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Implementing Fixed Back Porch Time on the Tevatron Energy Ramp

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Abstract

Title: Implementing a Fixed Back Porch Time on the Tevatron Energy Ramp

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Category: Tevatron sextupole (b2) field drift.

Goal: Recent MTF measurements of the b2 drift in the Tevatron dipole magnets demonstrate that the amount of b2 drift on the front porch is a function of the time spent on the back porch after decelerating from flattop. Presently the time spent on the back porch is not well controlled because the "Decelerate" and "Goto Injection Porch" aggregates of the sequencer are run separately. A new sequencer aggregate "Decelerate, Goto Inj Porch" has been developed which provide a consistent back porch time for all Tevatron shot setups.

Aggregate implementation:

The new "Decelerate, Goto Inj Porch" aggregate was implemented on February 9, 2004. The back porch time is 96 seconds (= 90 seconds after a $44 event + 6 seconds to start the reset portion of the Tevatron ramp.)

Aggregate checkout:

On January 26th, while the Tev was down for repairs, the updated aggregate was tested without beam and ready for use. A run through of the Tevatron shot setup sequence with the new aggregate in place of the existing "Decelerate" and "Goto Injection Porch" aggregates was performed. Monitor devices such as separators, b2 drift compensation, etc. and compare to C23 files to verify devices are at their proper settings.

Notes on the Back Porch Time :

During the aggregate checkout the relative timing of various clock events were recorded and are shown in the table below.

Description	TCLK event	Time in SC		Total time	Time difference
DFG Continue	$63	33.25728	0	33.25728	
Start of decceleration	$6D	41.25573	0	41.25573	7.998453
Start of BP	$44	4.876218	120	124.8762	83.62049
DFG stop	$62	6.876222	120	126.8762	2.000004
DFG continue	$63	37.45923	180	217.4592	90.583
Tev Reset	$41	3.003353	240	243.0034	25.54413
Start of FP	$43	7.25648	240	247.2565	4.253127
DFG stop	$62	9.256486	240	249.2565	2.000006

A summary of events in the new aggregate:

- Tev at flattop.
- Sequencer issues the $63 to start the Tevatron ramping.
- Event $6D triggers 2 seconds after $63. This marks the start of the down ramp.
- Event $44 triggers 83.57 seconds after the $6D. This marks the start of the BP. The TCHROM OAC also reacts to the Event $44 and marks the start of the back porch time.
- Event $62 triggers 2.0 seconds after the $44. This stops the Tev ramp.
- The sequencer waits 90 seconds after event $44 then SETS_SEQ STATE 22 (Tev Reset).

- The TCHROM OAC reacts to the state change to Reset and loads the front porch curves for the b2, tune, and coupling compensations. The time on the back porch (the time since the Event $44) is used for the BP time and used in the b2 algorithm. This time is recorded in the TCHROM log (OACTCHRM on D112.)
- The sequencer waits for T:CHRLST to indicate the front porch tables were properly loaded.
- The sequencer triggers event $63 to start the Tev ramping.
- 6.12 – 2.0 = 4.12 seconds after the $63, the Tev starts to ramp down to 90 Gev.
- The sequencer waits for the Tev bus to reach 400 amps, waits for 4 seconds, then triggers the $41 event.
- Event $43 triggers 4.25 seconds after the $41 event and marks the start of the front porch. This also triggers TCHROM to mark the end of the back porch and the start of the front porch. The time difference between the start of the front porch and the start of the back porch is calculated and loaded into T:BPTIME by TCHROM. (See note below.)
- Event $62 triggers 2 seconds after the $43 event and stops the Tevatron ramp.
- The Tevatron is now on the front porch at 150 Gev.

There are actually three separate times associated with the back porch.

1) This first is the time from the start of the back porch till the time that TCHROM detects the transition of V:CLDRST to RESET. This is the time used by THCHROM in the algorithm to calculate the front porch chromaticity corrections.
2) The second is the actual time at 150 Gev on the back porch. This is the above time, plus a delay for the sequencer to issue the $63, plus 4.12 seconds after the $63 event is triggered before the Tev starts its ramp down.
3) The third is the time from the start of the back porch to the start of the front porch. This is the time recorded in T:BPTIME.

These are recorded in the table below for the test of the new aggregate.

1)	TCHROM log BP Time	89 seconds
2)	(Event $63 + 4.12) – Event $44	96.7 seconds
	TCHROM log BP Start Time	1075119539 seconds
	TCHROM log BP End Time	1075119661 seconds
	TCHROM log FP Start Time	1075119661 seconds
3)	T:BPTIME	122 seconds

Decelerate, Goto Inj Porch **Aggregate**

This is a listing of the new aggregate used on Jan 26th, 2004.

```
TV Window 'Decelerate, Goto Inj Porch'

::: CHECK_DEVICE C:LBSEQ READING   .
::: KILL_BEAM TEVATRON             .
::: CTL_DEVICE T:PBKTC  RESET      .
::: CTL_DEVICE T:ABKTC  RESET      .

::: COG ABSOLUTE 0                 .
::: SET_DEVICE T:FWLATT 0          .
::: SET_SEQ FILE 22                .
::: ACL DAMPER_OFF                 .
::: ACL HORZ_DAMP_OFF              D
::: SET_SEQ FILE 13                .
::: SEQ_PGM REQUEST vsa collider   .

::: SET_ENUMERATED V:TEVMOD        .
::: SET_DEVICE V:SDAENB 2          ?
::: SET_DEVICE V:SDAENB 1          ?
::: SET_DEVICE V:SDAENB 1          D
::: SET_DEVICE V:TUNEUP 1          .
::: SET_DEVICE V:RHCNT  0          .

::: FTP decelerate   0             .
::: FTP b2 plot      0             .

::: SET_SEQ FILE 8                 .
::: TIMER T:TD6D DECELERATE        .
::: NOTIFY deceleration            .
::: SET_SEQ STATE 19               .
::: WAIT_STATUS T:CHRLST           .

::: EVENT 63 TRIGGER               .
::: WAIT_FOR EVENT 62              .
::: SET_SEQ FILE 17                .
::: SET_SEQ STATE 20               .
::: LEAD_FLOW OFF HIGH             .

::: CHECK_DEVICE C:LBSEQ READING   .
::: EVENT C7 TRIGGER               .
::: WAIT_DEVICE C:LBSEQ            .
::: EVENT D4 TRIGGER               .
::: NOTIFY backporch               .
::: EVENT 46 TRIGGER               .

::: REPLAY C49  reloadafterstore   .

::: FTP b2 plot      0             D
::: FTP b2 correct   105           .
```

```
::: WAIT_FOR EVTSEC 44  + 90       .
::: SET_SEQ STATE 22               .

::: WAIT_STATUS T:CHRLST           .

::: EVENT 62 ENABLE                .
::: EVENT 43 ENABLE                .
::: EVENT 63 TRIGGER               .
::: WAIT_DEVICE T:IPROG            .
::: WAIT_FOR SECS 4                .
::: EVENT C1 ENABLE                .
::: EVENT 41 TRIGGER               .
::: EVENT C1 DISABLE               .
::: WAIT_FOR EVENT 62              .


::: SET_SEQ FILE 50                .
::: POLARITY C:B0SHP PLUS          .
::: POLARITY C:B0SVP MINUS         .
::: ABORT_MASK ALL_TEV DISABLED    .
::: SET_SEQ FILE 48                .
::: EVENT 74 TRIGGER               .

::: SET_SEQ FILE 52                .

::: SET_SEQ RUN +=1                .
::: ACL WAIT_FOR_READING_MATCH     ?
::: SHOT_LOG Chapter               ?
::: SHOT_LOG COMMENT               ?
::: SET_SEQ STATE 1                .

::: ACKNOWLEDGE                    .
::: ACL SET_C49_DEVICES            .
ERR SEQ_PGM REQUEST C23_front_por  .

::: NOTIFY front porch             .
```