

Updating the HST/ACS G800L Grism Calibration

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We present results from our ongoing work on obtaining newly derived trace and wavelength calibrations of the HST/ACS G800L grism and comparing them to previous set of calibrations. Past calibration efforts were based on 2003 observations. New observations of an emission line Wolf-Rayet star (WR96) were recently taken in HST Cycle 25 (PID: 15401). These observations are used to analyze and measure various grism properties, including wavelength calibration, spectral trace/tilt, length/size of grism orders, and spacing between various grism orders. To account for the field dependence, we observe WR96 at 3 different observing positions over the HST/ACS field of view. The three locations are the center of chip 1, the center of chip 2, and the center of the WFC1A-2K subarray (center of WFC Amp A on chip 1). This new data will help us to evaluate any differences in the G800L grism properties compared to previous calibration data, and to apply improved data analysis techniques to update these old measurements.

HST/ACS Grism

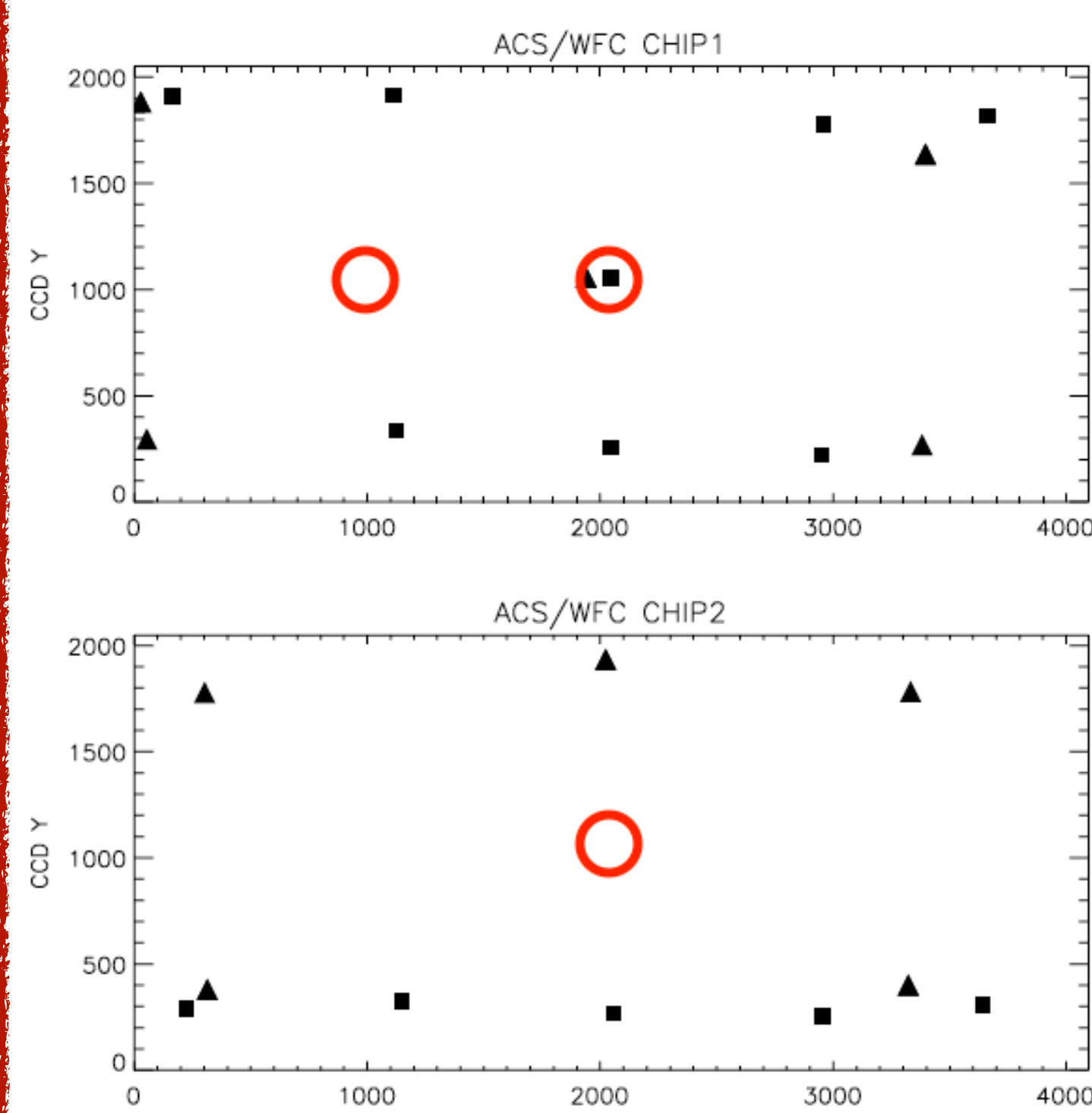
HST/Advanced Camera for Surveys (ACS) Wide Field Channel (WFC) has a $3.4' \times 3.4'$ field of view at a spatial resolution of $0.05''/\text{pixel}$ and is equipped with a grism (G800L) covering the spectral range from 5500\AA to 10000\AA . The grism resolving power is ~ 100 , and the dispersion is nearly linear: $\sim 40\text{\AA}/\text{pixel}$ in the first order.

This mode is important to spectroscopically investigate different kinds astrophysical objects (stars, emission line galaxies, passive galaxies, high redshift galaxies) as shown by various surveys (e.g., GRAPES, PEARS).

2018 Calibration Program

We observed Wolf-Rayet star (WR96), which is a bright point source with strong emission lines, at 3 different positions (as shown below) on the two ACS WFC chips to check various properties (shape, length and spacing of grism orders, spectral tilt, wavelength calibration) of the ACS grism and its field dependence.

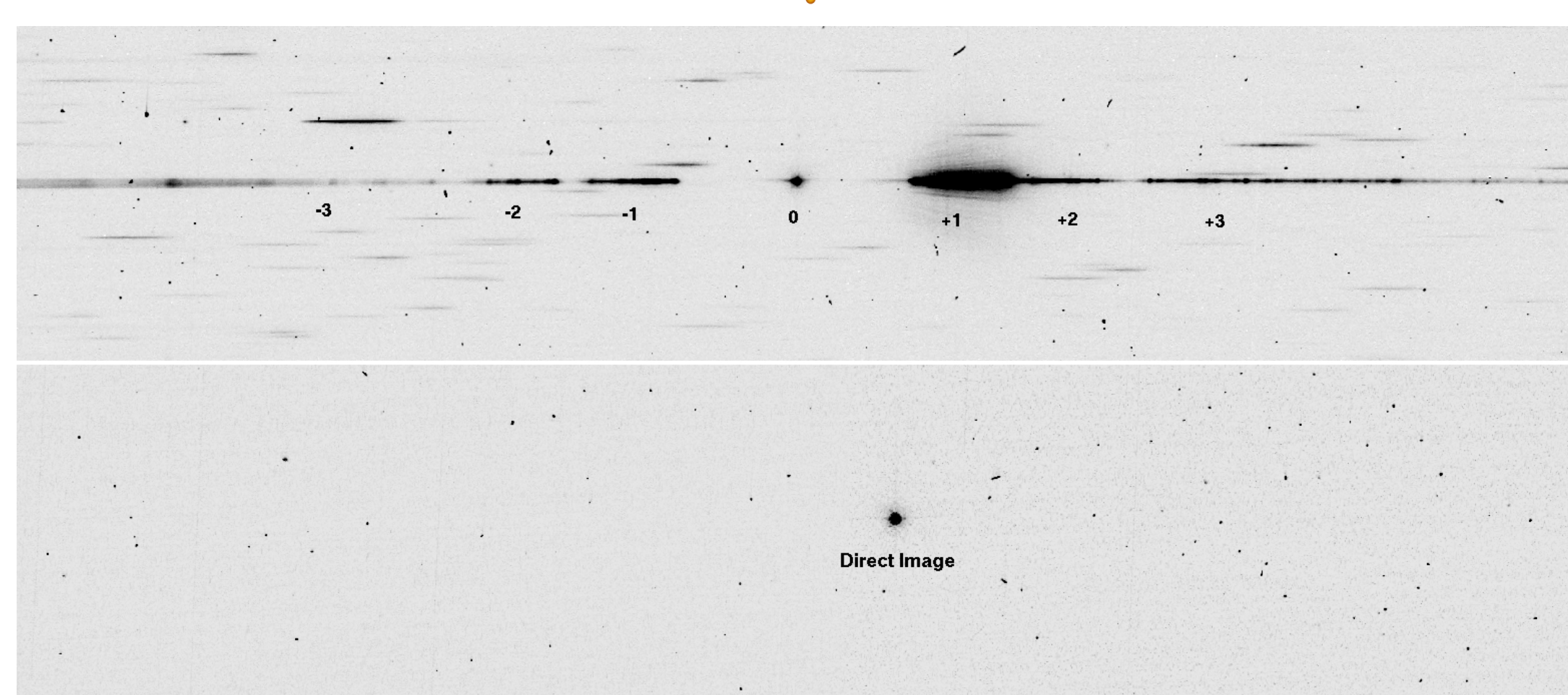
The major goal of this program is to verify prior calibration results obtained from 2003 data (Pasquali+ 2003, 2006, Larsen+ 2005).



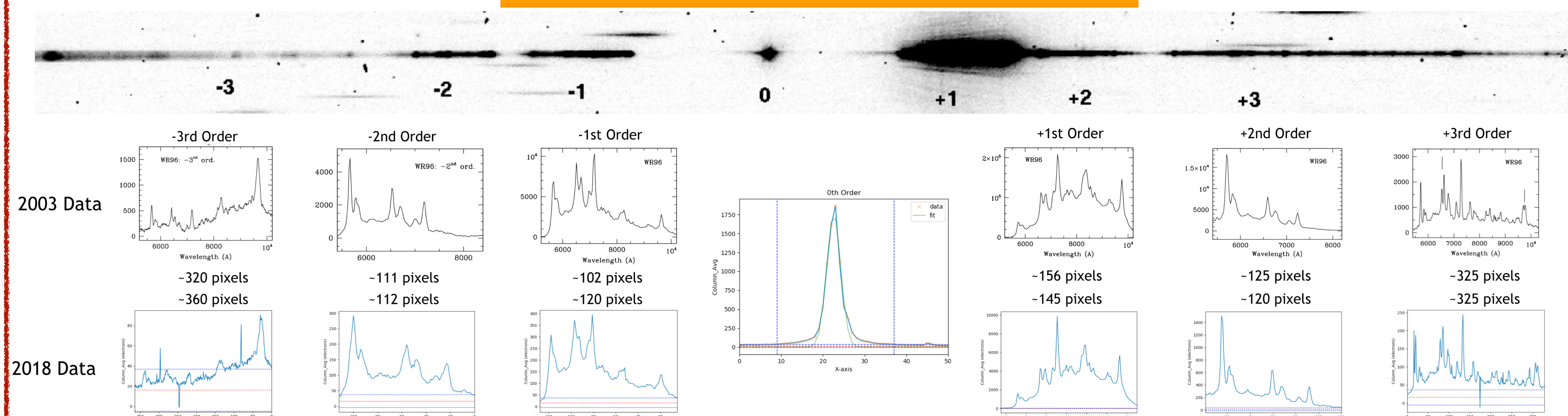
Wolf-Rayet star (WR96)

Observing positions of WR96 — red circles (2018) and black symbols (2002–2003)

Direct image (F775W) and grism image (G800L) of WR96

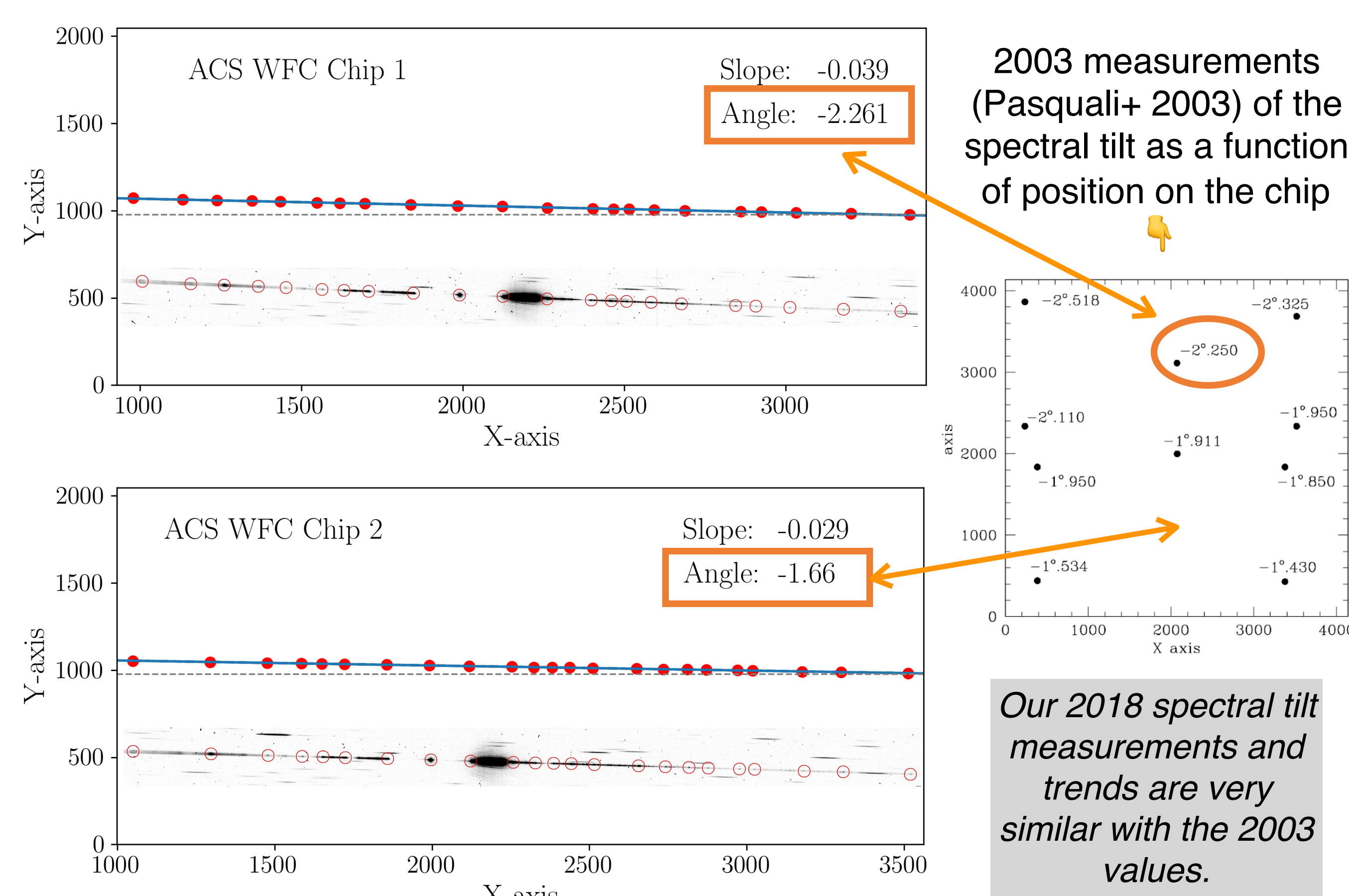


Length and Shape of Different Orders



The length and shape of WR96 spectrum in different orders (-3, -2, -1, +1, +2, +3), obtained in February 2018, is very similar to 2003 data. The 0th order FWHM (~ 4 pix) and dispersion (~ 25 pix) are also very consistent with the 2003 data (Pasquali+ 2003).

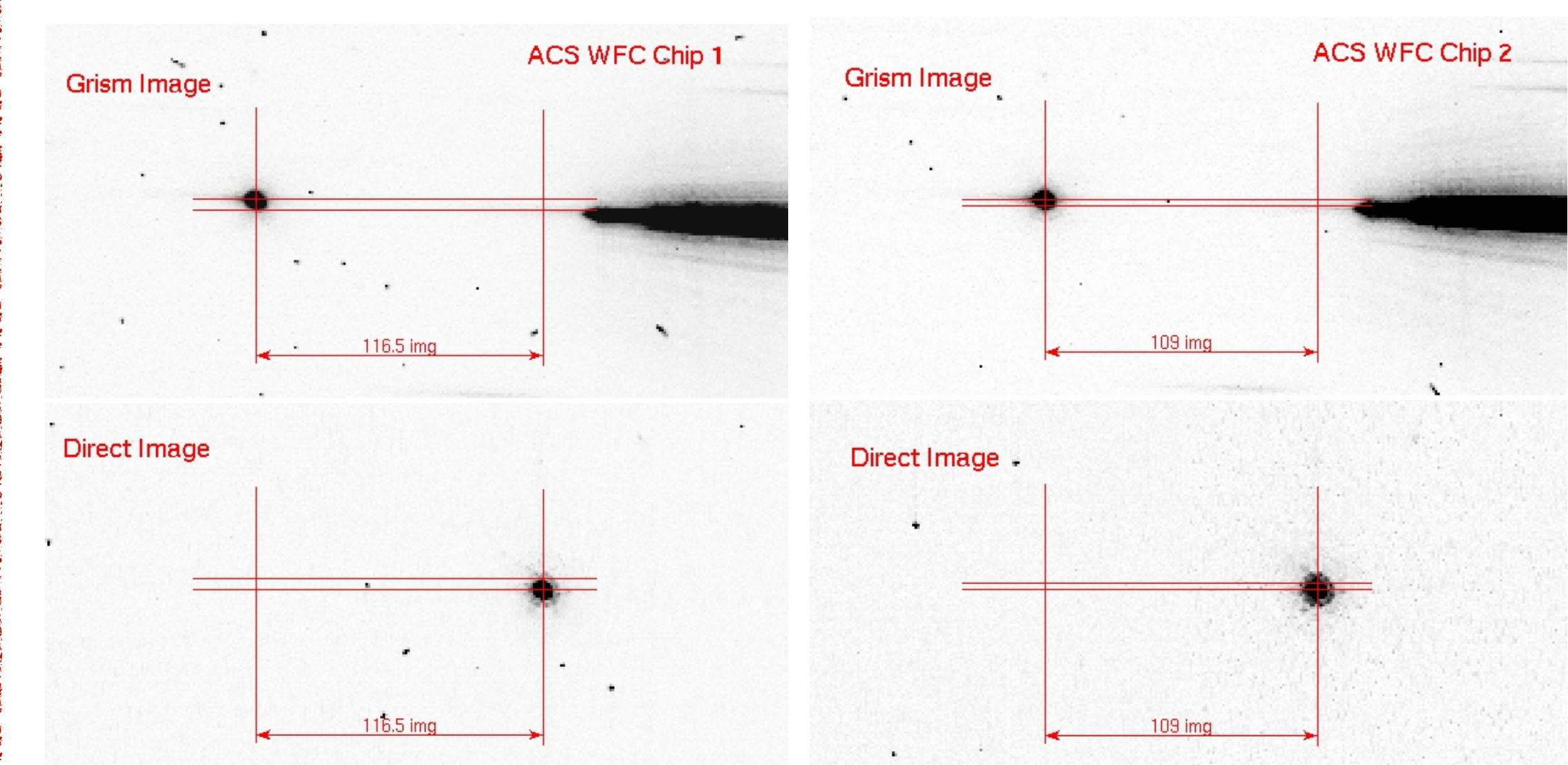
Spectral Tilt Measurements



Following Pasquali+ 2003, we measured the (X,Y) coordinates of the knots/emission line peaks along the whole spectrum and fitted them with a first order polynomial to determine the slope of the spectrum with respect to the X-axis.

Our 2018 spectral tilt measurements and trends are very similar with the 2003 values.

Distance / Separation from the 0th Order



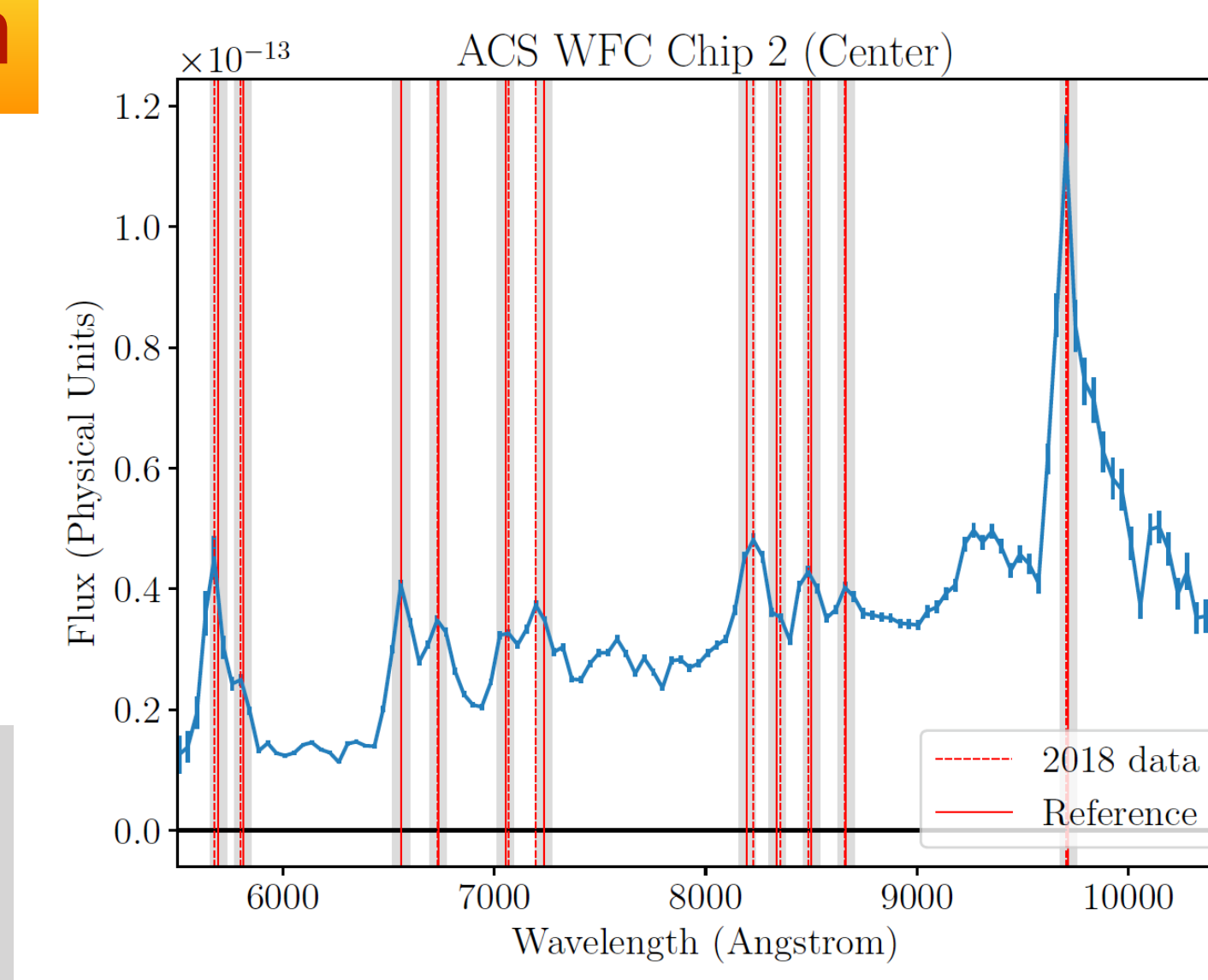
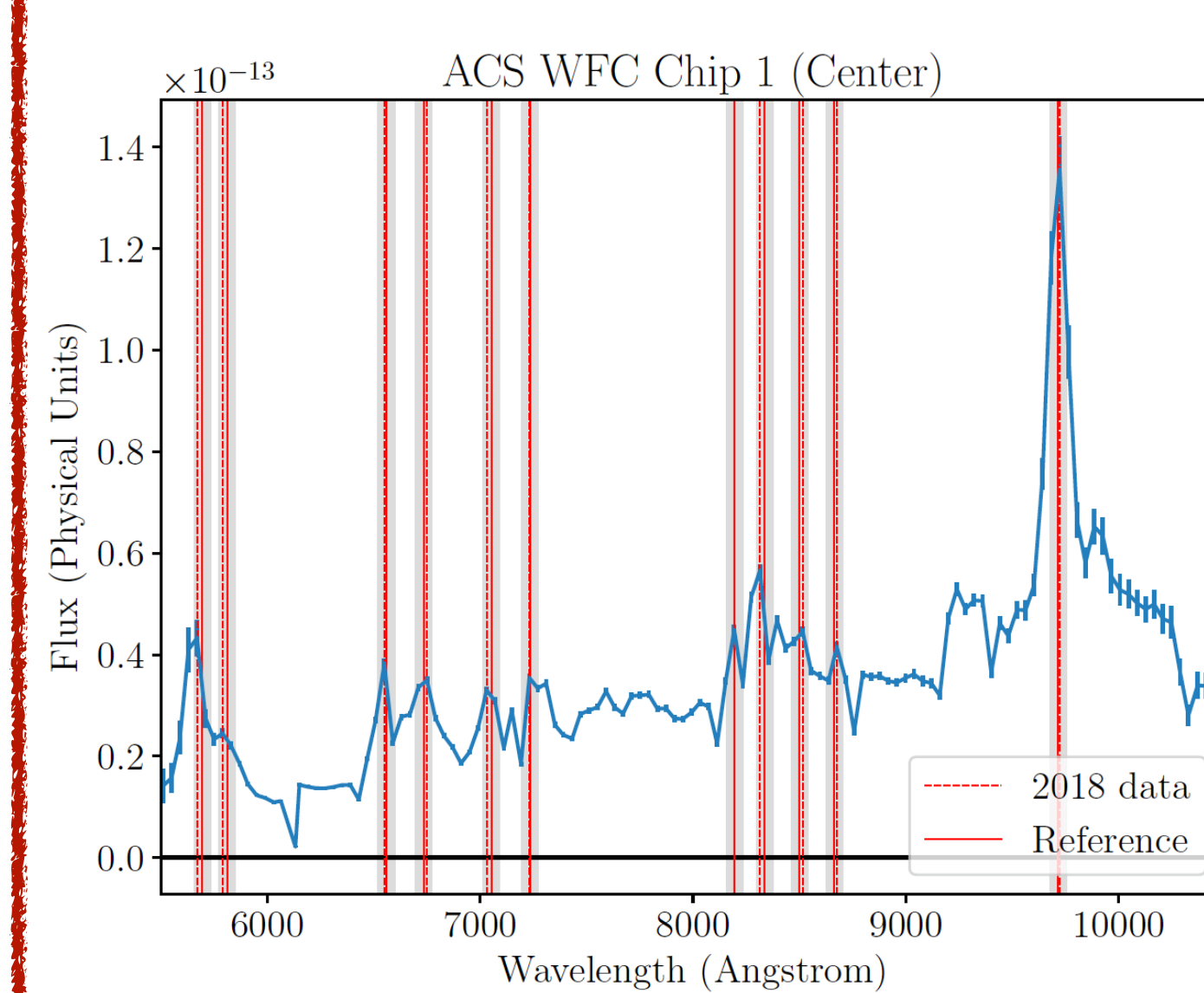
Distance / Separation from the 0th order					
Data	0th \rightarrow Direct Chip 1 X / Y pixels	0th \rightarrow Direct Chip 2 X / Y pixels	0th \rightarrow +1st avg pixels	0th \rightarrow +2nd avg pixels	0th \rightarrow -1st avg pixels
2003	117.3 / -4.2	108 / -2.2	93	251	122
2018	116.5 / -4.5	109 / -2.5	~95	~255	~130

We measured the separation of various grism orders from the 0th order and found consistent results with 2003 measurements. The 2003 values are averaged over multiple positions on the ACS WFC detector. Additionally, we also measured distance between grism 0th order and the direct image at the center of the two chips, and found very similar values.

Wavelength Calibration

After reducing the grism data using aXe software (<http://axe-info.stsci.edu>), we compared observed emission line wavelengths with the reference emission line wavelengths (Pasquali+ 2006) and consistently found that the difference between those wavelengths is within $\sim 40\text{\AA}$ (~ 1 pixel), as expected based on prior wavelength calibrations (Pasquali+ 2003, Larsen+ 2005).

Future Goal: Our aim is to use new WFC3 wavelength calibration technique (Pirzkal+ 2016) to improve ACS wavelength calibration using all existing data.



References

- Pasquali+ 2003, ST-ECF ISR ACS 2003-001;
- Pasquali+ 2006, PASP, 118, 270;
- Larsen+ 2005, ST-ECF ISR ACS 2005-08;
- Pirzkal+ 2016, STScI ISR WFC3 2016-15

