March 8, 2004

TeV BPM Echotek Board: Data from Mar 5, 2004

Rob Kutschke

Abstract

This note shows some data from the TeV BPMS HA15 and VA14 read out using a recycler Echotek board. The data was taken after some modifications were made to the board. Some problems appear to have been fixed but new problems are present.

The data discussed in Beams-doc-1059 showed that there was a phase instability with the recycler Echotek boards: the phases of the Pbar signals jumped around with respect to the the phases of the proton signals. Jim Steimel reported that that the channels used for Pbars were configured differently than those used for protons. On the Pbar channels there was a delay of 3 ticks of the 7/5 RF clock.

On March 5, this was fixed and the boards redeployed. Late that afternoon Mike Martens found that the boards were hung up and rebooted them.

The data discussed here were taken after all of this, during the shot which started about 10 PM.

Because this note will show problems with the board some plots from other ACNET devices are provided for reference. Figure 1 shows the proton intensity, the Pbar intensity and the state of one of the separators between about 9:55 and 11:15 PM. Note the the proton injection, the Pbar injection and the opening of the helix.

The first problem with the board was that reading it via the array device returned 4 identical (I,Q) pairs. To work around this I looked at the 1 Hz log of the 8 individual I or Q devices. It is these data that are discussed below.

Figure 2 shows a set of plots illustrating the response of HA14 during the same time interval. The first thing to note is that the proton A and B signals during proton injection have the wrong shape. The rise from zero occurs at the correct time but it rises to full intensity in seconds instead of over 12 minutes - compare with T:FBIPNG on the previous page and to the figure Feb18.ps, page 1, from Beams-doc-1059. It is also odd that the full scale signal for this data is 10 times smaller than for the Feb 18 data. On the other hand, compared to the Feb 18 data, the proton position signal seems to makes sense.

Also in Figure 2, the corrected Pbar sum signal looks odd. Reference to T:FBIANG on the previous page shows that the signal starts at the correct time but it rises instantly to its full value, instead of rising in 9 steps over about

20 minutes. The corrected Pbar position signal can be compared with that from the Feb 18 data and appears sensible.

Figure 3 shows phases for the signals on the 4 cables. The phase is the argument of the complex number (I,Q). The fivefold pattern seen before remains.

Figure 4 takes out this fivefold pattern by subtracting the phase of (A+B). To be precise the correction is:

$$A'_p = A_p e^{-i\arg(A_p+B_p)} \quad (1)$$

$$B'_p = B_p e^{-i\arg(A_p+B_p)} \quad (2)$$

$$A'_{\bar{p}} = A_{\bar{p}} e^{-i\arg(A_p+B_p)} \quad (3)$$

$$B'_{\bar{p}} = B_{\bar{p}} e^{-i\arg(A_p+B_p)} \quad (4)$$

The quantities plotted are the phases of the primed variables. This shows that the Pbar phase is now stable with respect to the phase of A+B. The previous behavior of being bistable has disappeared.

Of course, in light of the problem with the sum signals, it is hard to be sure that the problem is really solved.

Figures 5 through 7 repeat the last three pages but for the VA14. Qualitatively similar behavior is observed.

1 Some Remaining Puzzles

Consider Figure 3. We see that there are 5 allowed values for the phase. This arises because the 7/5 RF clock comes back in phase with RF clock every 5 cycles. The trigger signal for the measurement is a turn marker which is in phase with the RF clock. Therefore the 7/5 RF clock has one of 5 different values when the trigger arrives. These values are separated by 1/7 of the RF period. Looking at the figure we can see that there are allowed phases for A Proton at values 5 consecutive values separated by $2\pi/7$; remember that the phase cut implies that the isolated one at the bottom is really consecutive with the top 4. There is also a gap of two consecutive missing steps.

The puzzle is this: I expected two gaps of one missing step, rather than one gap of two missing steps.

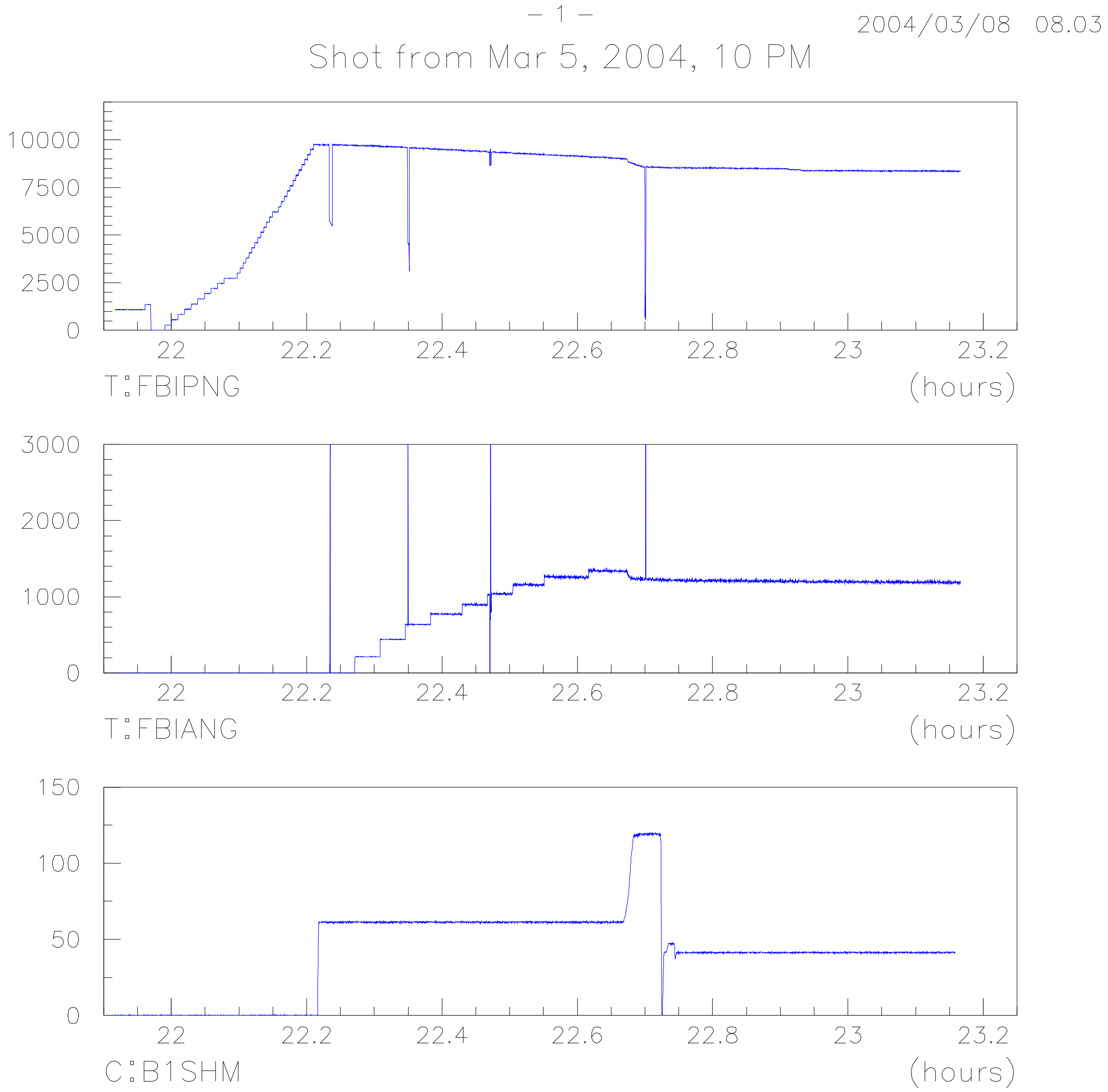

Figure 1: The ACNET variables T:FBIPNG, T:FBIANG and C:B1SHM. These measure, respectively, the proton intensity, the Pbar intensity and the voltage applied to one of the separators. These look normal for a shot and indicate the times at which various events take place.

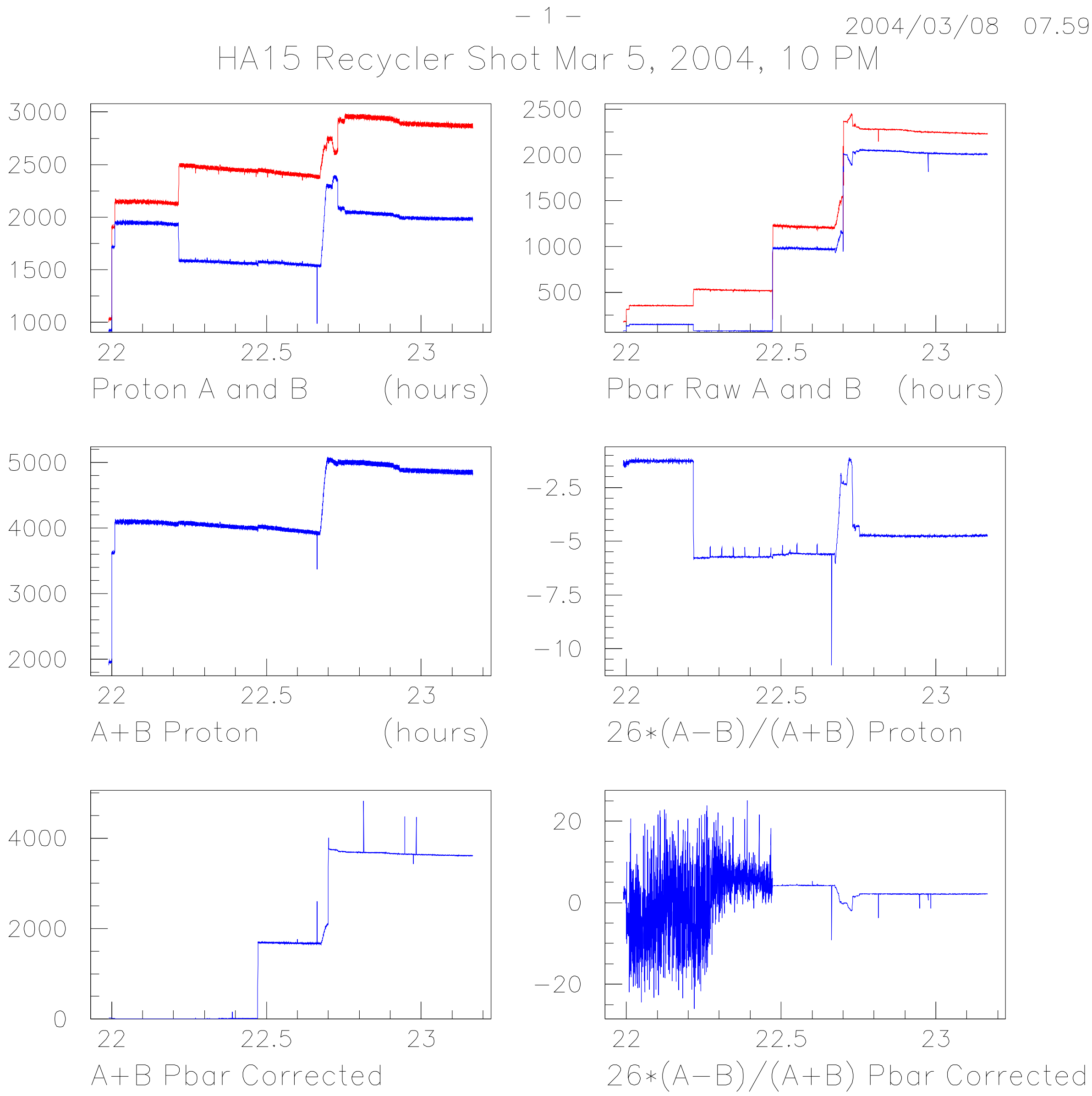

Figure 2: Plots for HA15. The top row shows the magnitudes of the proton A and B signals and of the uncorrected Pbar A and B signals. The middle row shows the proton sum and position signals. The last row shows the Pbar sum and position signals after subtraction of the proton contribution on the Pbar cables.

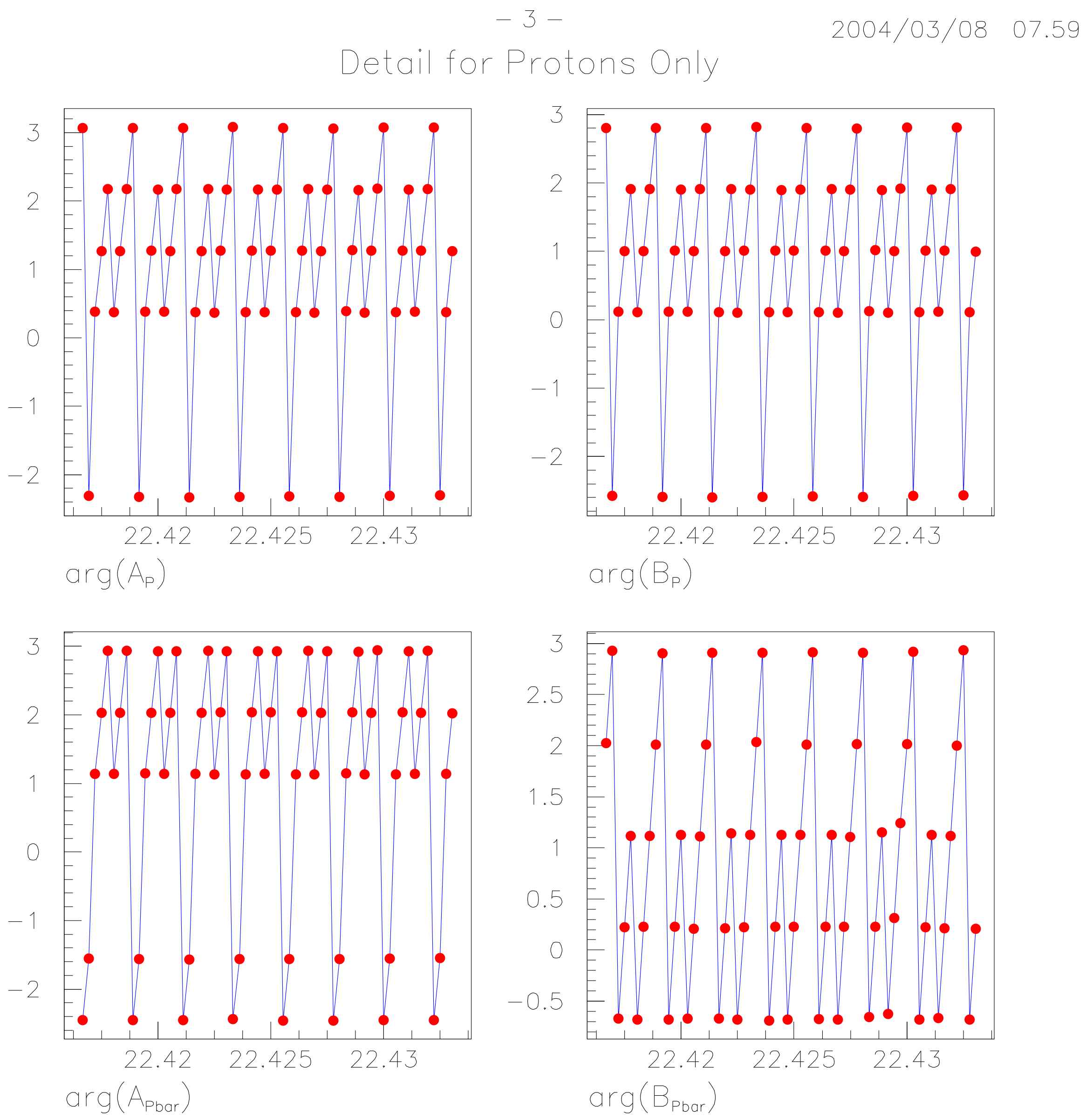

Figure 3: Plots for HA15. Absolute phases of the 4 signals. The 5 fold pattern remains.

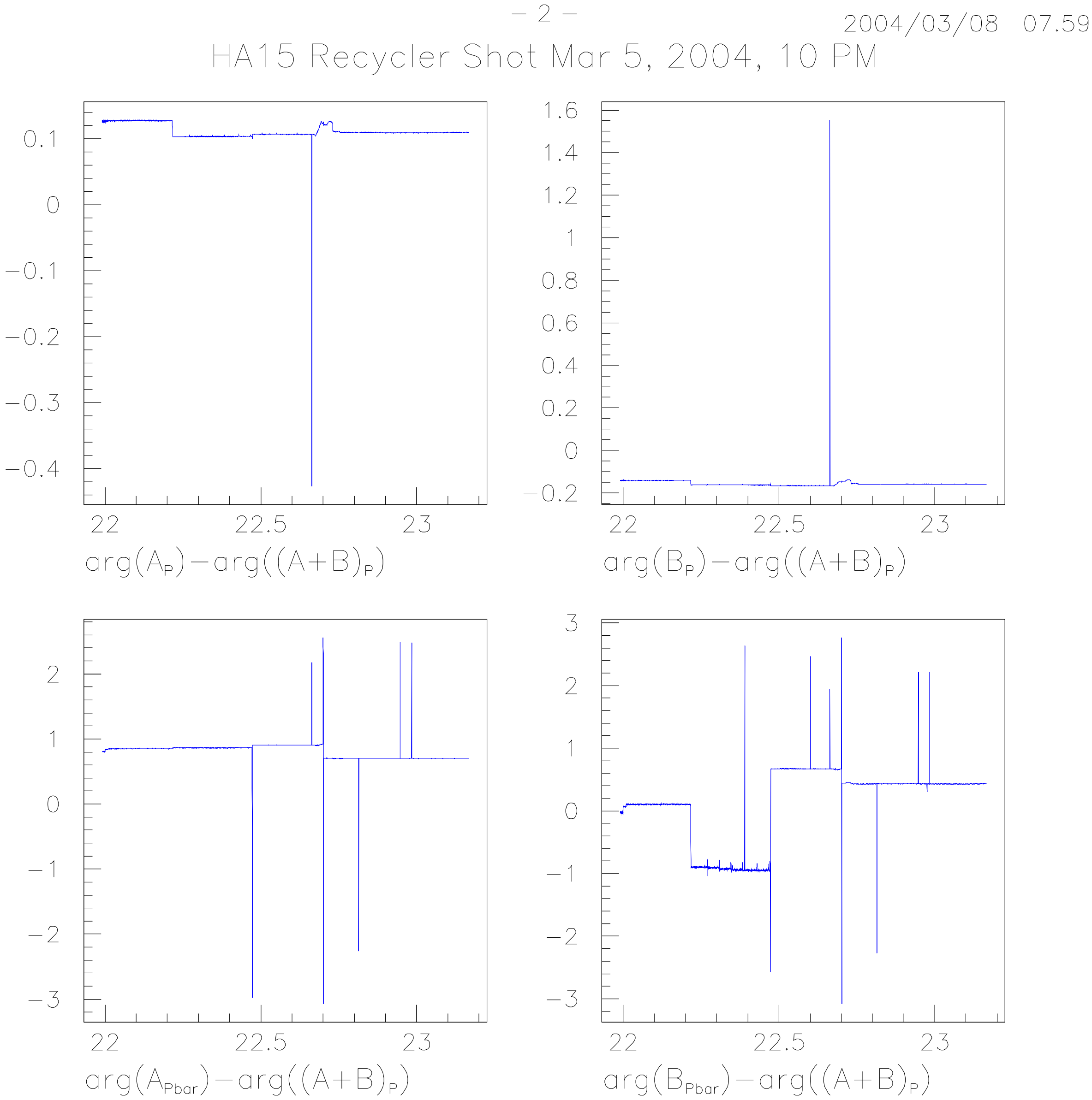

Figure 4: Plots for HA15. Phases of the 4 signals, relative to the phase of proton A+B.

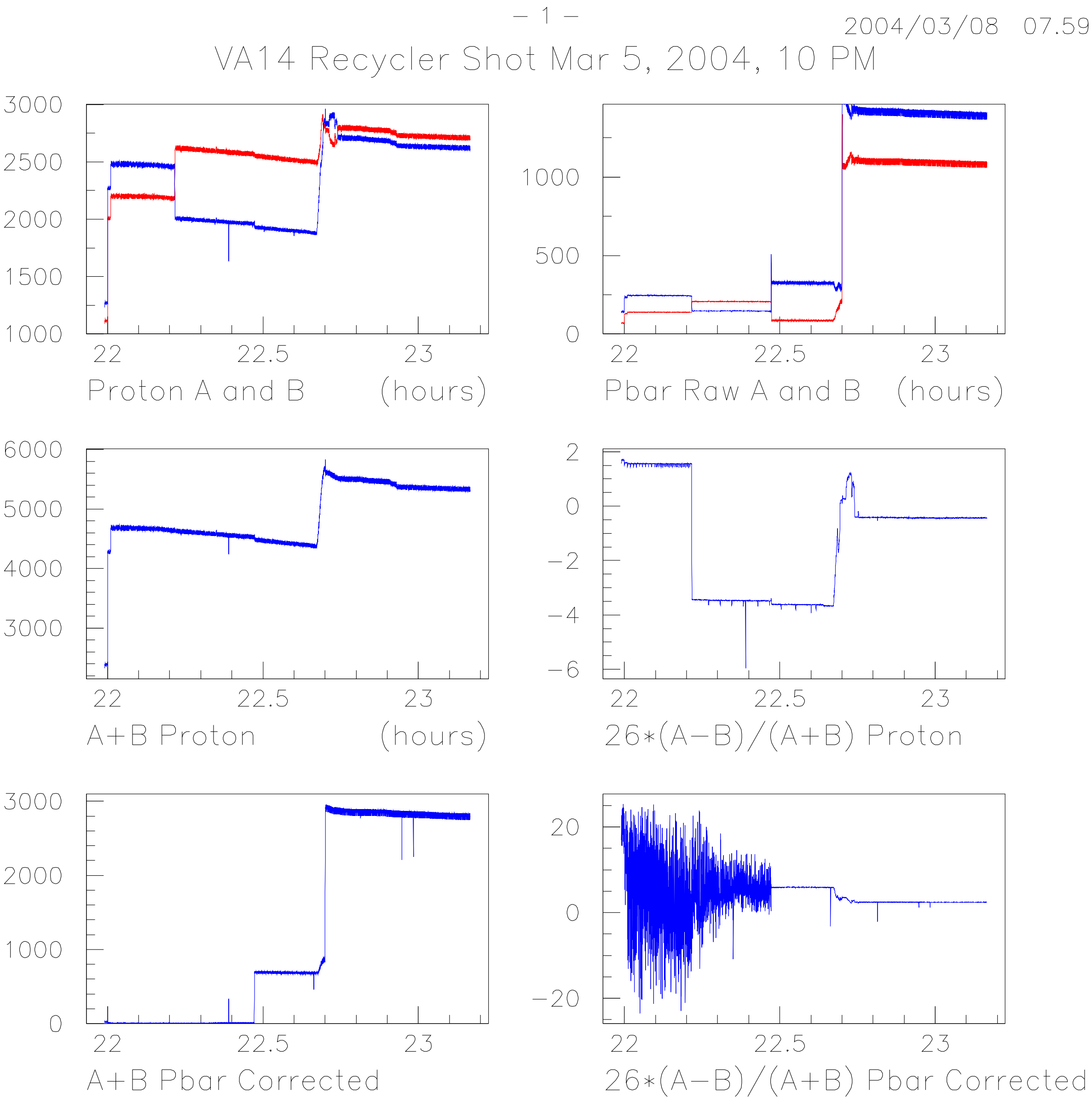

Figure 5: Plots for VA14. The top row shows the magnitudes of the proton A and B signals and of the uncorrected Pbar A and B signals. The middle row shows the proton sum and position signals. The last row shows the Pbar sum and position signals after subtraction of the proton contribution on the Pbar cables.

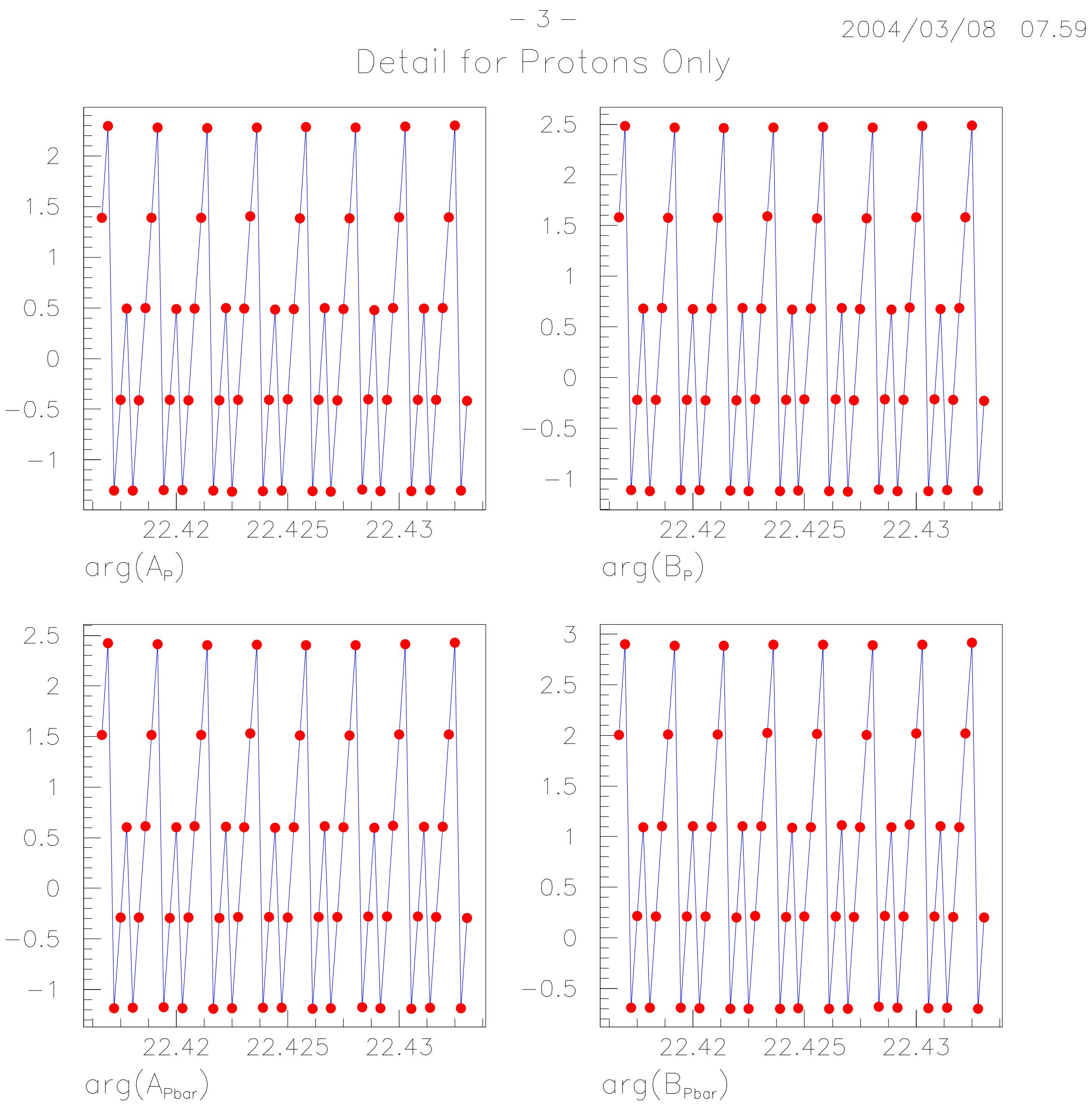

Figure 6: Plots for HA15. Absolute phases of the 4 signals. The 5 fold pattern remains.

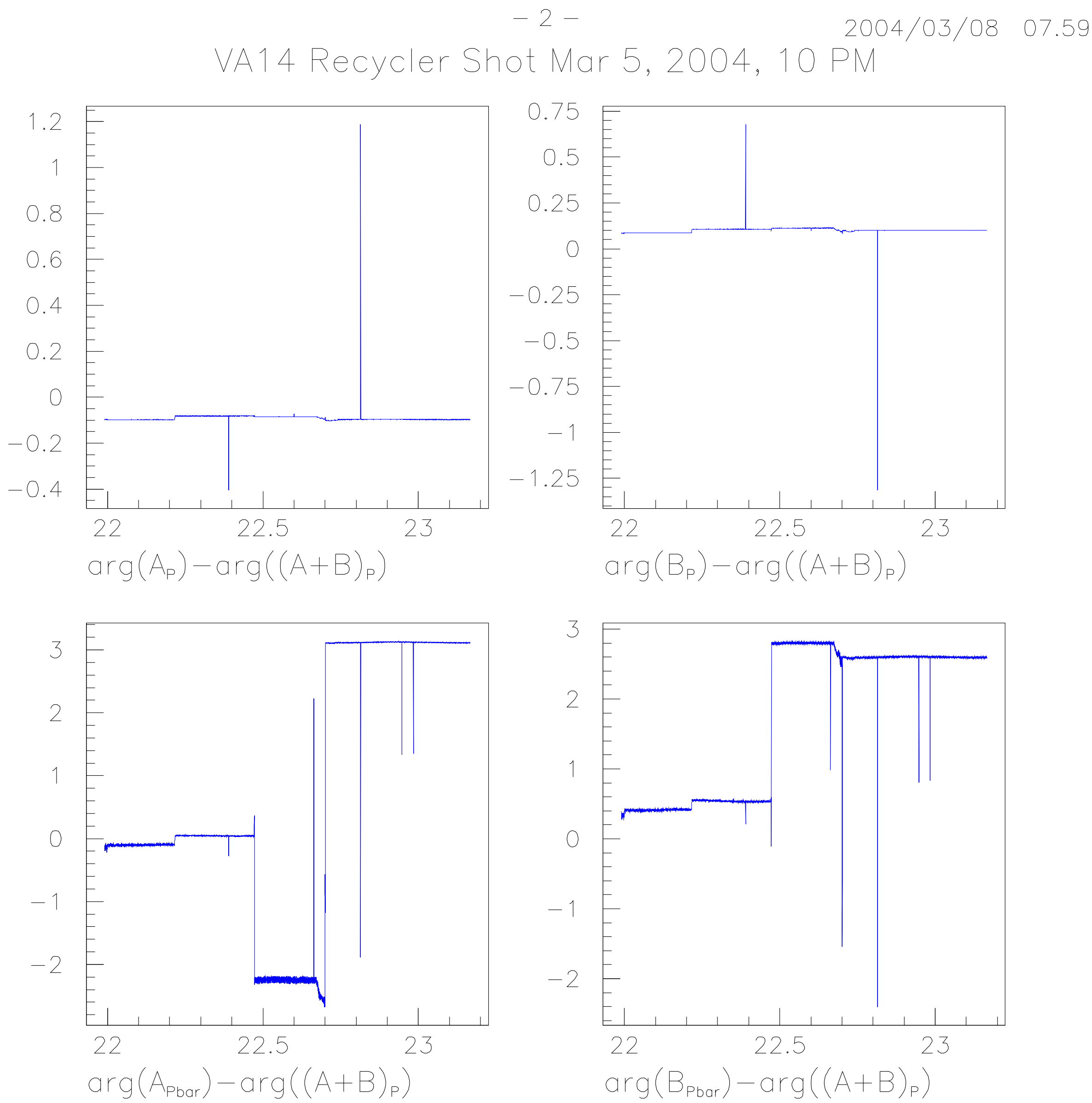

Figure 7: Plots for VA14. Phases of the 4 signals, relative to the phase of proton A+B.