THE EVOLUTION OF THE ACS/SBC SENSITIVITY

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ABSTRACT
The Solar Blind Channel on the Hubble Space Telescope has been in orbit for over 11 years and is one of the oldest far ultraviolet imagers on the telescope. Here we present the first study of the evolution of the sensitivity of the camera. A long baseline has been established by observing a calibration field (NGC6681) every year since launch in all six filters (five long- and one medium-pass). From these observations we derive the sensitivity curves from launch to present.

INTRODUCTION
The Solar Blind Channel (SBC) on the Advanced Camera for Surveys (ACS) is a spare detector from the Space Telescope Imaging Spectrograph (STIS) program. The SBC is a photon-counting Multi-Anode Microchannel plate Array (MAMA) detector capable of two-dimensional imaging in the UV at wavelengths 1150–1700 Angstroms, with a field of view of 31 x 35. It has five long-pass filters (F115LP, F125LP, F140LP, F150LP, F160LP) for imaging. Figure 1 shows the throughput curves for these five filters. A study of the time-dependent sensitivity of these filters has not been undertaken since 2005 (Mack, et al). We report preliminary results of the time dependent sensitivity for these five filters derived from 11 years of on-orbit data from multiple calibration programs.

OBSERVATIONS AND DATA REDUCTION
Since launch the ACS team has used the globular cluster NGC6681 as the calibration field for SBC. This cluster is rich in blue horizontal branch stars which are bright in the UV. Figure 2 shows an image of the stars in the core of the cluster used for this analysis. This study used images from calibration programs spanning 11 years, from May 2002 (just after installation of ACS during SM3B) to May 2013. The observations were taken at different orientations, dithers, and exposure times as these images are also used for other calibration programs (geometric distortion characterization, PSF characterization, absolute flux calibration, and UV contamination monitor). Table 1 summarizes the characteristics of the data used in this study.

![Figure 1 - Throughput curves for each of the SBC long pass filters.](image1)

![Figure 2 - RGB representation of the core of NGC6681. Only the stars within the circle (r=12.5") were used as this region can be found in every image in the stack. Blue = F140LP, green = F150LP, red = F160LP. North is up and east is to the left.](image2)

![Table 1 - Summary of data used in this study for each filter. The number of stars reflects the number of stars found in the detection image of each filter.](table1)

Images were downloaded from the Mikulski Archive for Space Telescopes (MAST) in FLT/FITS format. These images have been bias subtracted and flat fielded using the standard CALACS pipeline. Note that SBC images are not dark corrected by default since MAMA arrays do not suffer from hot pixels. For each filter, the first observation is used as reference and the header WCS of the rest of the images in the stack is aligned to that image. Once all the images are registered, they are processed through AstroDrizzle (Fruchter & Hook, 2002) to remove distortion and produce the science image. Additionally, for each filter, a detection image is made by drizzling together all the images in the filter stack. These detection images are used to generate stellar catalogs for each filter. We only keep the stars in the catalog that lie in the region of the image that is observed in all the images in the stack.

We used the stand-alone photometry program DAOPHOT [Stetson, 1987] to measure the flux of the catalog stars in each individual science image. For this study, the absolute flux calibration is not important - the physical quantity of interest is the change in the flux with time. For this reason we assume that the sensitivity is 100% in the earliest image in each filter set and compare the flux of stars in subsequent images to that. We do quality cuts on the photometry by keeping only stars with magnitude errors less than 0.1 mag.

RESULTS
Figure 3 shows the median of the flux of stars for each observation in an image compared to their fluxes in the reference image. A simple linear fit to all the observations shows that the sensitivity of the detector is decreasing with time, to varying degree depending on the filter.

![Figure 3 - Results from photometry of each image. Yellow boxes represent the median of the flux of stars in an image compared to their fluxes in the reference image. Red lines represent the fit to all the data. Blue lines show the fits to the pre- and post-2004 epochs.](image3)

Previous analysis done by Mack et al. (2005) showed that the sensitivity of the instrument decreased for the first 1.6 years in orbit, and then remained negligible after that. At the time, the flattening of the slope was observed for only 1.5 years and it was unclear whether the trend would continue. We now have 8 additional years of observations to study the flattening trend. We conducted similar analysis to Mack et al., where they measure the slope of the sensitivity at different epochs, one pre-2004 and one post-2004. We confirm that the sensitivity dropped quickly for the first ~1.6 years in all filters, and then leveled off beyond that time. The full results of the time dependence sensitivity study are shown in table 2.

![Table 2 - Slopes of the time dependent sensitivity for each filter. The first column shows the result when all observations are taken into account. Columns 2 and 3 show the results from using different epochs to do the fitting.](table2)

REFERENCES