Technical Evaluation Report
"FUV Detector QE Enhancement Grid Design Guidelines"

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1. INTRODUCTION

The purpose of this technical evaluation report is to capture the current set of requirements for the quantum efficiency (QE) enhancement grid for the HST/COS FUV detector. The QE enhancement grid applies an additional electric field above the surface of the microchannel plates (MCPs) so that photoelectrons emitted from front surface, i.e. not in an MCP pore, are driven back onto the MCP to hopefully initiate an electron cascade. This increases the detection quantum efficiency of the detector by ensuring that the majority of the emitted photoelectrons initiate an event in the MCP stack.

It is the current understanding that an electric field of approximately 250 V/mm is required to maximize the likelihood that an escaping photoelectron will be detected without blurring the resolution. Furthermore, this electric field should be uniform to the 10% level within 100 microns of the top surface of the MCP.

This electric field is typically produced by placing a electro-formed nickel mesh about 6 mm above the detector face with a voltage of about 1500 V higher than the top MCP. The spacing of the grid wires is typically on the order of 1-2mm and the wires are about 25 microns thick.

The QE grid necessarily casts a shadow on the detector face when the detector is exposed to a light source. This is rarely a desirable situation as the shadows introduce features into the spectra which can be mis-interpreted as scientifically meaningful. In the case of COS, which has an F/24 beam, models indicate the QE grid introduces ~25% variations in the efficiency of the instrument. Therefore, it is important that great pains are taken to minimize the negative impact of the QE grid on the performance of COS.

2. APERTURE FOOTPRINT ON THE DETECTOR

The aperture plate design for COS has matured sufficiently that it is appropriate to discuss it's impact on the QE enhancement grid and to determine whether or not the QE grid's design can be optimized to minimize the shadowing on the detector.

Figure 1 shows the baselined aperture plate design. The current plan is that science data will only be acquired in the region defined by the primary science aperture (PSA). If the bright object aperture (BOA) is to be used it will be moved in the cross-dispersion direction to the position normally occupied by the PSA. Flat fields will be acquired in this manner. The result of this aperture usage scenario is that only the central 3 mm of the detector of the FUV detector will ever be exposed to photons from a scientific target.

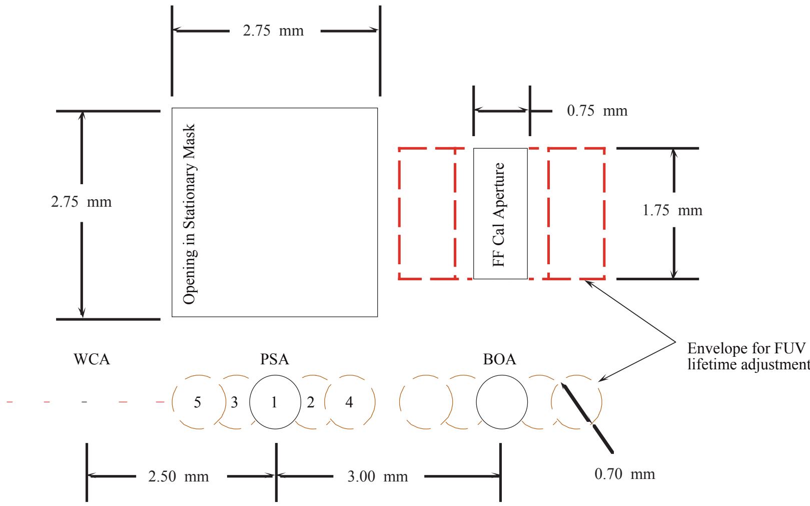
The wavelength calibration aperture (WCA) must also be considered. As shown in Figure 1, the WCA is located 2.5 mm from the PSA in the cross-dispersion direction. The WCA will be used frequently to acquire wavelength calibration spectra. The QE enhancement grid shall not prohibit the acquisition of wavelength calibration spectra for any of the positions of the PSA shown in Figure 1. Shadowing in the wavelength calibration spectra is more acceptable as the data are used to determine the wavelength scale only and can be characterized easily during thermal vacuum testing.

3. SUMMARY

The design guidelines presented in this document are secondary to achieving the maximum quantum efficiency for the detector. The design guidelines for the QE enhancement grids can be summarized as follows:

1. It is highly desirable to have no wires possible in the central 4 mm of the detector active area. The 4 mm includes defocus of the light cone and adds a bit of margin. If wires are required then they shall be as small as possible to minimize the potential for scattered light on the detector.

2. The QE grid must support acquisition of wavelength calibration spectra, i.e. the light cannot be blocked by "large" structures of any sort. However, the presence of thin wires in this region is acceptable.



Notes:

1) Numbers at potential PSA positions denote the sequence of PSA positions used to accommodate FUV detector lifetime.
2) BOA science will be conducted by moving the BOA into the current PSA position. Wavelength calibration spectra must be taken prior to moving the BOA into final position for observing.
3) Flat field data must be acquired by moving the FF Cal Aperture (FCA) in the opening in the fixed mask.

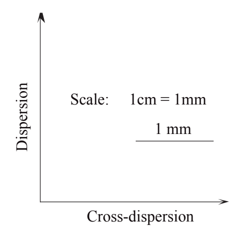


Figure 1