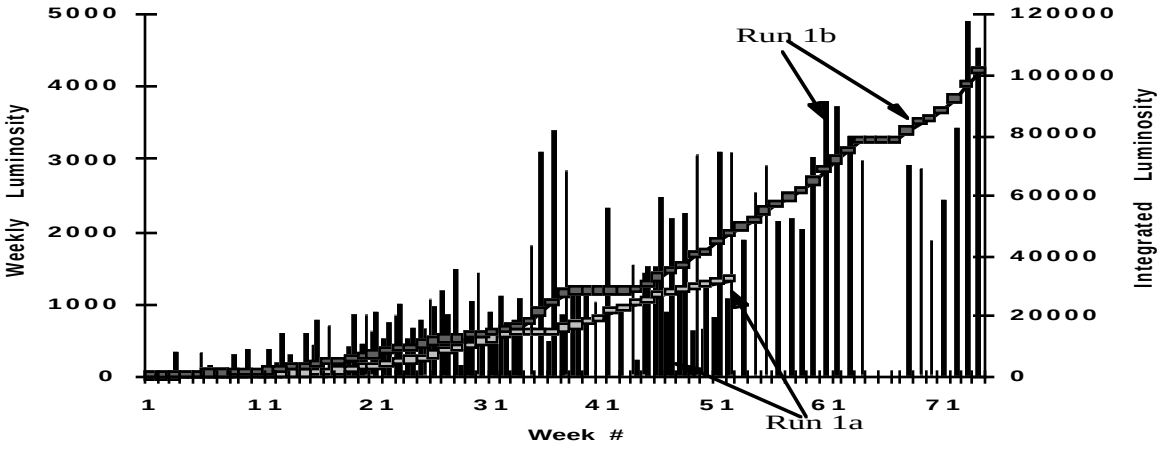

Figure 3: Antiproton Stacking ($x10^{10}$ antiprotons)

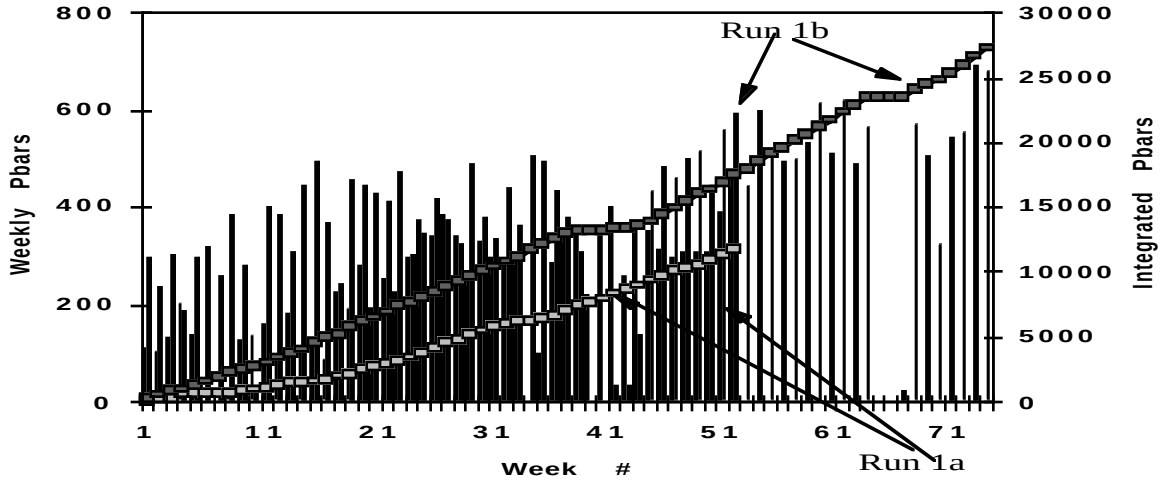

Figure 4: Luminosity per Store Hour (nb^{-1} /hour)