Operational Experience with Collimators in the Tevatron Collider

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ABSTRACT

During the last year the Tevatron Collider has been running not only with two new low beta insertions and electrostatic separators to keep the protons and p-bars from colliding anywhere except where desired, but also with a new collimator system. We report on this system, including sensitivity of halo evolution to Tevatron operating point

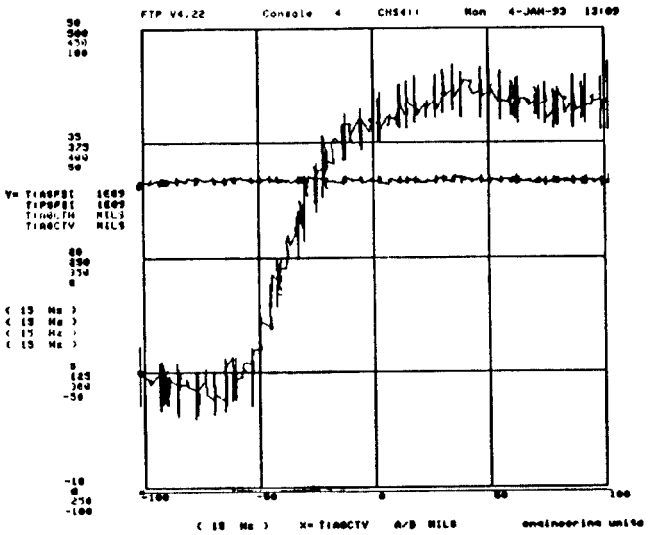
INTRODUCTION

In a previous paper[1], I reported on the design for the halo scraper system to be used in the present Tevatron Collider run. In this system, eight scrapers are available. Because of the separated orbits, protons and anti-protons must be scraped independently. There are scrapers for both vertical and horizontal planes. For every primary scraper, there is a secondary scraper to catch particles scattered back out of the edge of the primary scraper. This design has not been required for operations, however. Of the eight scrapers installed, only four are normally used. The design provided for the possibility of using the scrapers to localize beam loss away from the experiments and thus use scrapers during colliding running as shields for the experiments. Just as in the 1989 run however[2], it is only necessary to scrape away the initial large amplitude halo at the start of a store, and then withdraw the collimators about three beam sigma. If the machine parameters have been set to keep the particle betatron tunes well away from resonance lines, then once the large betatron amplitude (halo) particles have been scraped away, the background loss rates at the two experiments are tolerable for them - 2 to 10 kHz.

SINGLE BEAM EXTINGUISH DATA

The most significant change from the 1989 collider run for the scraper system is the seperated orbits of the protons and anti-protons. It is no longer normally possible to scrape the halo of both beams with a single scraper. The single exception to that statement is any beam that has been lost from the RF bucket and is losing energy by sychrotron radiation. These particles, both protons and anti-protons, gradually drift toward the radial inside of the machine and can be removed by a single scraper at a high dispersion point. Figure 1 below shows the effect of moving the primary anti-proton verticle collimator down from above into and through the anti-proton beam. The anti-proton intensity signal is somewhat noisy, but can be seen to decrease from ~40E9 to 0 as the collimator moves from right to left from about 40 mils to about -60 mils. The proton signal remains at about 350E9 all during this process. Finally, just below -100 mils, the proton signal began to drop..This is consistent with the flying wire measure of the beam sigma of 25 to 30 mils and a beam seperation of about 5 sigma.

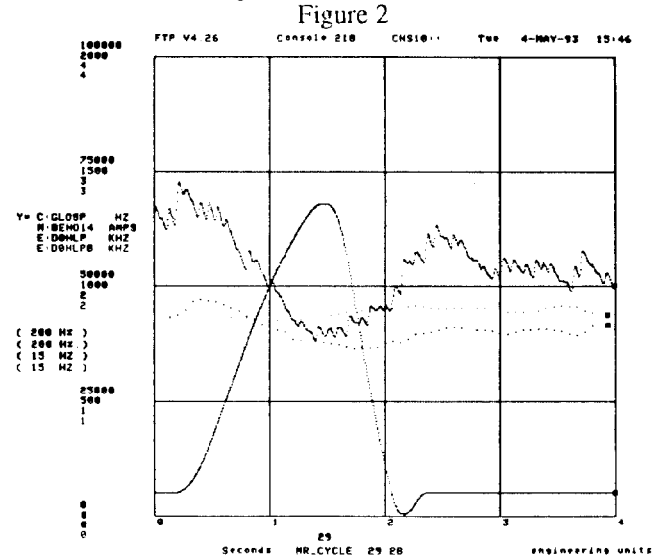
Figure 1



EFFECT OF MAIN RING RAMP

It is fortunate that it has proved not necessary to use the collimators to shield the experiments from losses during their data-taking, since the Main Ring ramp stray field has a large effect on losses and reduces the efficiency of the secondary colimator to clean up particles scattered from the primary. This is illustrated in Figure 2.

Figure 2



References

(1) S.M.Pruss, "A Design for a Beam Halo Scraper System for the Tevatron Collider," in 1991 IEEE Particle Accelerator Conference, San Francisco, Calif., May 1991, pp. 2340-2341.

(2)S.M.Pruss,C.Crawford,D.Finley and M.Harrison, "Operational Experience with Using Collimators to Remove Halo in the Tevatron Collider," in 1989 IEEE Particle Accelerator Conference, Chicago, IL., March 1989, pp. 439-440.