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A CHECK ON THE WAVELENGTH CALIBRATION

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(If you use information or advice from this memo, please acknowledge it and the net site http://etacar.umn.edu/ in any resulting publications; thanks)

1. Introduction

In most cases the Eta Carinae Treasury Project STIS/CCD data is wavelength calibrated using standard WAVCALs (see Section 11.2.1 of the STIS Instrument Handbook (Kim Quijano et al., 2003)[1]). During six visits/datasets including 92 spectra, the WAVECAL was omitted to optimize scientific return on a limited number of orbits. In those cases the zero point for the wavelength calibration was determined by alternate means: either using the narrow emission line spectrum of the Wiegelt blobs or fainter nebular emission lines in the Homunculus (see Section 3a of Technical Memo 11 (Martin et al., 2005)[2]).

We are uncertain about the reliability of the alternate wavelength calibrations. To investigate this we used the interstellar absorption features in the spectrum of Eta Car as fiducials to check for any erroneous wavelength shifts. The results show that in most cases, the alternate wavelength calibration methods are at least as accurate as the traditional WAVCAL method.

2. Radial Velocities of Interstellar Absorption

Interstellar absorption is responsible for a number of omnipresent features in the spectra of stars. Unfortunately in the case of Eta Carinae, there is also a significant amount of circumstellar absorption which interferes with the most prominent interstellar absorption lines (i.e. Ca II H & K, Na II D). Therefore we had to use lesser known features such as Mg I λ2853 and diffuse interstellar bands (Herbig, 1995) which are not obviously contaminated by circumstellar absorption.

The the velocities of interstellar features are unvarying so that the maximum depth in their profiles should consistently occur at the same wavelength. Therefore, an error in the wavelength calibration of the STIS would manifest itself as a shift in the interstellar absorption profiles. Table 1 lists the average radial velocity for each feature measured from STIS/CCD spectra with WAVCALs. The diffuse interstellar bands have more uncertainty in their radial velocities because they are amorphous bands rather than single sharp lines. Table 2 lists the differences between the average velocities and the velocities measured for the same features in STIS/CCD datasets without WAVCALs.

Table 1: Average Radial Velocity Measured from Good WAVCALs (km s^{-1})

Mg I	Diffuse Interstellar Bands					
2853	5782	5799	6205	6271	6286	6615
-9.2±2.7	+1.5±7.4	+3.6±6.8	-18.0±12.9	+13.4±7.5	+1.4±7.0	+1.2±3.9

Table 2: Radial Velocity Offset (km s^{-1})

	Mg I	Diffuse Interstellar Bands						
Dataset	2853	5782	5799	6205	6271	6286	6615	Avg
c890							+6.0	
c914	-0.3	-10.3	-8.7	-9.1	+4.3	-1.4	-1.3	-4.4±5.3
cA20	+10.2						+6.9	
cA22	+1.8	-8.7	-10.8	-9.6	-4.8	-10.5	4.6	-6.6±5.4
cA77							-2.2	
cE18	+5.0	-5.1	-8.8	-4.7	-5.3	-6.7	2.4	-2.5±5.3

Nearly all the datasets have no significant erroneous wavelength shift in their interstellar features. Dataset c890 might have a slight positive shift. However that offset is smaller than a two sigma deviation from mean velocity of a single DIB. The shift in the cA20 dataset shows a more significant offset in both Mg I λ2853 and the λ6615 DIB. In both cases however, these offsets are approximately a third to a fifth of the nominal STIS/CCD spectral resolution (roughly 30 km s^{-1} and 50 km s^{-1} at 2853Å and 6615Å respectively).

We are also unsure if an offset in the wavelength calibration mesured in spectrum taken with one grating tilt are applicable to another sepctrum with a different grating tilt. Unfortunately we do not have several interstellar features on each grating tilt to investigate this.

In most research applications these offsets will have no affect on the results. However users should be aware of them for applications that require high absolute precision from the wavelength scale.

References

Herbig, G. H. 1995, ARAA, 33, 19

Kim Quijano, J., et al. 2003, "STIS Instrument Handbook", Version 7.0, (Baltimore: STScI)

Martin, J. C., et al. 2005, "Release Notes For Version 1.2 of the Database," HST Eta Car Treasury Project Technical Memo, 11

[1] http://www.stsci.edu/hst/stis/documents/handbooks/currentIHB/cover.html

[2] http://etacar.umn.edu/treasury/techmemos/pdf/tmemo011.pdf