OPERATING PROCEDURE CHANGES TO IMPROVE ANTIPROTON PRODUCTION AT THE FERMILAB TEVATRON COLLIDER*

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Stacking Performance

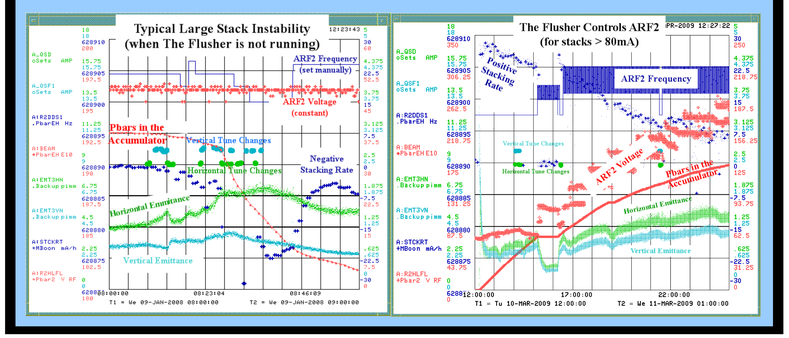
The Antiproton Source has doubled the rate at which antiprotons are produced over the last three years. The three plots below show the stack rate as a function of stack size, the weekly antiproton production and average stacking rate over a number of years. In each plot we can see a measurable increase in antiproton production.

Abstract

Since the start of Fermilab Collider Run II in 2001, the maximum weekly antiproton accumulation rate has increased from 400 x 10^{10} Pbars/week to approximately 3,700 x 10^{10} Pbars/week. There are many factors contributing to this increase, one of which involves changes to operational procedures that have streamlined and automated Antiproton Source production. Automation has been added to the beam line orbit control, stochastic cooling power level management, and RF settings. In addition, daily tuning efforts have been streamlined by implementing sequencer driven tuning software.

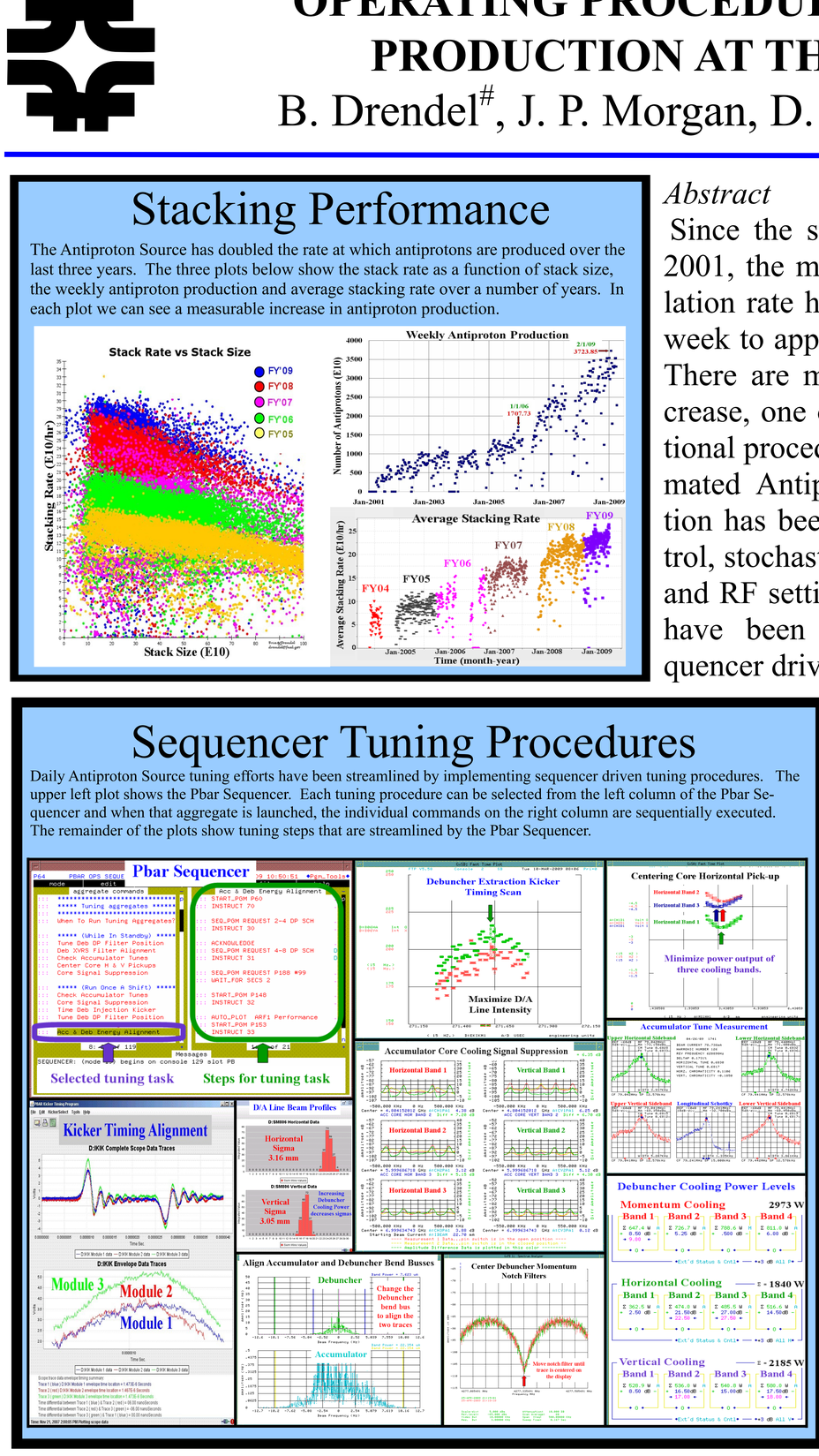
The Flusher

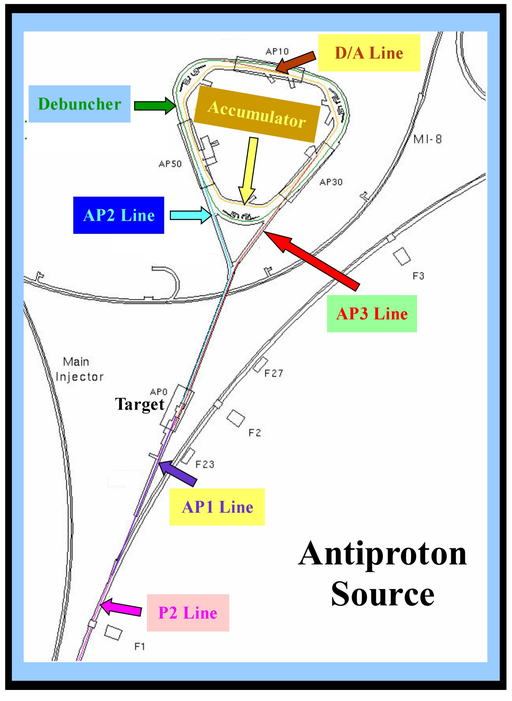
The Flusher is an Accelerator Command Language (ACL) script is used to improve beam stability in the Accumulator by changing the voltage and modulating the phase of the Stabilizing RF. The stabilizing RF bunches the beam which provides one mechanism to remove trapped positive ions that accumulate as a result of the antiproton beam passing through the residual gas in the Accumulator vacuum chamber. The plot on the left shows a typical large stack instability when the flusher is not run. Accumulator Transverse emittances increase and beam starts to fall out of the Accumulator. The plot on the right shows the flusher running with a large stack. In this case the Accumulator transverse emittances stay under control and we continue to stack antiprotons.



Sequencer Tuning Procedures

Daily Antiproton Source tuning efforts have been streamlined by implementing sequencer driven tuning procedures. The upper left plot shows the Pbar Sequencer. Each tuning procedure can be selected from the left column of the Pbar Sequencer and when that aggregate is launched, the individual commands on the right column are sequentially executed. The remainder of the plots show tuning steps that are streamlined by the Pbar Sequencer.

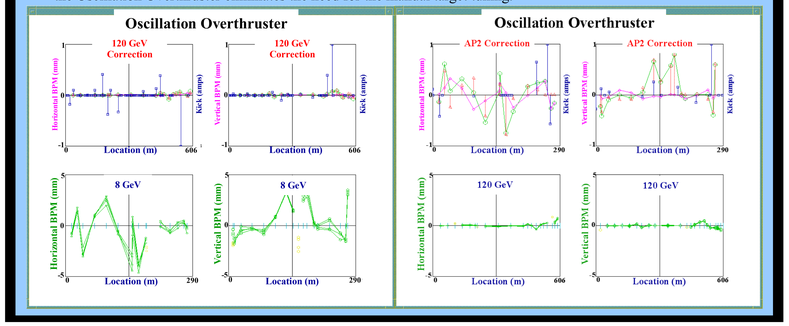




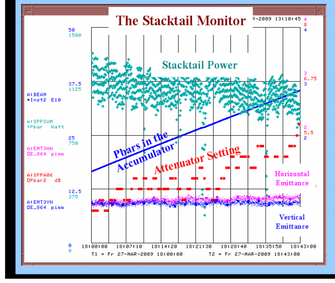
Antiproton Source

Automated Beam Line Tuner

The beam line tuner (called the "Oscillation Overthruster") provides automated beam line steering control using Beam Position Monitors (BPMs). The application corrects the beam orbit for over 600 m of 120 GeV proton beam line (P1, P2 and AP1 lines), as well as approximately 275 m of secondary 8 GeV beam line (AP2 line). Prior to the implementation of this software, any beam line orbit drift was manually corrected by changing a pair of trim magnets in the AP1 line. This task, called "target tuning", was performed a number of times each day. Running the Oscillation Overthruster eliminates the need for the manual target tuning.



Stacktail Monitor



The Stacktail Monitor is an Accelerator Command Language (ACL) script that regulates stacktail power based on stack size. The plot on the left shows the stacktail trunk attenuator changing with stack size to regulate the stacktail power. The two plots on the right show the Accumulator longitudinal profile. The top plot shows beam pushed out the low energy side of the core, a possible consequence of the stacktail power being run too hard. The bottom plot shows a normal stacktail profile.

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