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Reading TeV BPMs with a Recycler Board

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Abstract

A look at Tevatron BPM information, processed by the recycler board, for data taken during the shot on the evening of Feb 18, 2004. For reference a BPM readout using the damper board is also provided.

The accompanying figures show both damper board data and recycler echotek data taken during the shot on Wed. Feb 18, 2004 from 9PM to 11 PM. Presume that this is 36 on 36 but I have not checked.

The Damperboard was set up to log data from BPM ??? . A recycler echotek board (or boards?) was setup to log data from BPM's HA15 and VA14. The Dampber boards were setup to record I and Q values for each of the 4 cables on the BPM about once every 8 seconds. The bandwidth of each measurement corresponds to about 9.7 turns. The recycler echotek board was modified to datalog the I and Q signals for each of the 4 cables on each BPM once per second. The bandwidth of each measurement is about 1 Khz.

The data processing for Damper boards follows the algorithms described in Beams-doc-988. That document describes the conversion of I and Q to position and sum; it also describes the cancellation of the proton signal on the pbar plate. For the recycler data, the final I and Q values are taken directly from the data logger; after that the processing continues as for the Dampber board data.

Figure 1 shows the raw A and B signals for protons and antiprotons, for each of the three BPMs. The horizontal axis is time in hours since midnight on Feb 18 and the vertical axis is the magnitude of the signal, in the units of I and Q as produced by the two boards. In all cases one can clearly see the proton injection, the helix open, the protons coasting during antiproton injection, the energy ramp and the low beta squeeze. The antiproton signals have signficant contamination from the protons but the same general features are present.

Figure 2 shows the proton A+B sum signal and the proton position signal. These make sense.

Figure 3 shows the sum and position signals, for antiprotons, for each of the three boards. These plots use the cancelation method described in Beams-doc-988. I choose points just before and just after the helix opening to calibrate the correction function. I did not use a correction for movement in the orthogonal transvserse plane. The Damper board intensity signal shows relatively poor cancelation during the proton injection, giving rise to the bump at times less than 21.5. The antiproton injection in 9 steps is clear. The damper board antiproton position signal has an odd behaviour at the time of the ramp — it initially moves in the same direction as the protons, not in the opposite direction.

The recycler board plots are horribly noisy.

Figure 4 shows a blow up of the HA15 recycler A+B signal near t=22 hours. from this we can see that the noise has a structure. This yet understood. This noise was not present on the recycler data of Feb 7, Feb 10 and Feb 13. I have not yet published those data but will soon.

Figure 5 is a repeat of figure 3 but the recycler board quanitities are plotted without any attempt to cancel the proton signal. This gets rid of the horrible noise but the standard diseases due to the proton contamination are present.

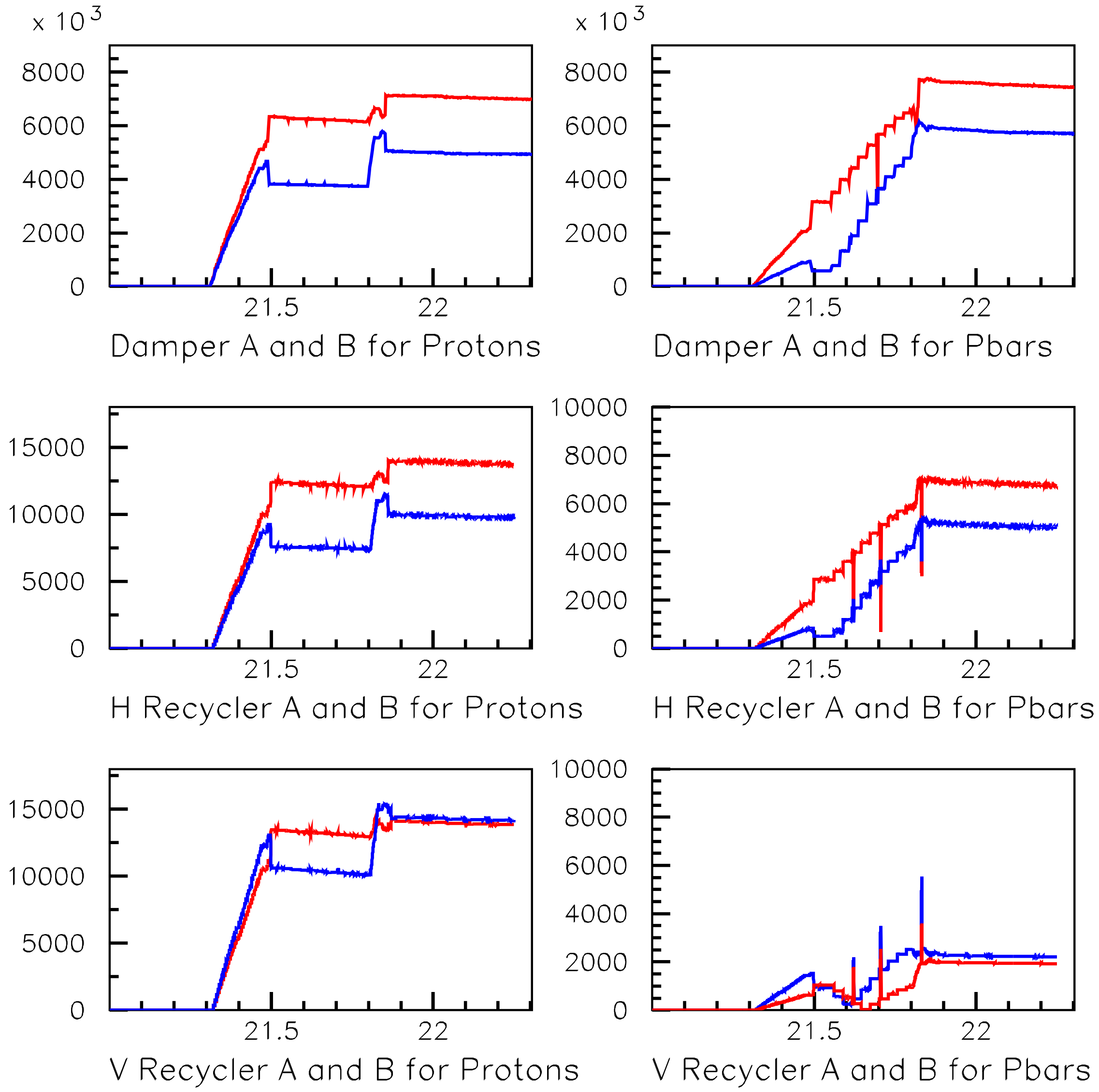

Figure 1: Raw $|A|$ and $|B|$ signals for protons and antiprotons, for each of the three boards.

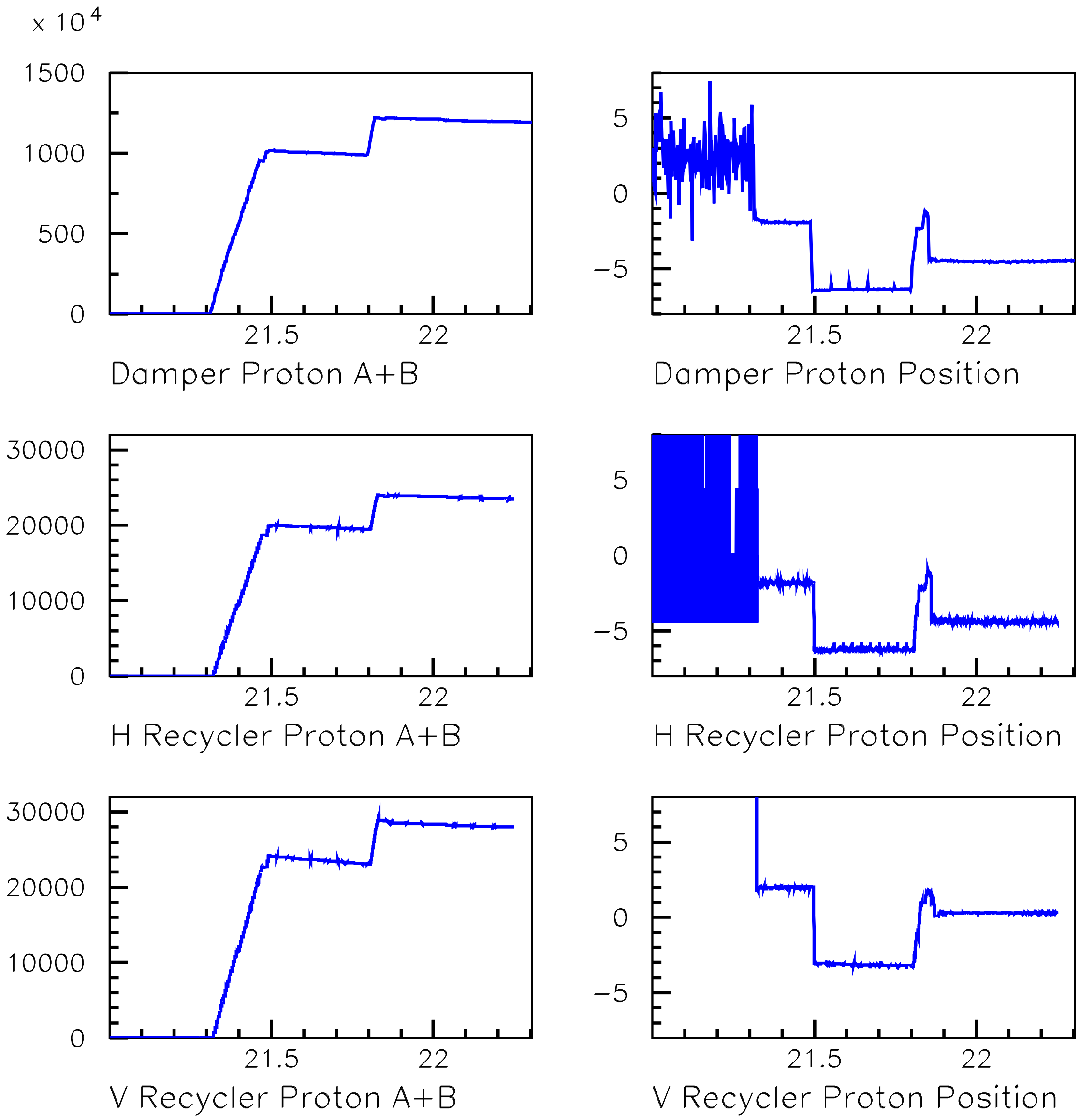

Figure 2: Proton sum and position signals, for each of the three boards.

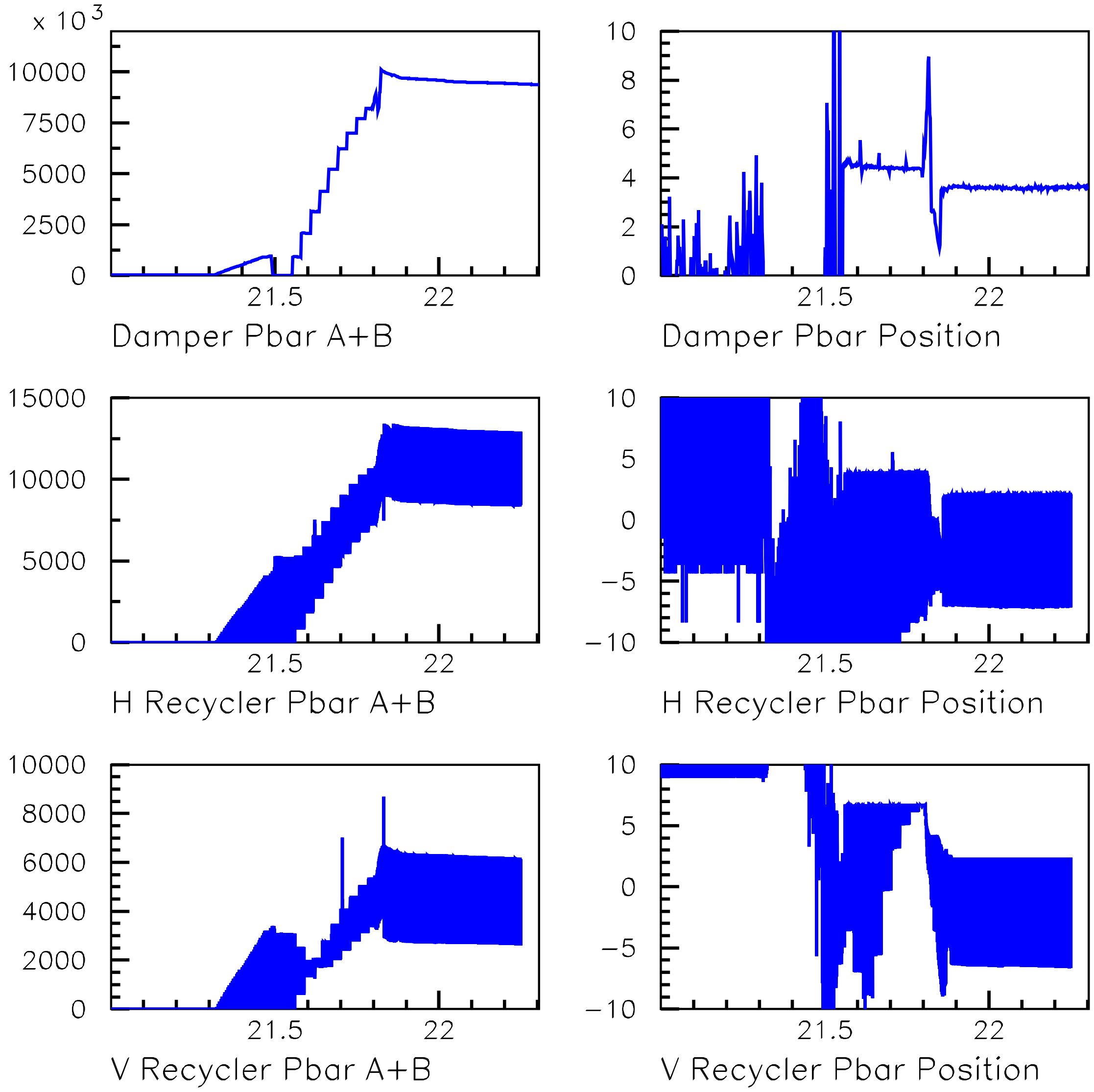

Figure 3: Antiproton sum and position signals, for each of the three boards. The proton signals on the antiproton cables were canceled as described in Beams-doc-988.

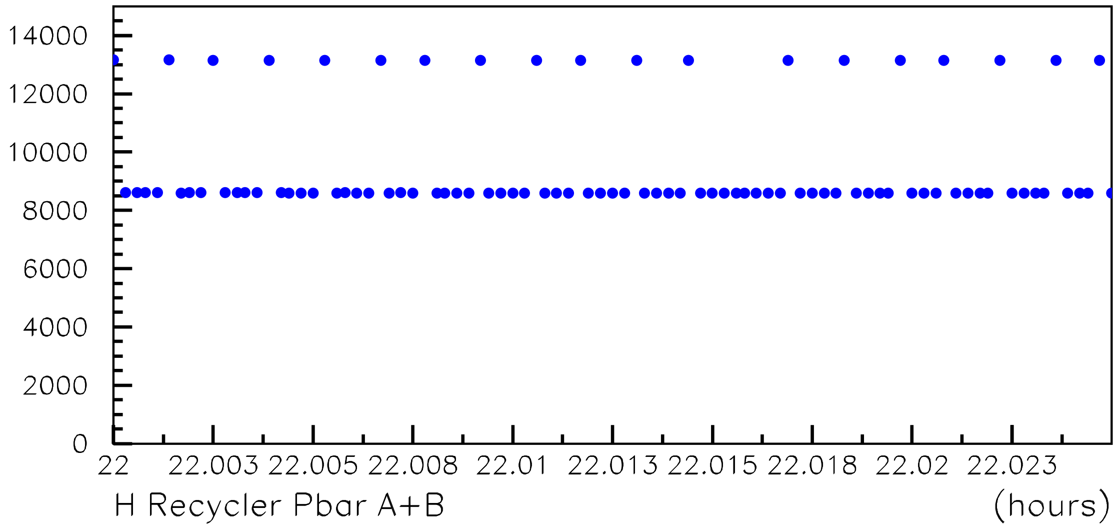

Figure 4: A detail of the noise on the HA15 sum signal.

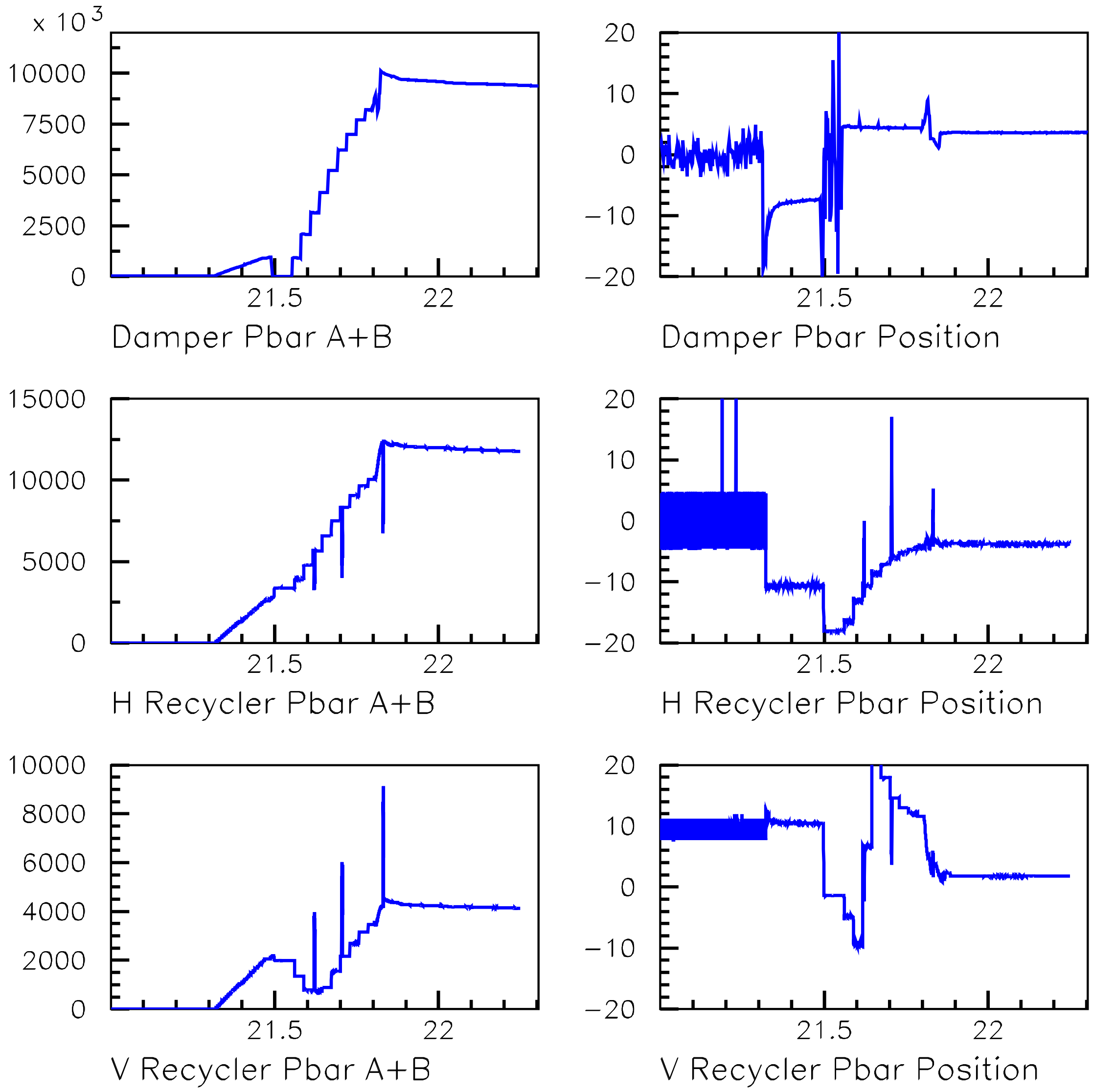

Figure 5: The damper board data is the same as figure 3. For the recycler board data, this is the same as figure 3 but without the cancelation of the proton noise on the antiproton cables.