Harvard-Smithsonian Center for Astrophysics

TRES Technical Note

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Issue Date:	22 Nov 2010	*Date:*	November 22, 2010
Subject:	ADC on TRES		
cc:	A. Szentgyorgyi		
#:	TR-221110		

TRES Atmospheric Dispersion Corrector report

In this report I briefly summarize the test results, conducted on November 15 and 16, 2010 using the ADC prism for TRES. The ADC was mounted just before the October run. Manual *tcs* commands were implemented to conduct the testing:

tele adcd_homeA	this command homes prism A
tele adcd_homeb	this command homes prism B
tele adcd NN.N X	this command moves prism X to position NN.N degree

For the tests we used the star HIP105881 (RA=21:26:40, DEC=-22:24:41) from the brightstar catalog. At the time of the tests the star was passing the meridian at airmass 1.7, so the atmospheric dispersion vector was pointing towards the zero marker on the rotator ($PA = 0$).

The coordinate system for the prisms is such (see Fig. 1) that when homed both prisms are along the 67–247 degree line and the dispersion vectors null each other out (they are anti-parallel). E.g. at home, the arrow of the dispersion from prism A points toward 67 degree, and the arrow of B really points to $67 + 180 = 247$ degree position. So, for A the commanded position is where the arrow is pointing, for B where the tail is pointing.

The direction of a movement is negative, so sending prism A from home (67 degree) to above mentioned $PA = 0$ requires a move of 67 degrees. To have the ADC nulled at this PA value prism B also has to be sent to 67 degree (in which case its tail is pointing to 0 degrees, and the arrow of vector A is also pointing to 0 degree value). To make both prism dispersion point upward on Fig 1, to $PA = 0$ one has to issue the commands:

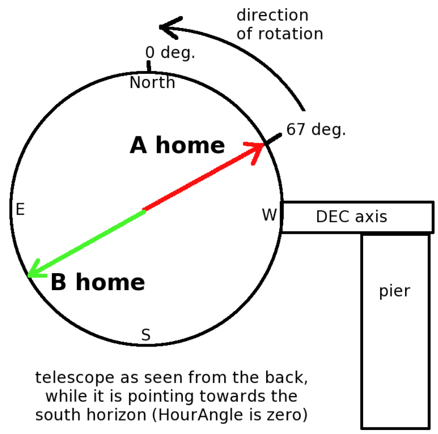

Figure 1: The directions on the rotator

tele adcd 67 A
tele adcd 247 B

Similarly, to make both vectors point downwards, the commands are:
tele adcd 247 A
tele adcd 67 B

In the following examples the figure captions will provide the commanded positions, and the arrows of the figures will represent the actual positions of the dispersion vectors, similar to the way seen on Fig. 1. Since all the test were conducted on a star just passing the meridian (hour angle is zero) and at a high airmass near the horizon, the atmospheric dispersion was pointing upwards to PA=0.

Medium Fiber

The seeing conditions were not great, around 1.5 arcsecond, and the medium fiber covers 2.3 arcsec on the sky. The star was focused, set on the fiber, with the ADC prism nulled (image 0126 from 11/16) we took a reference frame. Same exposure time was used while properly correcting for atmospheric dispersion (image 0130, Fig. 2) and overcorrecting for it (image 0131, Fig. 3) by setting the maximal dispersion value for the prisms. We also took exposures with the same amount of correction dialed in the ADC, but having the dispersion pointing in the wrong direction (parallel to the atmospheric dispersion) and thus make the atmospheric effect even more pronounced (see Fig. 4 and 5).

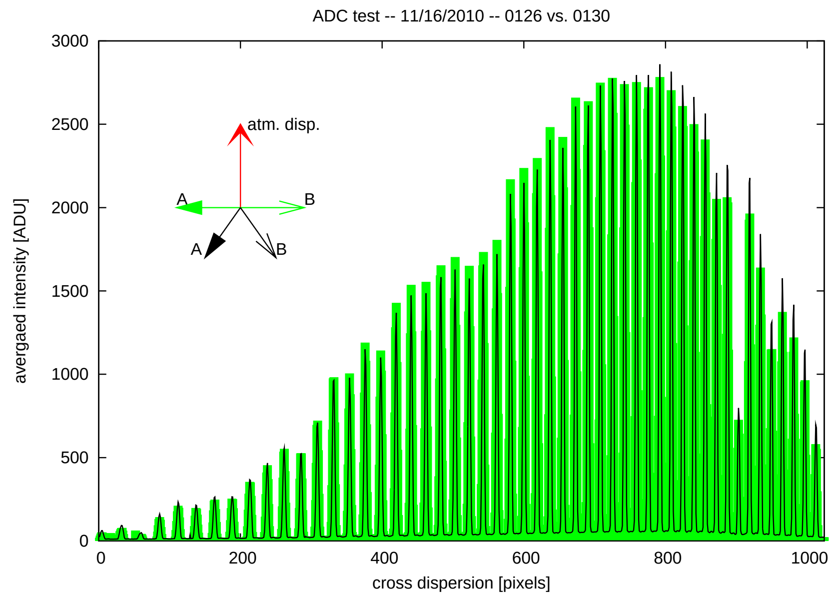

Figure 2: Commanded ADC positions: $A = 189$, $B = 125$ – within noise (centering, seeing) the effect of the ADC is not apparent.

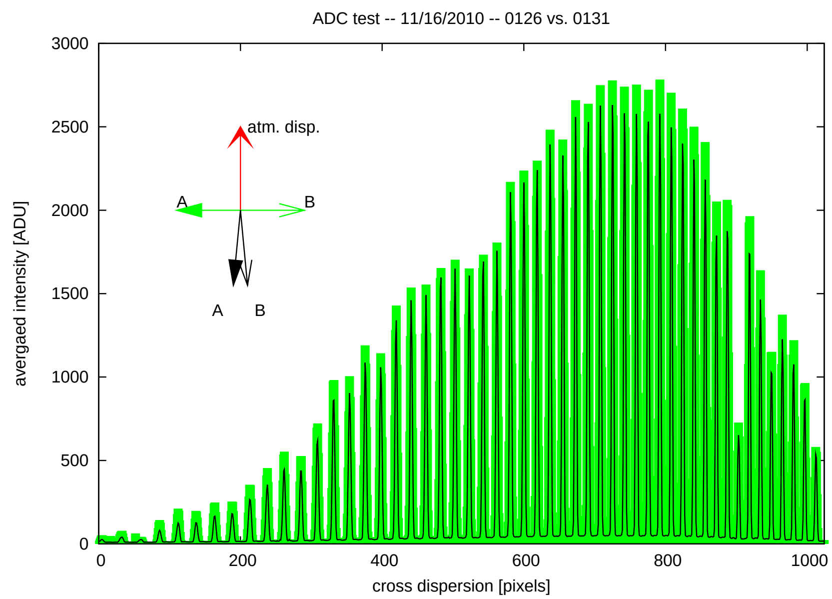

Figure 3: Commanded ADC positions: $A = 247$, $B = 67$ – overcorrecting the atmospheric dispersion seems to slightly decrease throughput both in the red and blue, as is expected. Compare to Fig. 2

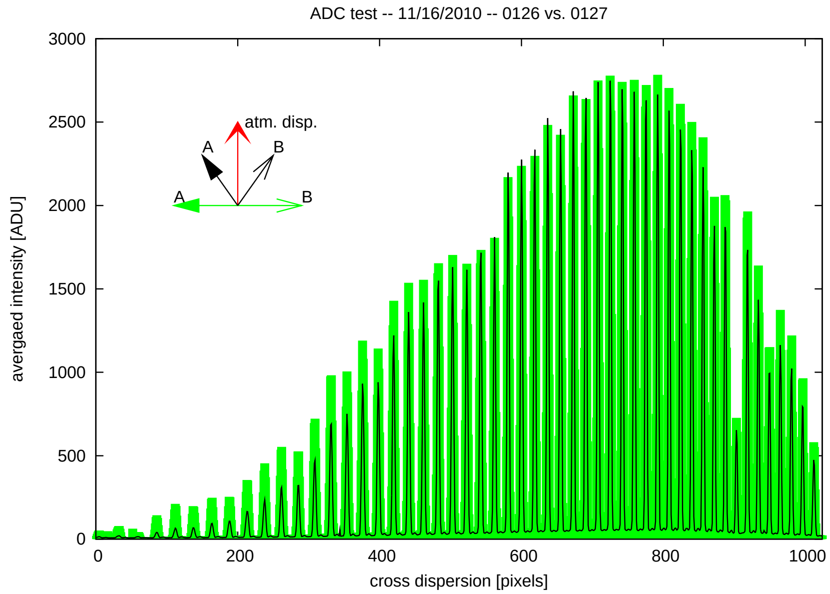

Figure 4: Commanded ADC positions: $A = 125$, $B = 189$ – dialing in the right amount of correction on the ADC but setting it in the wrong direction the blue light disappears from the spectrograph.

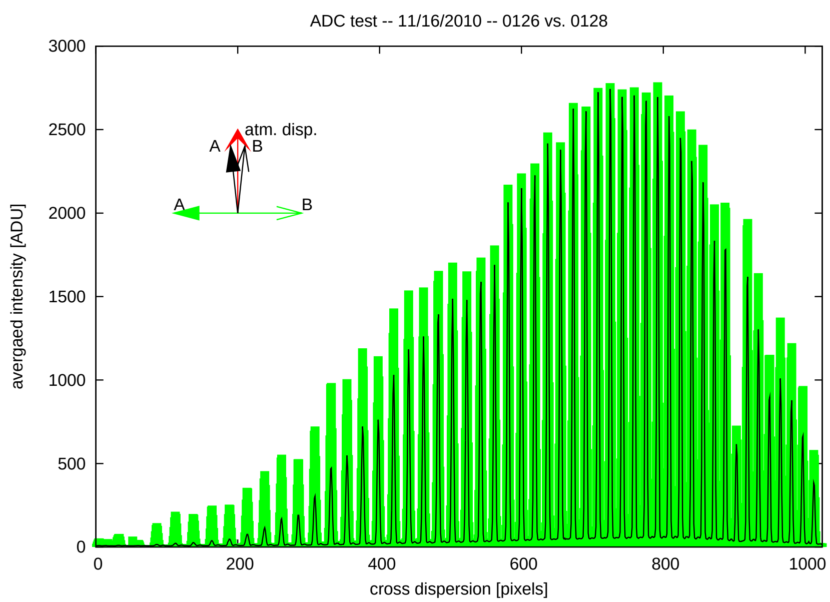

Figure 5: Commanded ADC positions: $A = 67$, $B = 247$ – dialing in the maximum amount of correction on the ADC but setting it in the wrong direction clearly decreases the blue light, and also suppresses the red. Compare to Fig/ 4.

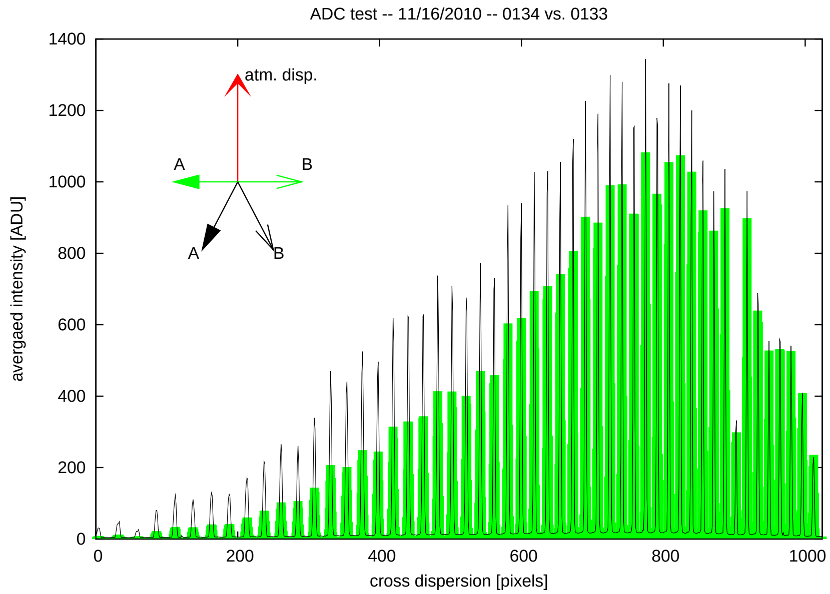

Figure 6: Commanded ADC positions: $A = 189$, $B = 125$ – the effect of the ADC is prominent.

Small Fiber

We have repeated the tests using the small (1.4 arcsec) fiber, with the proper amount of ADC dispersion (Fig. 6) and the overcorrected case (Fig. 7), both set to compensate the atmospheric effect. For the smaller angular coverage the effect of the ADC is more pronounced, as expected.

Since the small fiber covers a significantly smaller area than the seeing, we did set the ADC dispersion to maximum and set it to parallel to the atmospheric dispersion in order to simulate good seeing conditions. In this case the star apparently was elongated in the guider, by a ratio of ∼1:3 (1.5 arcsec seeing vs. ∼5 arcsec of "dispersion"), which would be similar for sub-arcsecond seeing conditions and no ADC correction (0.8 arcsec of seeing vs. 2.5 arcsec of atmospheric dispersion). Since the star was apparently elongated, we did guide on the northern (+2 arcsec, Fig. 8) and the southern (−2 arcsec, Fig. 9) tip of the elongated image, as well as at its center (Fig. 10), and compared it to an image where the ADC was nulled.

Conclusion

As a conclusion we can say that in average seeing conditions the ADC has a marginal effect on the medium resolution fiber. For the small fiber the ADC is worth using even in mediocre seeing conditions. For the medium fiber, ADC is recommended for good and excellent seeing conditions only.

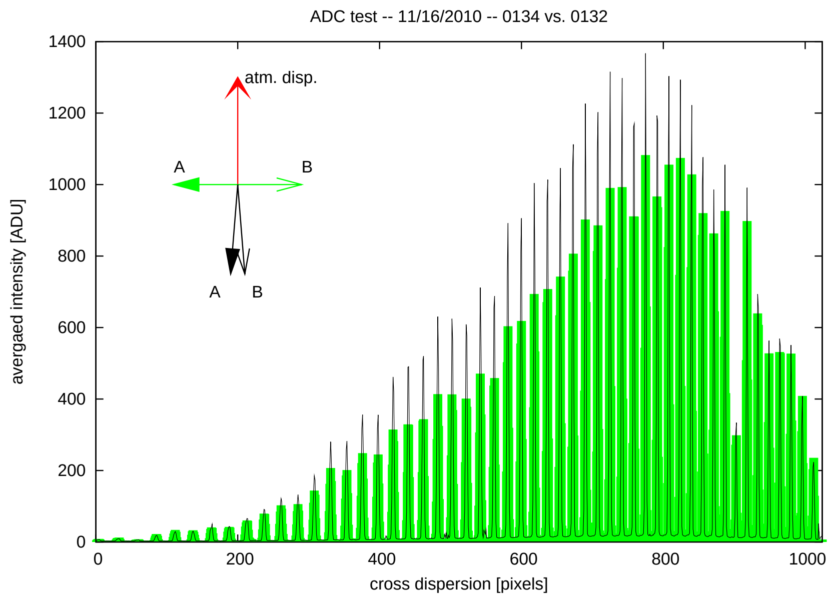

Figure 7: Commanded ADC positions: $A = 247$, $B = 67$ – overcorrecting the atmospheric dispersion seems to decrease the gain mostly in the blue. Compare to Fig. 6.

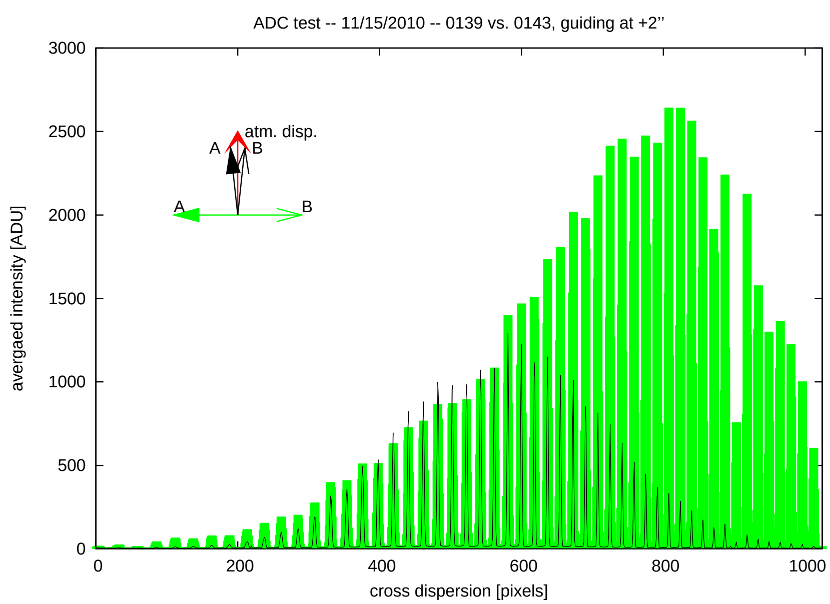

Figure 8: Commanded ADC positions: $A = 67$, $B = 247$ – dialing in the maximum amount of correction on the ADC but setting it in the wrong direction clearly elongated the guide image. Centering the small fiber on the north only blue light was collected by the spectrograph. Compare to Fig/ 9 and 10.

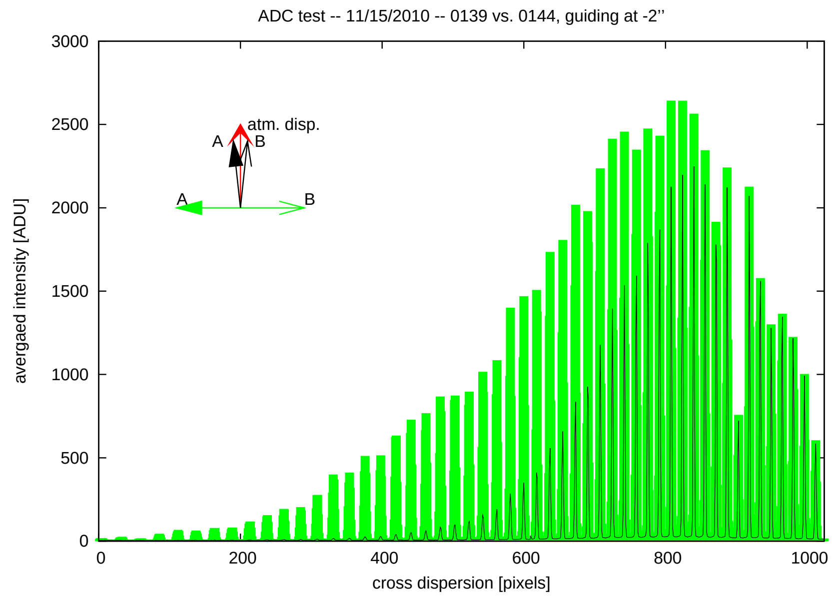

Figure 9: Commanded ADC positions: $A = 67$, $B = 247$ – dialing in the maximum amount of correction on the ADC but setting it in the wrong direction clearly elongated the guide image. Centering the small fiber on the south only red light was collected by the spectrograph. Compare to Fig/ 8 and 10.

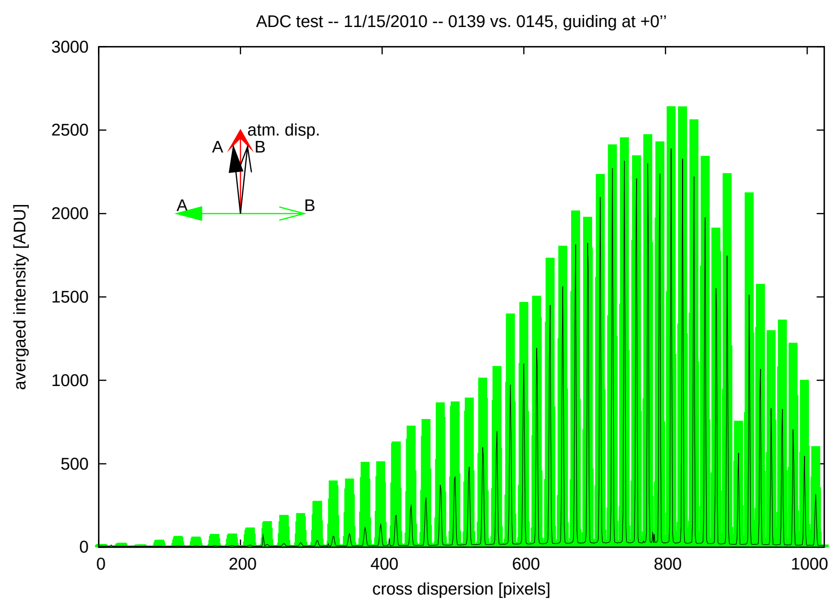

Figure 10: Commanded ADC positions: $A = 67$, $B = 247$ – dialing in the maximum amount of correction on the ADC but setting it in the wrong direction clearly elongated the guide image. Centering the small fiber in the middle blue and red light was highly suppressed. Compare to Fig/ 8 and 9.