



STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

Instrument Science Report COS 2022-07(v1)

Cycle 28 COS NUV Dark Monitor Summary

Christian I. Johnson¹ and Dzhuliya Dashtamirova¹

¹ Space Telescope Science Institute, Baltimore, MD

1 August 2022

ABSTRACT

Here we summarize the Cycle 28 NUV Dark Monitoring Program for the Cosmic Origins Spectrograph (COS) on the Hubble Space Telescope (HST) covering dates November 2020 to October 2021. We present an overview of the calibration plan and summary for this calibration program, and also provide an update to the calculation of the NUV dark rate reported to the Exposure Time Calculator (ETC). The adopted dark rate for the Cycle 28 ETC was $1.11e-03$ counts pixel⁻¹ second⁻¹.

Contents

1. Introduction	2
2. Analysis and Results	2
3. Summary	2
Change History for COS ISR 2022-07	2

1. Introduction

Program 16327 (“Cycle 28 COS/NUV Detector Dark Monitor,” PI D. Dashtamirova) was designed for routine monitoring of the NUV MAMA detector, and was used to produce a dark rate for inclusion in the Exposure Time Calculator (ETC). The main purpose was to look for evidence of changes in the dark rate, tracking both on-orbit time dependencies and checking for variations that may be due to anomalies or new features of the detector. For the NUV program, two 22 minute exposures were taken with a cadence of every two weeks, for a total of 52 orbits throughout Cycle 28, spanning November 2, 2020 to October 31, 2021.

2. Analysis and Results

For each exposure, the dark rate was measured and compared to all previous Cycle 28 observations in order to monitor the rate as a function of time. Immediately following COS commissioning, the dark rate of the NUV MAMA increased linearly with time, but Figure 1 shows that in recent years the dark rate increase has slowed considerably. Figure 1 also indicates that while the dark rate increase has declined with time, the scatter, both within an individual image and from exposure-to-exposure, has increased.

A mean dark rate (counts pixel⁻¹ second⁻¹) is calculated in 25 second increments for each dark exposure, which is plotted against the time in decimal year (Figure 1). The ETC estimate for the dark rate is calculated by creating a distribution of these mean dark rate measurements over a period of 6 months to 1 year and fitting a standard probability distribution to the data (see Figure 2). The reported ETC value corresponds to a dark rate level that encapsulates 95% of the distribution. The dark rate can vary significantly throughout an observation so the 95% level, or about 2σ above the mean, is chosen such that the vast majority of users can expect to have a mean dark rate at or below the ETC value. The dark rate adopted for the NUV detector in the ETC for use in Cycle 28 proposals was $1.11\text{e-}03$ counts pixel⁻¹ second⁻¹.

3. Summary

The COS NUV MAMA detector dark rate continues to follow former trends of a slow increase with time combined with enhanced variability. We will continue this monitoring program into future cycles and perform new analyses as necessary.

Change History for COS ISR 2022-07

Version 1: 1 August 2022- Original Document

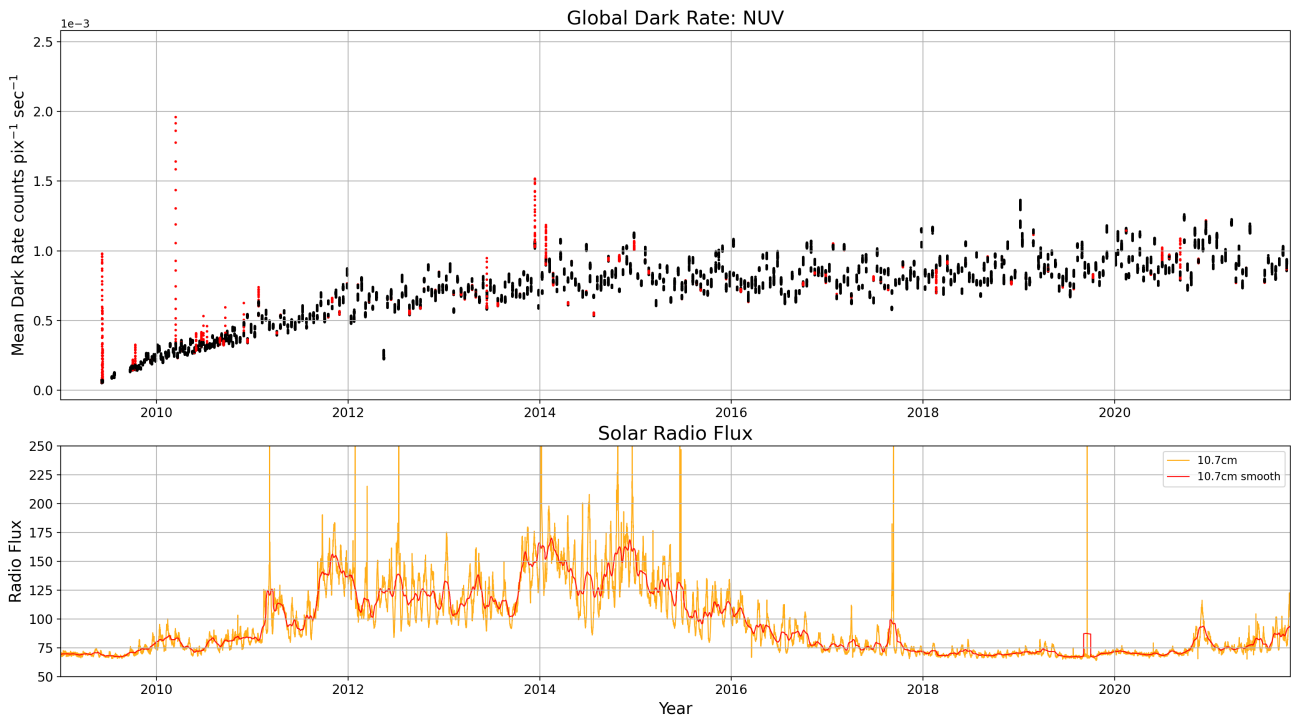


Figure 1. The COS NUV dark rate as a function of time, spanning from the beginning of COS operations through the end of Cycle 28. The dark rate is measured in 25 second intervals, which is then plotted against the time in decimal year (top). Groupings of points occur naturally, as they correspond to the individual exposures. The dark rates can also vary over the length of individual exposures. Points in red indicate observations taken near the South Atlantic Anomaly. The bottom panel shows the 10.7 cm radio flux trend as a tracer of solar activity.

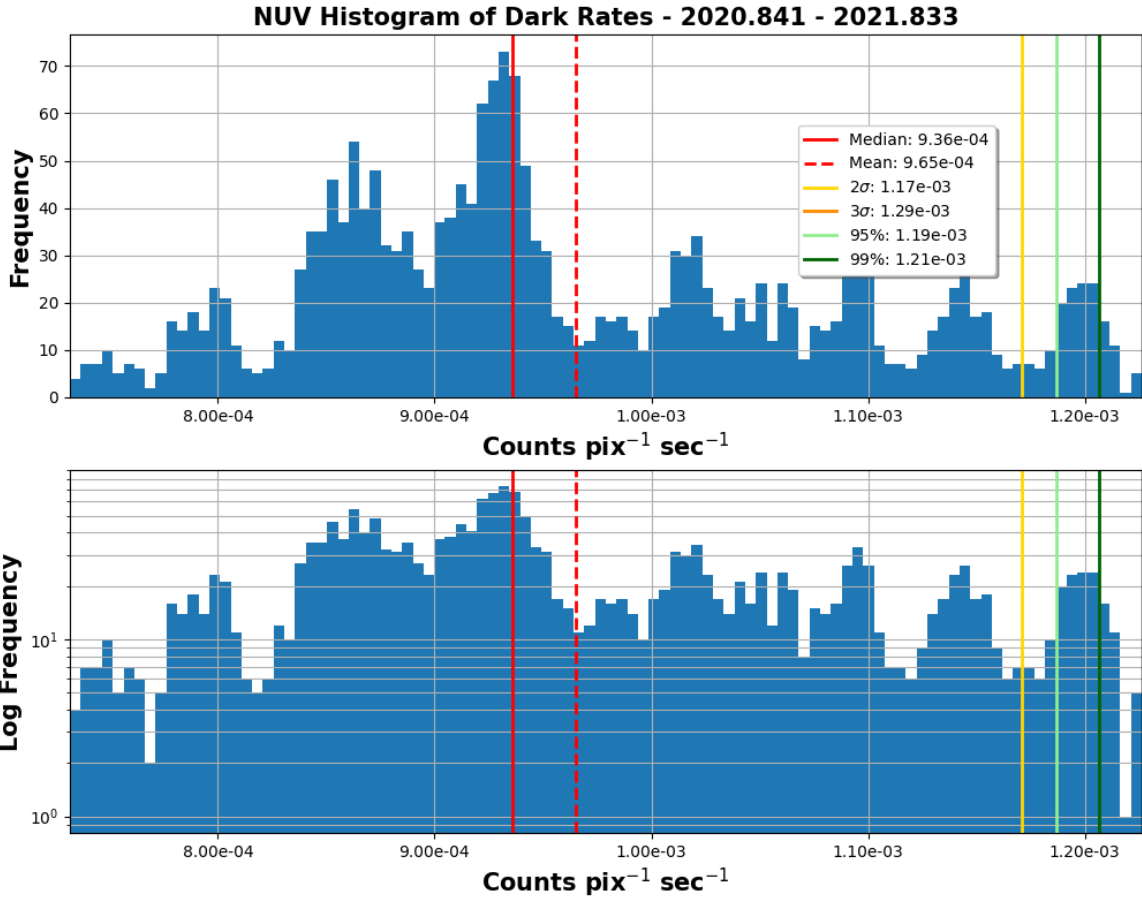


Figure 2. The COS NUV dark rate distribution for all of Cycle 28. The data are binned and then fit with a standard probability distribution to determine the value below which 95% of measured values fall.