

Observation of Antiproton Loss Before Collision

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This graph shows the typical antiproton intensity for bunch #1, #2, #3, #10, #11 and #12 during injection, ramp and squeeze until collision. You'll see a lot of antiproton lost during the ramp and squeeze. Especially the lifetime at 150GeV (injection) was bad, so the bunch #1-3 lost much intensity before ramp since they stayed longer.

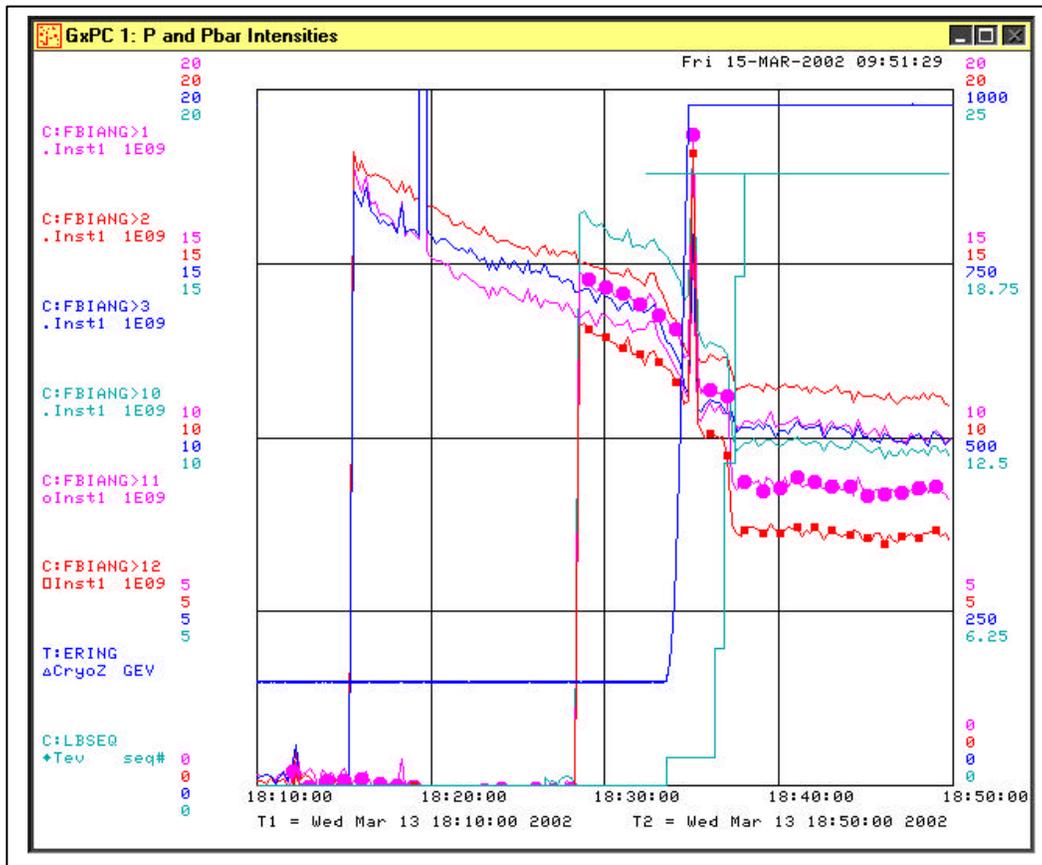


Figure 1. Antiproton bunch intensity from injection to collision

In above graph, T:ERING is the Tevatron energy and C:LBSEQ is the ramp and squeeze step number.

By picking up all 36 antiproton bunches for some stores, we got the statistic of the antiproton loss for the store before collision. The results are plotted in the following graphs:

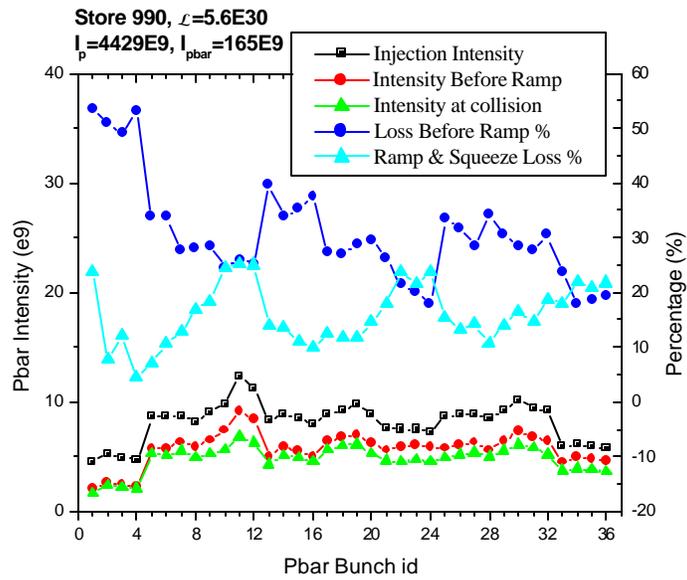


Figure 2. The antiproton injection intensity and loss before collision for store #990

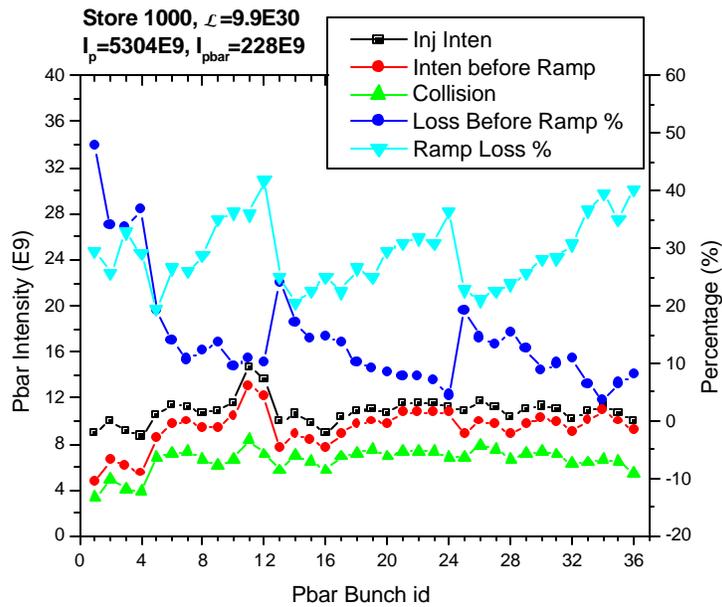


Figure 3. The antiproton injection intensity and loss before collision for store #1000

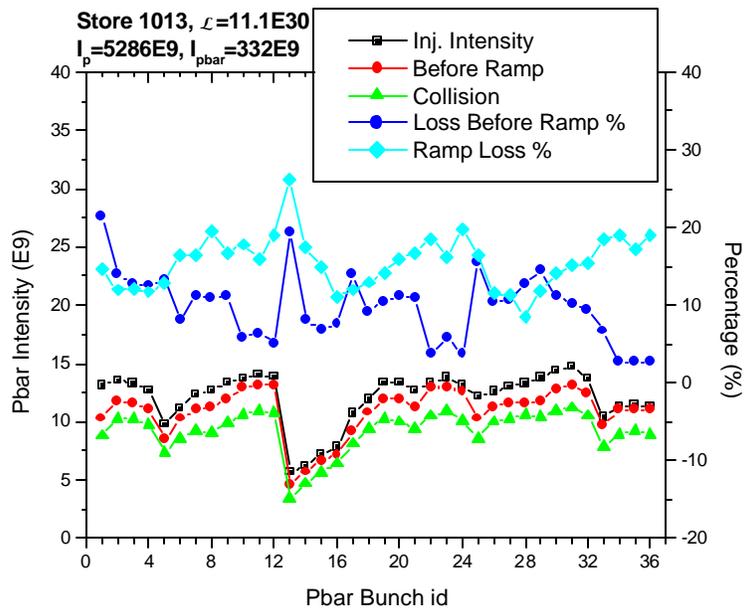


Figure 4. The antiproton injection intensity and loss before collision for store #1013

From all above plots, you'll see a clear pattern of antiproton loss for each group of the 12 bunches. The general summary of each group of the 12 bunches is listed below:

Summary:

- First group of bunches (#1,2,3,4) in the train suffered most at 150GeV, average loss 40~50%.
- The last group of the bunches (#9,10,11,12) suffered most during ramp and squeeze, average loss 20~38%.
- The weakest bunches are the 1st and the last bunch in the bunch train.
- The middle group loss about 10% both before and during ramping.

Suggestions:

- Change the Pbar injection order to: Middle Group Last Group First Group (*"It is unrealistic for this moment, since it implies more injection kicker is needed."* By Jerry Annala)
- More studies:
 1. Monitoring the emittance of the each proton and pbar bunch during injection. Minimize the injection emittance if possible.
 2. Computer tracking studies for dynamic aperture with and without long range beam-beam effect.
 3. Possible few more transition lattices to solve the dynamic aperture problems due to nonlinear elements in the lattice if there is any. (Studies and improvements are underway)
 4. Digital bunch-by-bunch feedback system. (also benefit the bunch-by-bunch dynamic studies, such as tune, orbit, etc. for each bunch)