D/A Beam Based Alignment
December 05 Study Period

P.F. Derwent
AD/Pbar Source

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Abstract

Documentation of D/A beam based alignment work during the December 05 Study Period.

1 Study Shifts

The following shifts were spent investigating the Accumulator injection region:

- Owl, Wed 23 Nov, Pbar 2005 E-log entry 676. Reverse proton TBT commissioning in Debuncher
- Owl, Thu 24 Nov, Pbar 2005 E-log entry 679. Relative TBT measurements, steering through Q807
- Owl, Mon 28 Nov, Pbar 2005 E-log entry 689. Steering through Q807
- Owl, Tue 29 Nov, Pbar 2005 E-log entry 692. Q806-803, vertical steering problems with 806 lead to time spent with vertical bump in Accumulator
- Owl, Thu 1 Dec, Pbar 2005 E-log entry 697. Q807-803 steering.

Dave Mcginnis commissioned a reverse proton TBT system in the Debuncher. Because of the large signal size with reverse protons compared to forward pbars (on order 20 dB), there are 2 sets of cables with splitters. Changing modes is an **EXPERT ONLY** (where Dave is currently the only expert) operation. As there were splitters added to the system, it still needs to be rephased for forward pbars. Details on the reverse proton TBT can be found in a Dec 05 Studies period document prepared by Dave Mcginnis.

2 Overview of centering

The reverse proton TBT algorithm is contained in the Pbar Pledge pin program. The general idea is that the user selects a magnet, sets minimum and maximum values, and tells the program to take data. TBT measurements in the Debuncher are taken with the minimum setting and the maximum setting (two separate pulses) and the vector difference between them is calculated and plotted. For example, in figure 1, the relative TBT for a $\pm$5A variation in Q807 is shown. The plots on the left in the figure are the last horizontal and vertical orbit while the plots on the right are the relative difference in the TBT. By varying a knob upstream of the magnet in question, a setting which minimizes the quad steering can be found. We still need to define an associated position (from a SEM or BPM measurement) with this setting so that we have an orbit which minimizes steering through the D/A line.

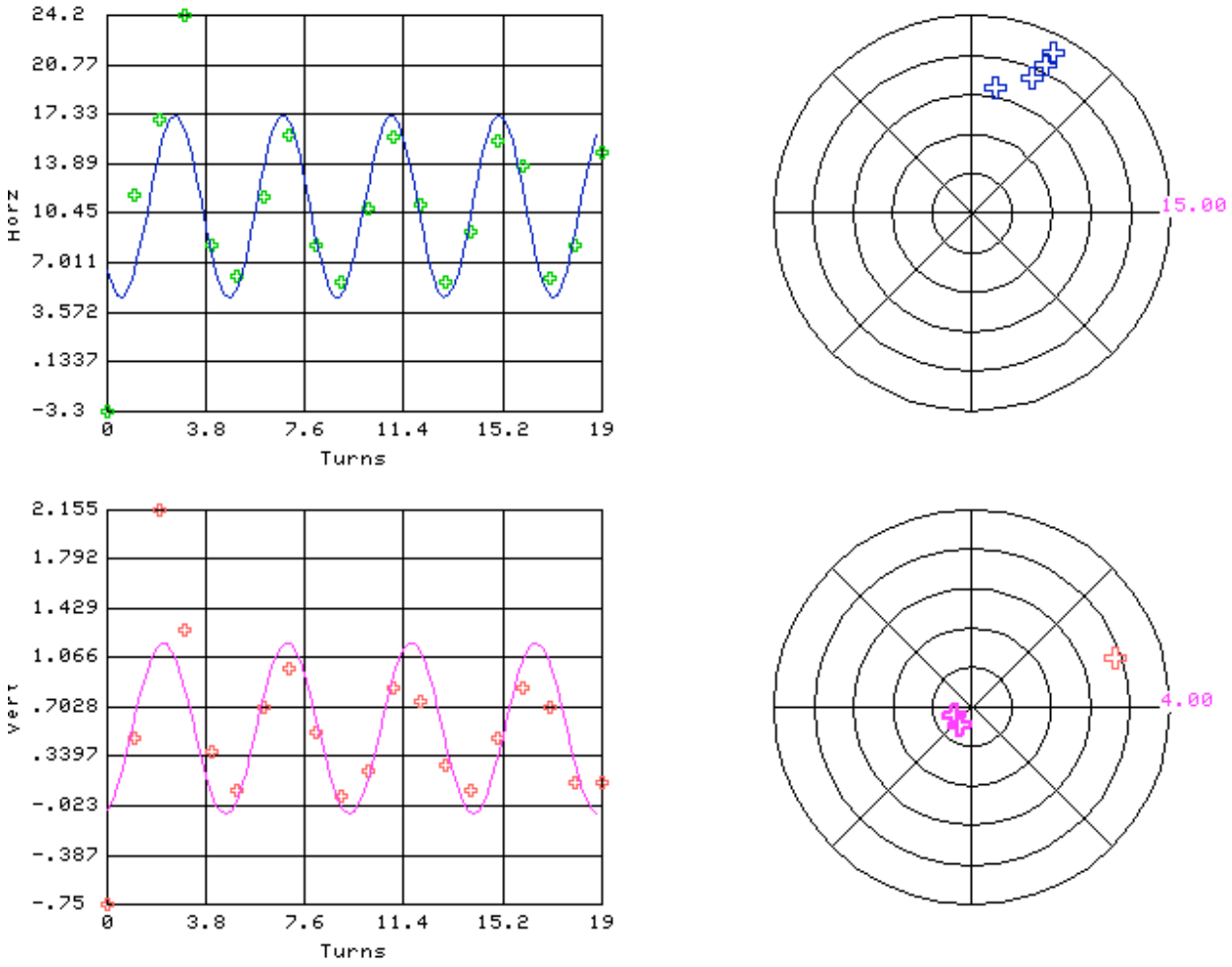

Figure 1: The relative TBT for a ±5A variation in Q807 is shown. The plots on the left in the figure are the last horizontal and vertical orbit while the plots on the right are the relative difference in the TBT. In this case, the beam was well centered vertically but not horizontally.

3 Problems encountered

Coupling between the two planes in the Debuncher can introduce problems with the interpretation of the relative TBT data, especially in situations where there is significant quad steering in both the horizontal and vertical plane. For example, the owl shift of Tue, 29 Nov (Pbar 2005 E-log entry 692) was working on horizontal centering through Q804. Variations of D:H807 did show horizontal steering but also show vertical steering. It was difficult to minimize the horizontal steering without also making a vertical correction to minimize the vertical steering. By changing D:VT806 as well, it was possible to minimize steering in both planes at Q804. This solution was not satisfactory as it introduced an absolute vertical TBT oscillation in the Debuncher, with VT806 as the nominal knob to take it out. A vertical angle bump in the Accumulator at A104 helped.

It was realized that it does not seem possible to correct the horizontal steering at Q807, Q806, and Q804 with changes to A:ISEP and D:H807 (three constraints – two knobs!). We should develop a horizontal angle bump in the Accumulator at A104 in addition to the position bump at that location.

4 Summary values found

The best setting for A:ISEP1V and A:ISEP2V to minimize horizontal quad steering at Q807 was found to be 665.5 V (Pbar 2005 E-log Entry 689, Owl 28 Nov).

The best setting for D:H807 to minimize horizontal quad steering at Q804 was found to be 623.8 A (Pbar 2005 E-log Entry 692, Owl 29 Nov) in conjunction with D:VT806 at -5 A. However these settings introduced an absolute vertical TBT oscillation in the Debuncher, which is nominally corrected with D:VT806. Using the vertical angle bump at A104 in the Accumulator allowed for corrections.

Three sets of data were taken on the 1 Dec Owl shift (Pbar 2005 E-log Entry 697): for nominal settings, for A:ISEP + 3V, and for D:VT806D +4A. Data was to be analyzed offline (at this writing, it is still waiting to be analyzed).

5 Conclusions

The procedures for quad steering in the D/A line using relative TBT measurements in the Debuncher have been developed. Data for the settings to minimize quad steering has been taken. These settings minimize steering for reverse protons through the D/A line and can be used to define a golden orbit using SEMs and/or BPMs. In the next study period we will need to take the time and define the golden orbit.