Cycle 25 COS FUV Detector Dark Monitor

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ABSTRACT

Here we summarize the Cycle 25 FUV Dark Monitoring Program for the Cosmic Origins Spectrograph (COS) on the Hubble Space Telescope (HST), covering dates 2017 November to 2018 October. We give an overview of the calibration plan and a summary for this calibration program.

Contents

1. Introduction

Program 14940 ("FUV Detector Dark Monitor," PI M. Fix) is designed to perform routine monitoring of the FUV XDL detector dark rate. The main purpose is to look for evidence of a change in the dark rate, both to track on-orbit time dependence and

Table 1. COS FUV ETC Dark Rates from Cycle 25

Detector	Mode	Dark Rate (counts s^{-1} pixel^{-1})
FUVA	Spectroscopic	2.43×10^{-6}
FUVA	Target ACQ	3.52×10^{-6}
FUVB	Spectroscopic	1.93×10^{-6}
FUVB	Target ACQ	3.10×10^{-6}

to check for any developing detector problems. Results from this program are used to update the COS/FUV Exposure Time Calculator (ETC). Every week, five 22 minute exposures were taken with the shutter closed, for a total of 260 orbits.

2. Analysis and Results

The dark rate of each observation in Program 14940 was measured in 25 s intervals for five different regions on the FUVA and FUVB detector segments. These regions have been newly redefined from Cycle 24 to better track the enhanced dark rate seen along the edges of FUVA. The five regions capture the top, bottom, left, right, and inner portions of the detector. Figure 1 illustrates where the edges are defined on the detector segments. More information can be found in COS ISR 2019-11 (Dashtamirova et al. 2019). Dark rates were measured versus time, and summed darks for each visit were constructed for each region of each segment.

The overall trend in the dark rate has been constant for Segments A and B. In Figures 2 and 3, we show the dark rate versus time for each of the five regions tracked for FUVA and FUVB, respectively. This cycle there was baseline jump behavior, most obviously seen in the bottom and left edge of FUVA around 2018.5 (see Figure 2). This has been seen in the past (see around 2015.5 in Figure 2) and is not unexpected. Additionally, both segments show individual observations and portions of observations that significantly vary from the baseline dark rate, which has also been observed in past cycles.

Due to the lack of a measurable trend and the extreme variability seen in observations, we adopt an ETC estimate for the dark rate that corresponds to the 95% level in the probability distribution function determined from dark measurements that exclude the enhanced edges over a period of the previous 6 months to 1 year. The ETC rates adopted from Cycle 25 data are listed in Table 1.
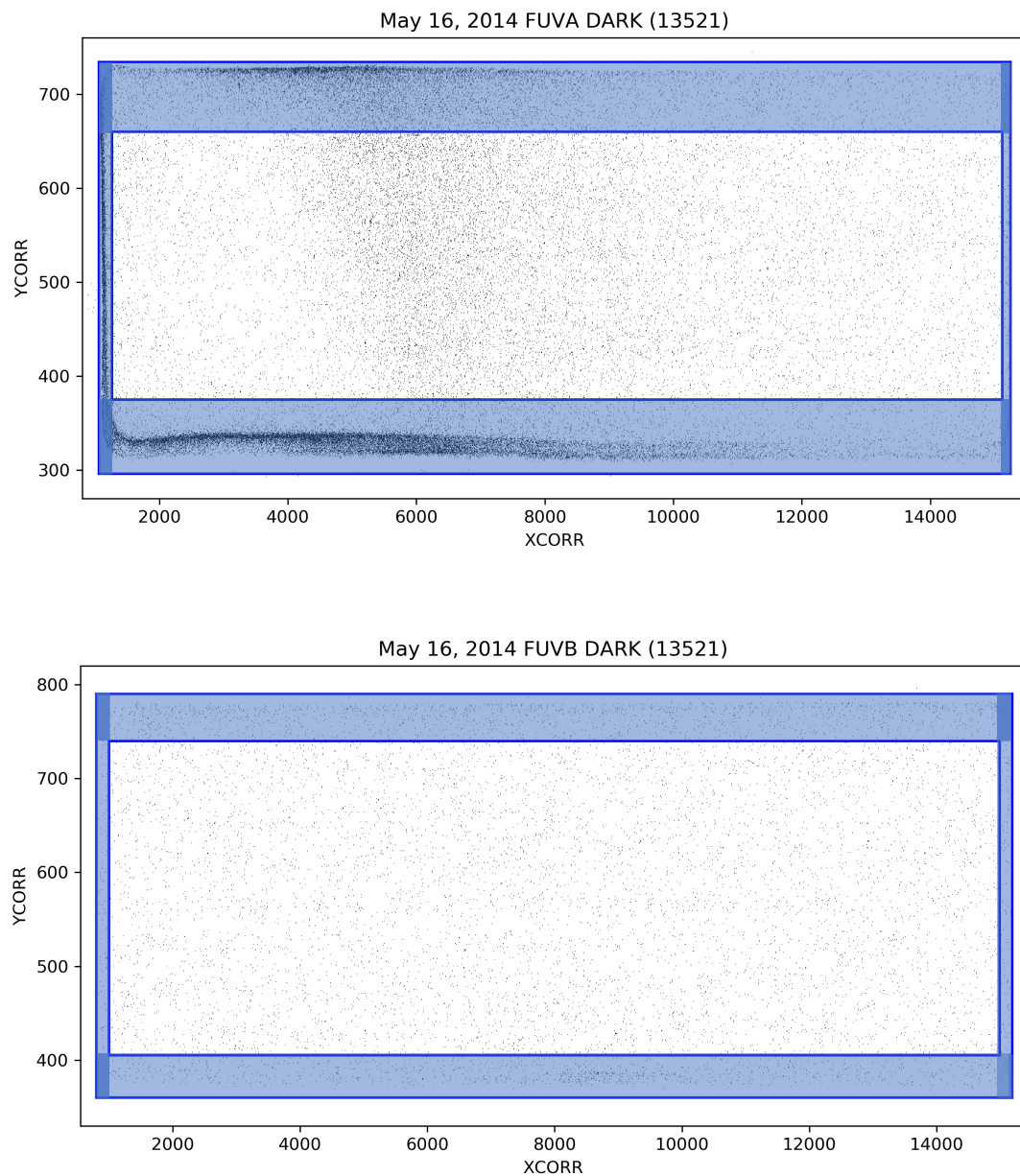
Figure 1. Overlay of the new edge regions used to separately monitor the dark rate on top of a dark image for FUVA (top) and FUVB (bottom). The dark image is composed of five 22 minute exposures from 2014 May 16 as part of Program 13521. Note the overlap of the corners.
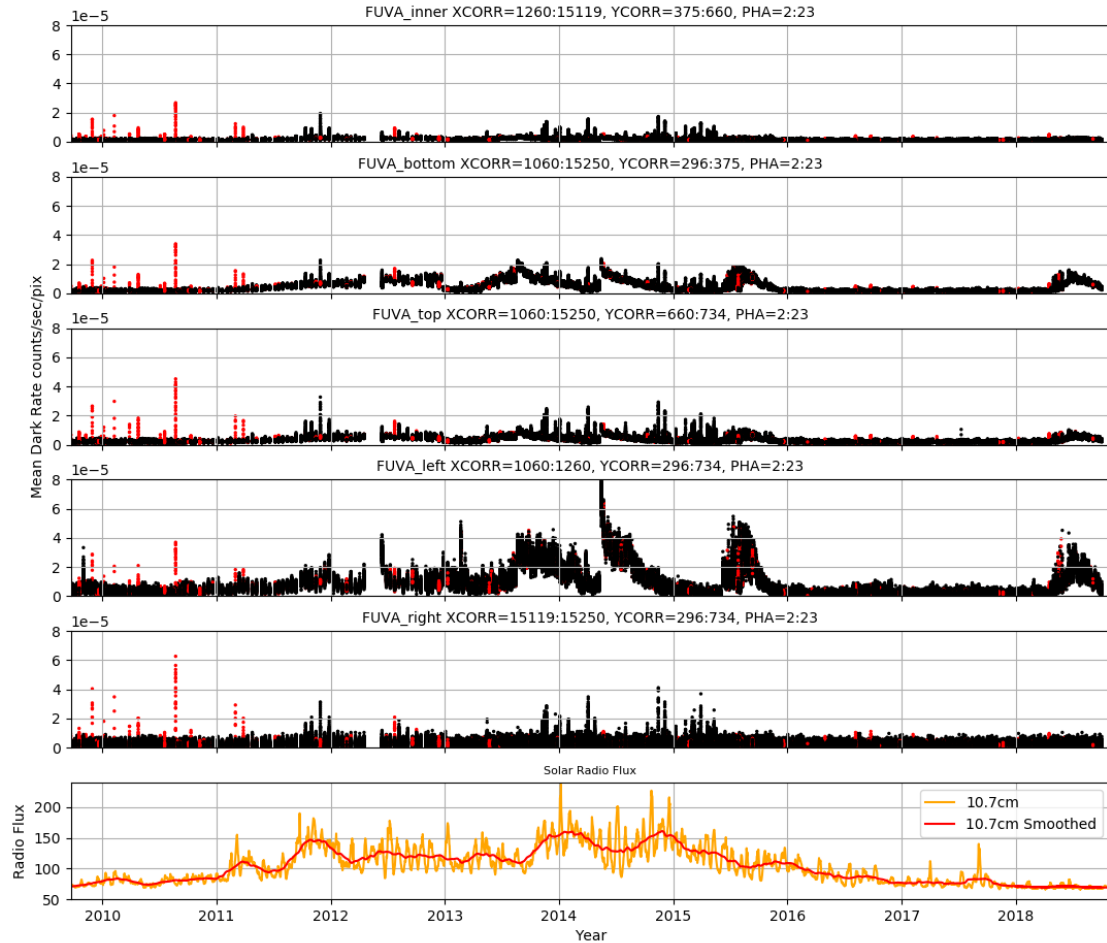
Figure 2. COS/FUV dark rates on FUVA as a function of time for each of the different areas on the detector monitored. The top five panels show the measured dark rate in 25 s increments throughout every exposure. The red dots represent dark rates that were observed close to when HST was passing over the South Atlantic Anomaly. The bottom panels display the 10.7 cm solar radio emission, tracking the solar cycle.
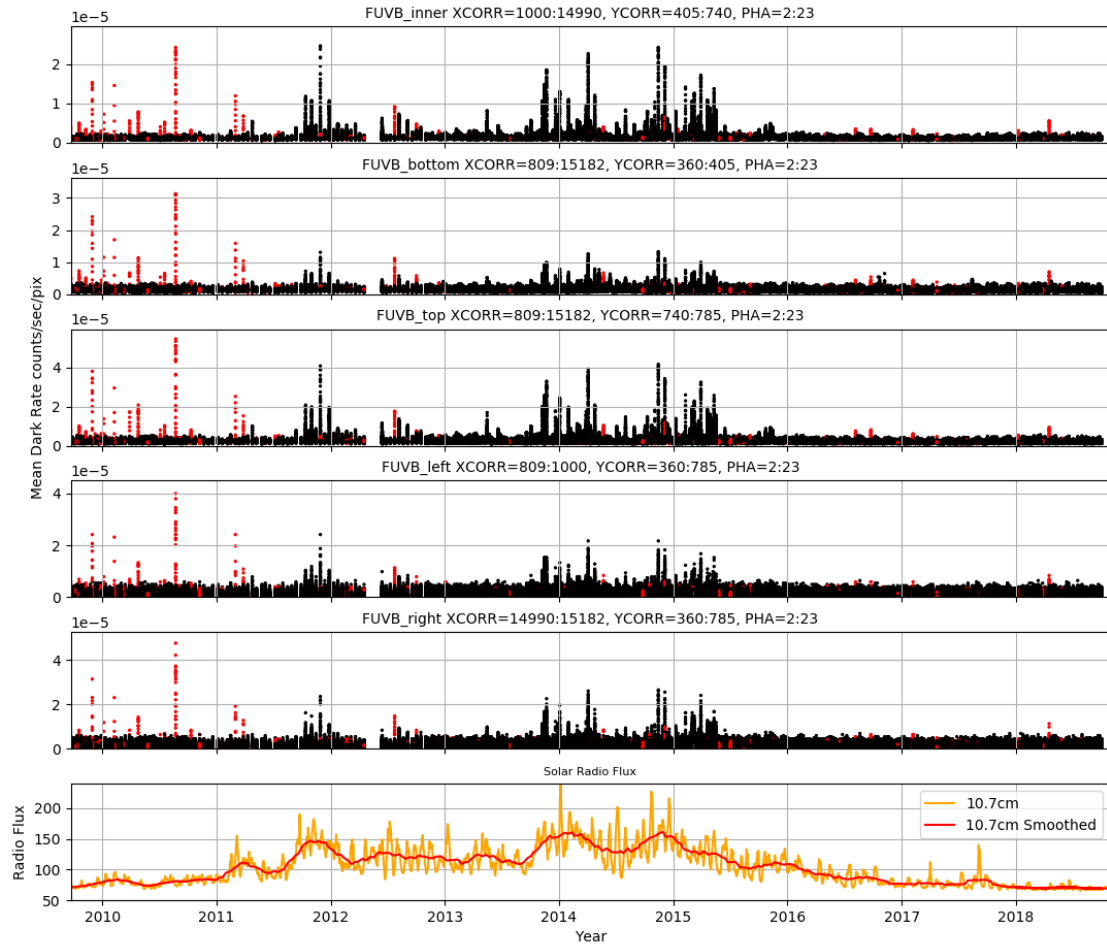
Global Dark Rate for Multiple Regions - FUVB

Figure 3. Same as Figure 2 but for FUVB.

3. Summary

The COS FUV XDL detector dark rate continues to follow former trends. The FUVB detector shows a relatively constant dark rate trend, whereas FUVA continues to experience a baseline increase and a slow decrease back to nominal as it has in the past.

Change History for COS ISR 2019-17

Version 1: 13 August 2019 – Original Document

Reference

Dashtamirova, D., White, J., & Sahnow, D. 2019, COS ISR 2019-11, "Changes in the COS/FUV Dark Rate: Impact on the Monitoring Program and Background Extraction Regions"