UVIS Calsystem Photometric Filter Flat Field Atlas

E. Sabbi
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ABSTRACT

This report presents an atlas of the most recent calsystem flat fields for all the UVIS photometric filters acquired during thermal-vacuum (TV3) testing in 2008. The aim of this report is to present the characteristic illumination patterns and features of the UVIS flat fields.

Introduction

The WFC3 instrument, with the UVIS-1' flight detector in place, recently underwent thermal-vacuum (TV3) testing in the GSFC Space Environment Simulator chamber, as part of the WFC3 calibration plan, between February and April 2008. Flat field illumination was provided by the calibration subsystem (calsystem), an internal stimulus for WFC3, designed to provide uniform illumination across the entire field of view for both the channels. Resulting flat fields are intended for use in monitoring the health and status of various instrument parameters such as gain, shutter travel, and changes in flat fields as well as correcting ground flat fields for use on-orbit. A deuterium lamp (D2) provides the necessary UV flux for the UVIS channel, while tungsten bulbs provide visible and IR flux for both the channels.

Here we present an atlas of all the UVIS tungsten, and Deuterium flat fields to show the typical structures of each photometric filter (optimum viewing is on-screen, not on paper; a power-point presentation is also available).

An inspection of the flat fields shows a variation of the structures with the wavelength:

- At shorter wavelength a quilt pattern is visible in both the CCDs;
- Flat fields become more homogeneous at wavelength longer than $\lambda \sim 500$ nm.

- Around λ~600 – 700 nm a diffuse dark spot appears in quadrant D (this is a QE feature, due to chip thickness rapidly changing in this area, as evidenced by the tight fringe pattern in e.g. F953N flat).
- Narrow band filters redder than λ> 600 nm are affected by fringing (the effect being particularly evident in the F953N filter)

All these structures are extremely stable, and, except for some of the fringing, repeatable from flat to flat (details to be presented in a future ISR).

A companion atlas for the UVIS flat fields illuminated with the CASTLE Optical Stimulus is also available (Sabbi 2008).

UVIS Calsystem Flat Field Characteristics

The UVIS calsystem flat fields presented here were drawn from the UVIS23 TV program, i.e. image names are distinguished by the first four characters iu23.

The flat fields were full-frame, unbinned, nominal gain (1.5 e-/DN) setting, default bias offset (setting 3, ~2500 DN), four-amp readouts. The majority of CCD images were taken at -81C. All images were processed through calwfc3 pipeline, performing the overscan correction (BLEVCORR) only. Quadrants are labeled in the first flat field.

Broad band filters

Typical UVIS flat fields for broad band photometric filters are shown in Figure 1. Images are presented in increasing wavelength.
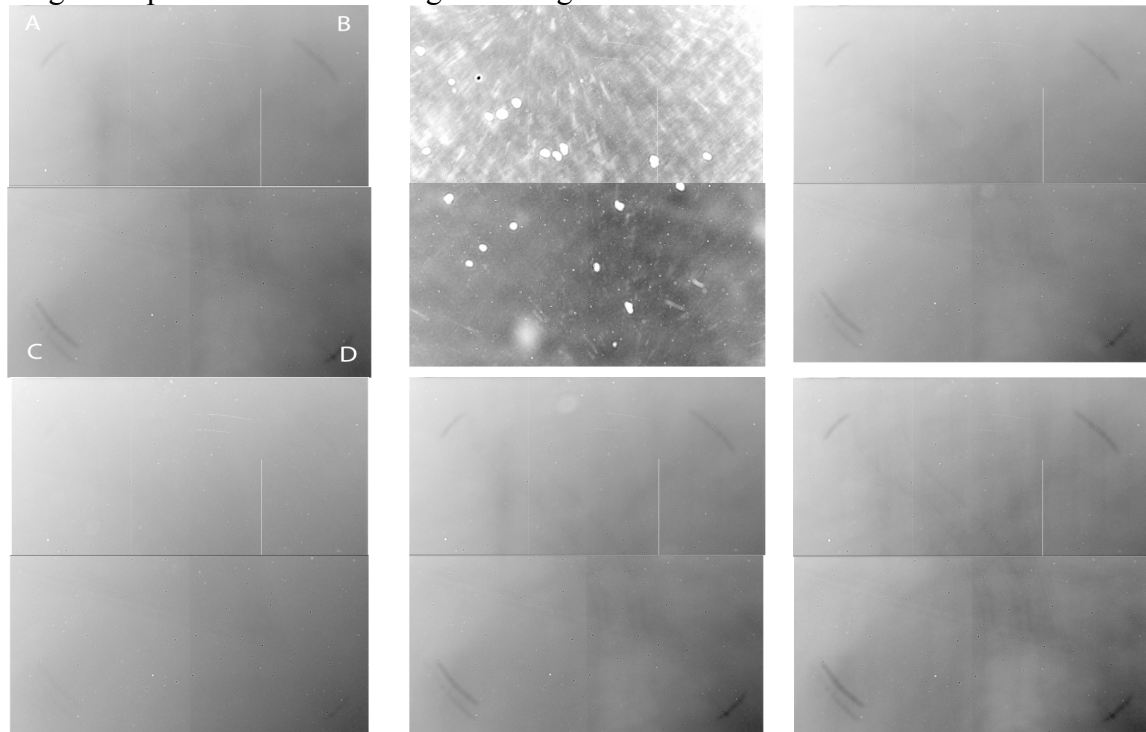

Figure 1: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flat fields in F200LP, F300X, F350LP, F475X, F600LP, and F850LP. All flat fields are

shown with stretch +/-30% with inverted grayscale, with the exception of F300LP and F300X (stretch +/-20%).

Wide band filters

Typical UVIS flat fields for wide band filters are shown in Figures 2 and 3. Images are presented in increasing wavelength.
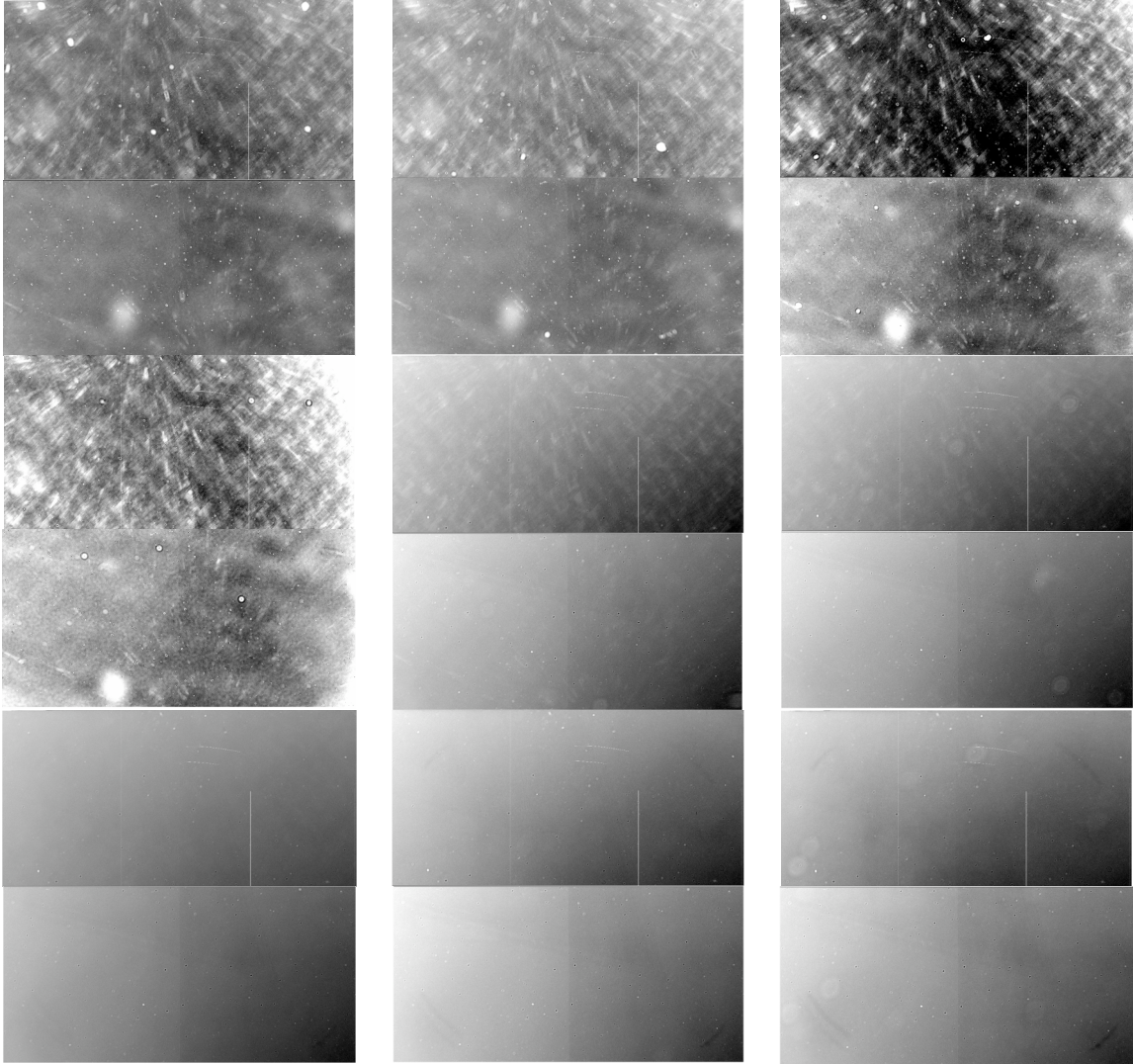

Figure 2: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flat fields in F218W, F225W, F275W, F336W, F390W, F438W, F475W, F555W and F606W. All flat fields are shown with inverted grayscale and stretch +/-20%, with exception of F475W (stretch +/-30%), and F606W (stretch +/- 10%).
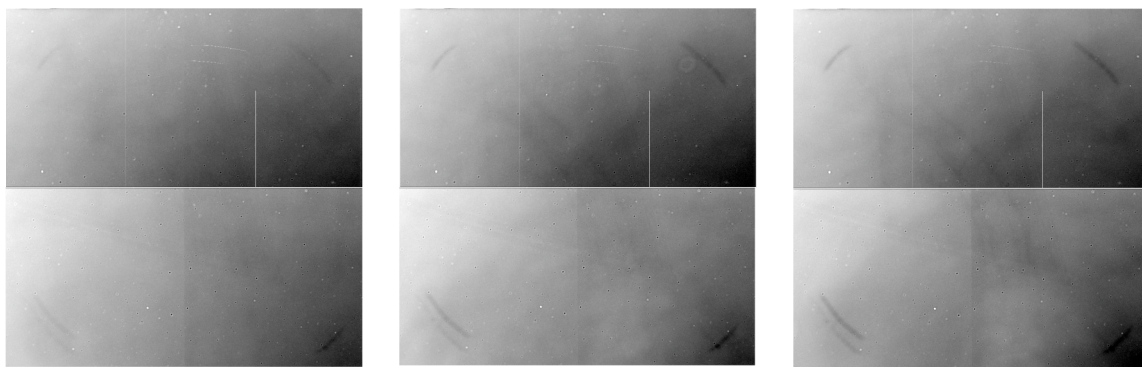
Figure 3: From left to right: Full-frame, four-amp readout calsystem flat fields in F625W, F775W, and F814W, shown with stretch +/-20% with inverted greyscale.

Medium band filters

Typical UVIS flat fields for medium band filters are shown in Figures 4 and 5. Images are presented in increasing wavelength.
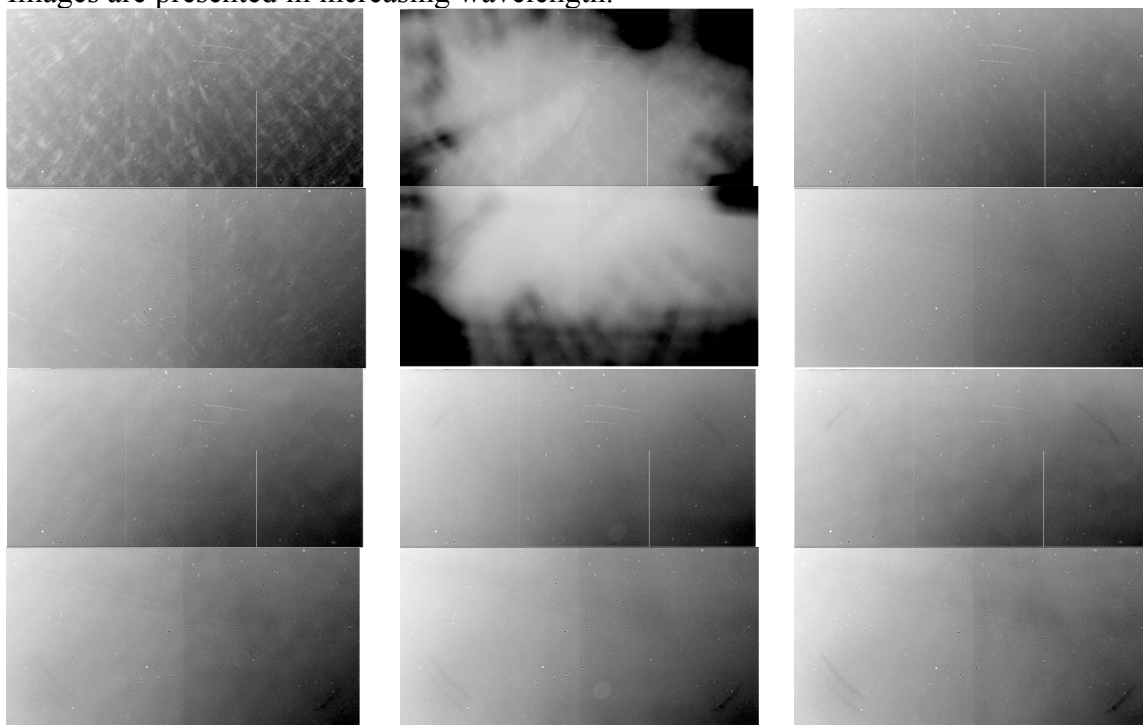

Figure 4: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flat fields in F390M, F410M, F467M, F547M, F621M and F689M. All flat fields are shown with inverted greyscale, and with stretch +/-20%, except F410M (stretch +/-30%).
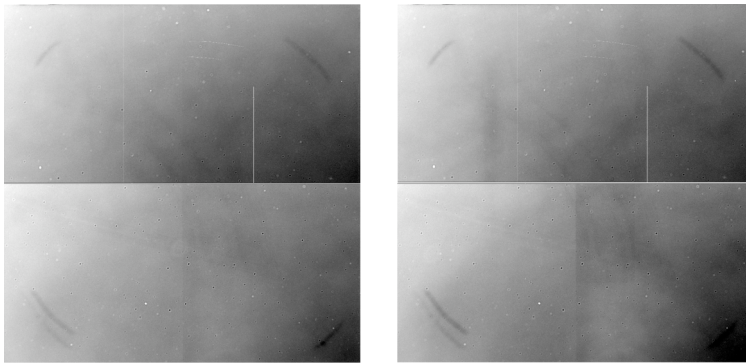
Figure 5: From left to right: Full-frame, four-amp readout calsystem flat field in F763M, and F845M, shown with stretch +/-20% with inverted greyscale.

Narrow band filters

Typical UVIS flat fields for narrow band filters are shown in Figures 6 and 7. Images are presented in increasing wavelength.
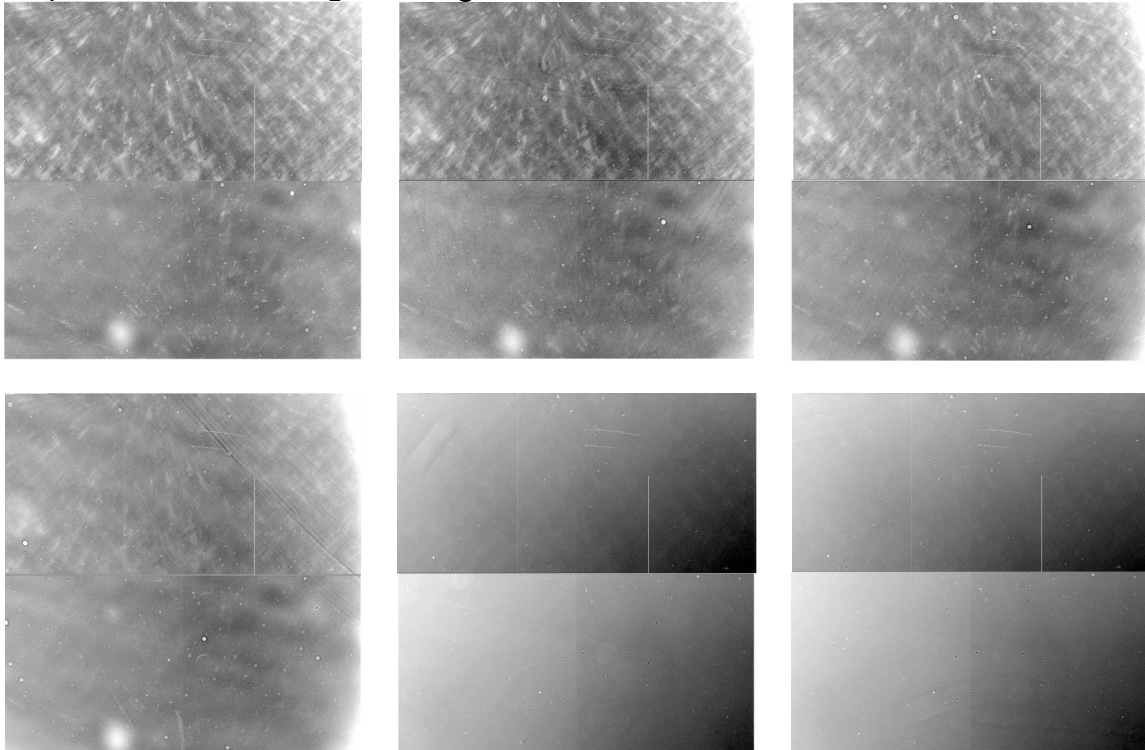

Figure 6: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flat fields in F280N, F343N, F373N, F395N, F469N, and F487N, shown with stretch +/-20% with inverted greyscale.
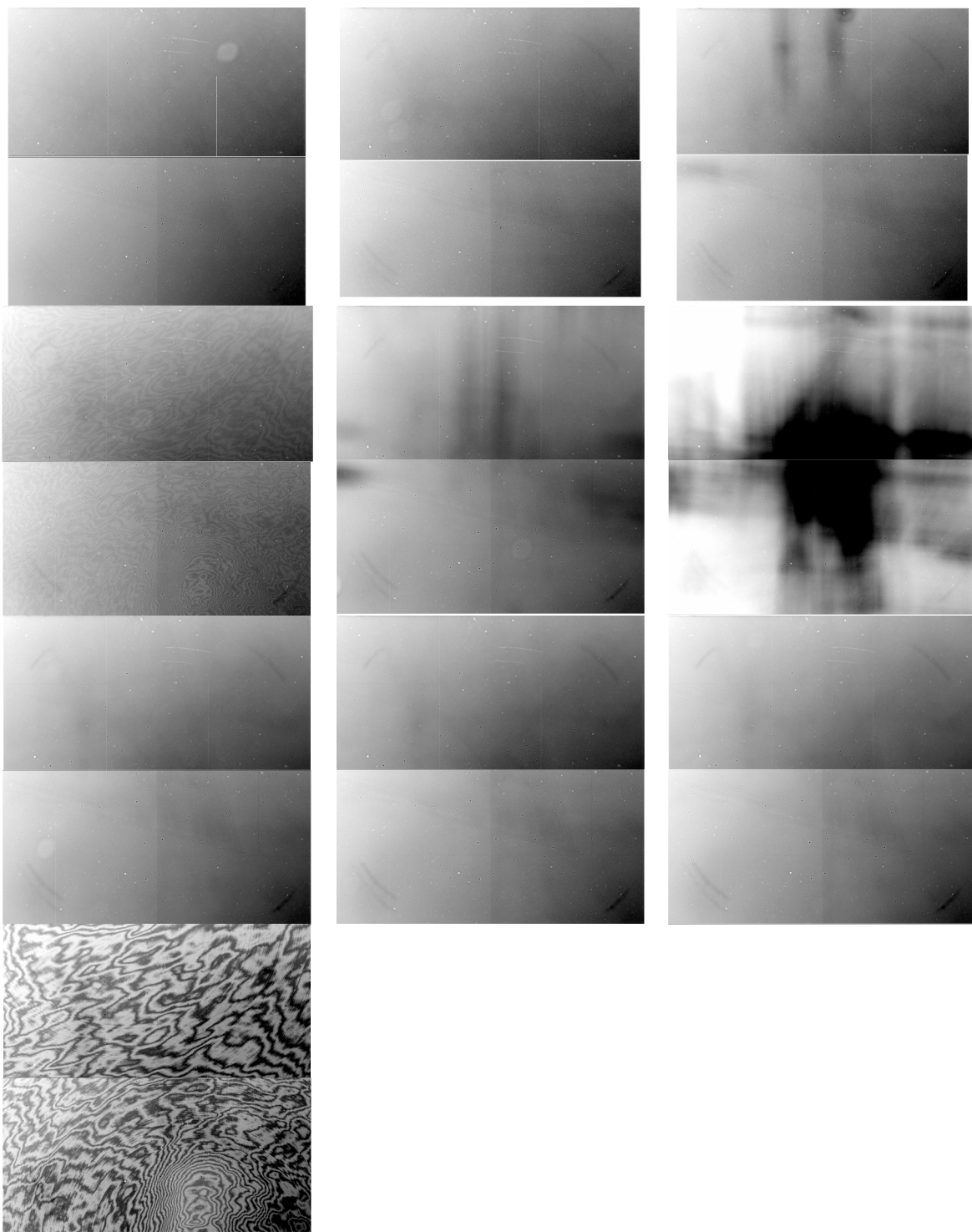
Figure 7: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flat fields in F502N, F631N, F645N, F656N, F657N, F658N, F665N, F673N, F680N, and F953N, shown with stretch +/-20% with inverted greyscale.

Quad filters

Five quad filters, namely quad, quad1, quad 2, quad3 and quad4, are available on the UVIS selectable optical filter assembly. Quad filters are 2x2 mosaics occupying a single filter slot. A quad provides four different bandpasses, at the cost of each one covering only about 1/6 of the field of view. The quad filter flat fields are shown from Figure 8 to Figure 12.
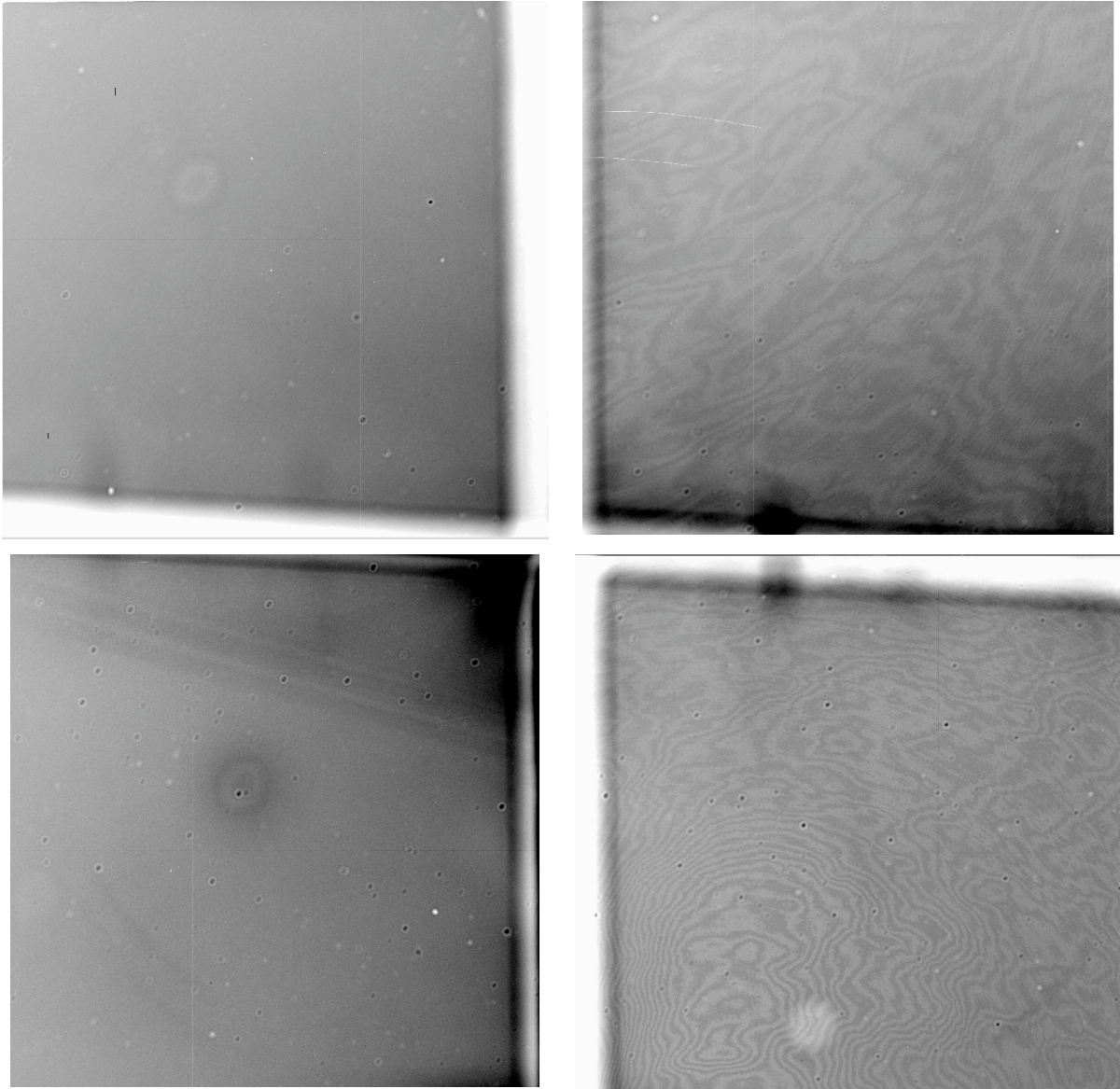

Figure 8: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flat fields for the quad filter. Flat fields are shown with +/-30% stretch, with inverted grey scale. Quadrant A shows the FQ508N filter, filter FQ674N is in quadrant B, FQ575N and FQ672N are shown in quadrant C and D respectively.
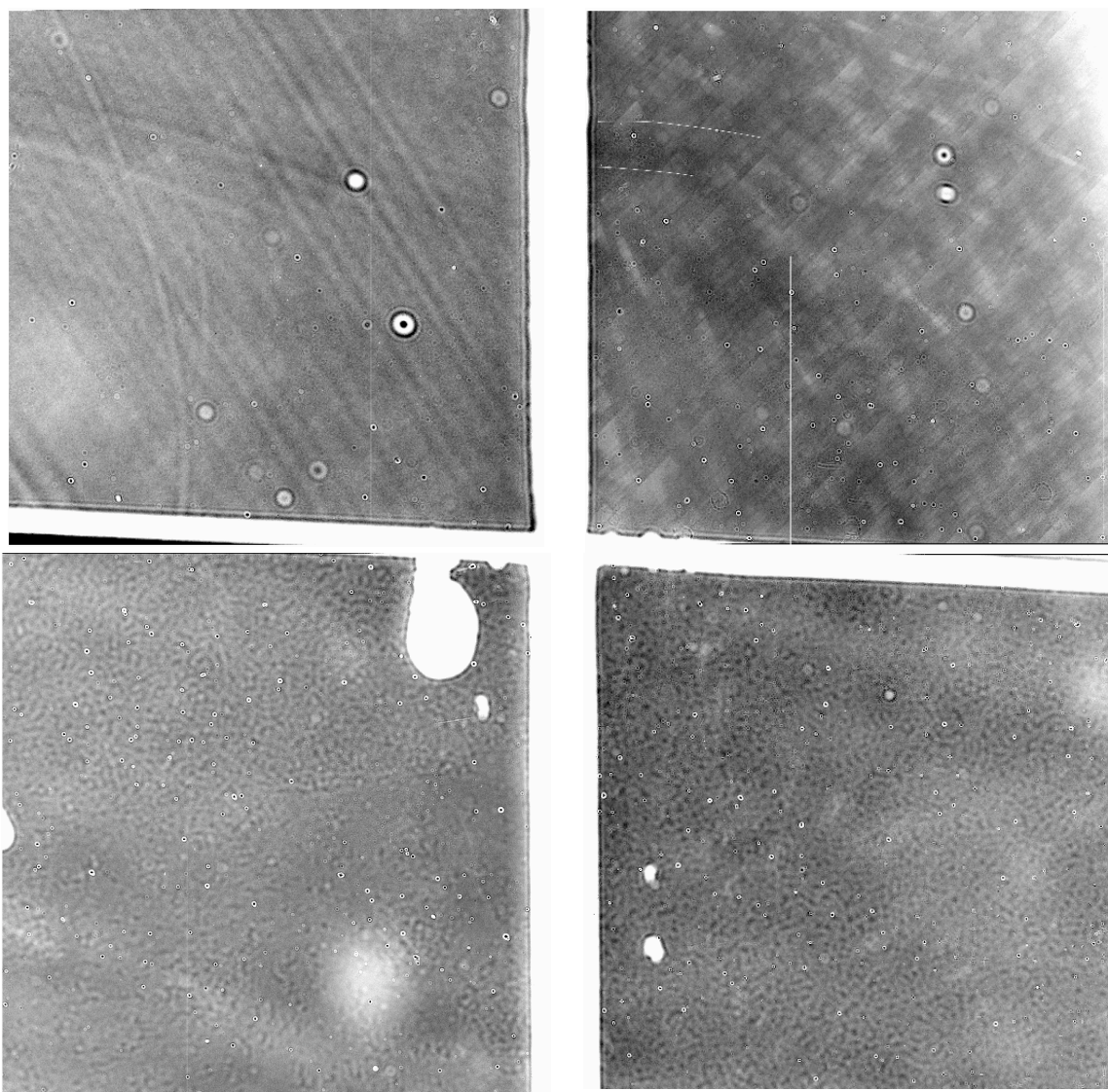
Figure 9: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flat fields for the quad1 filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ437N filter, filter FQ378N is in quadrant B, FQ232N and FQ243N are shown in quadrant C and D respectively.
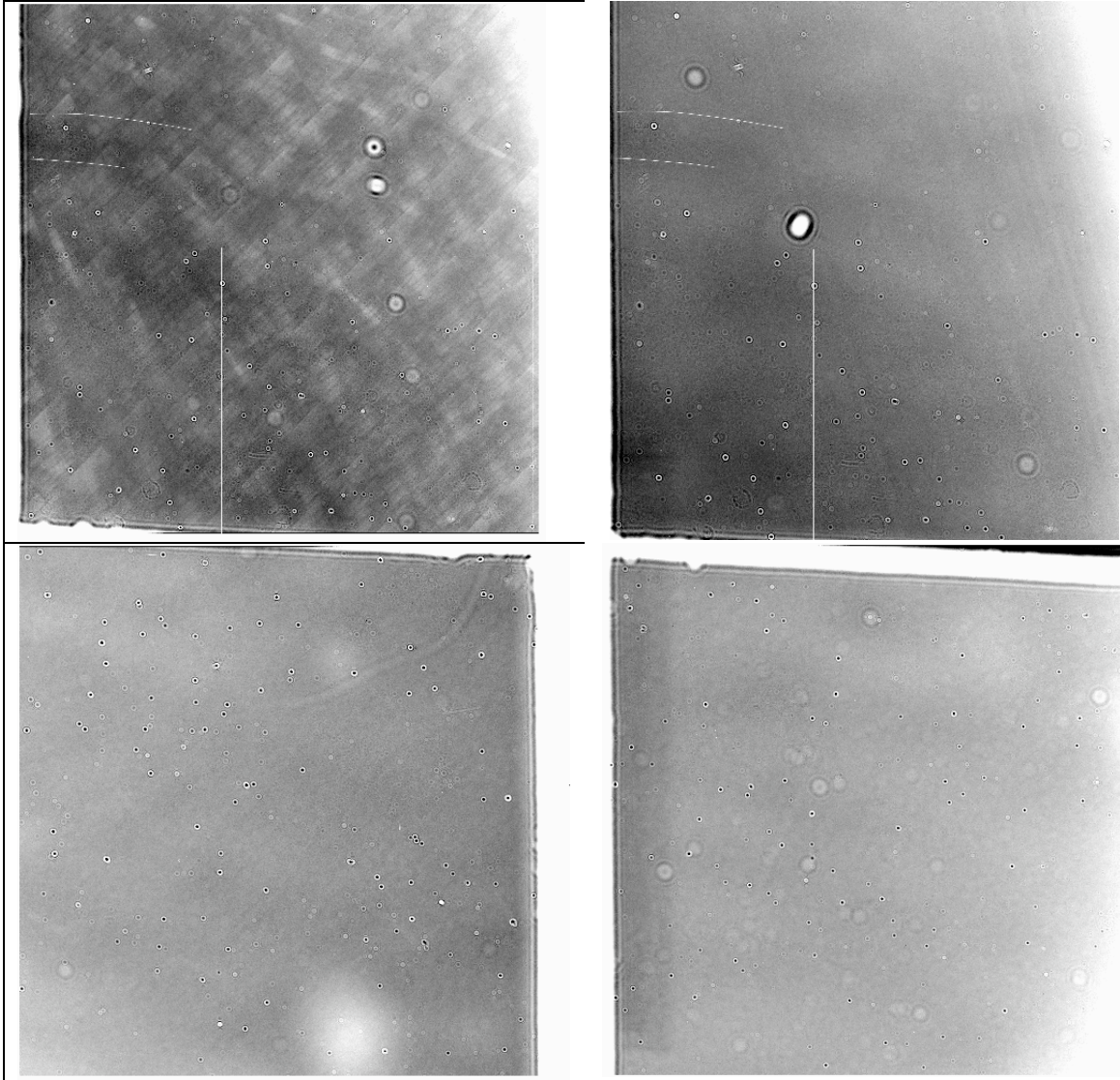
Figure 10: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flatfields for the quad2 filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ387N filter, filter FQ492N is in quadrant B, FQ422M and FQ436N are shown in quadrant C and D respectively.
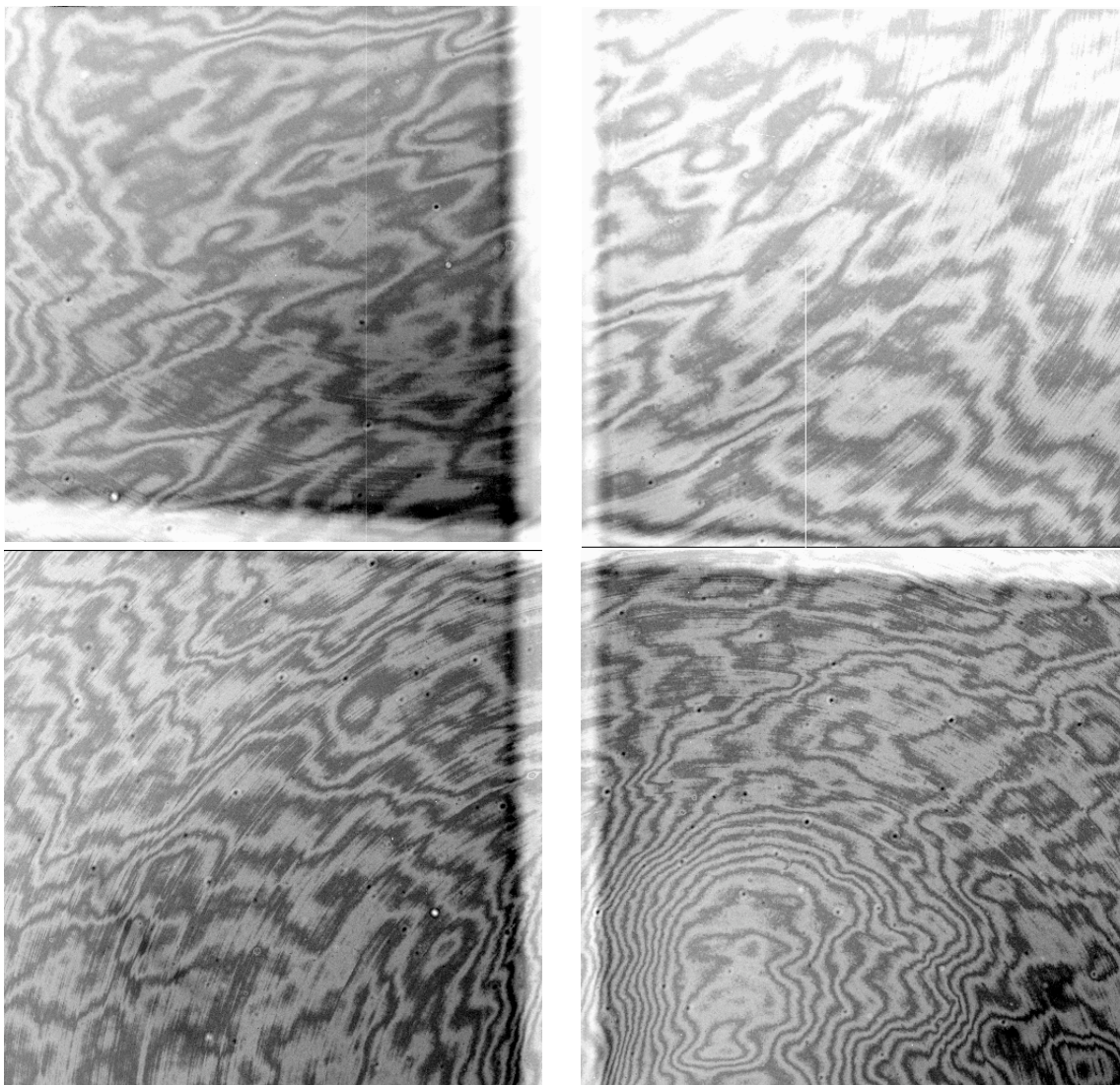
Figure 11: From left to right, from top to bottom: Full-frame, four-amp readout calsystem flat fields for the quad3 filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ889N filter, filter FQ937N is in quadrant B, FQ906N and FQ924N are shown in quadrant C and D respectively.
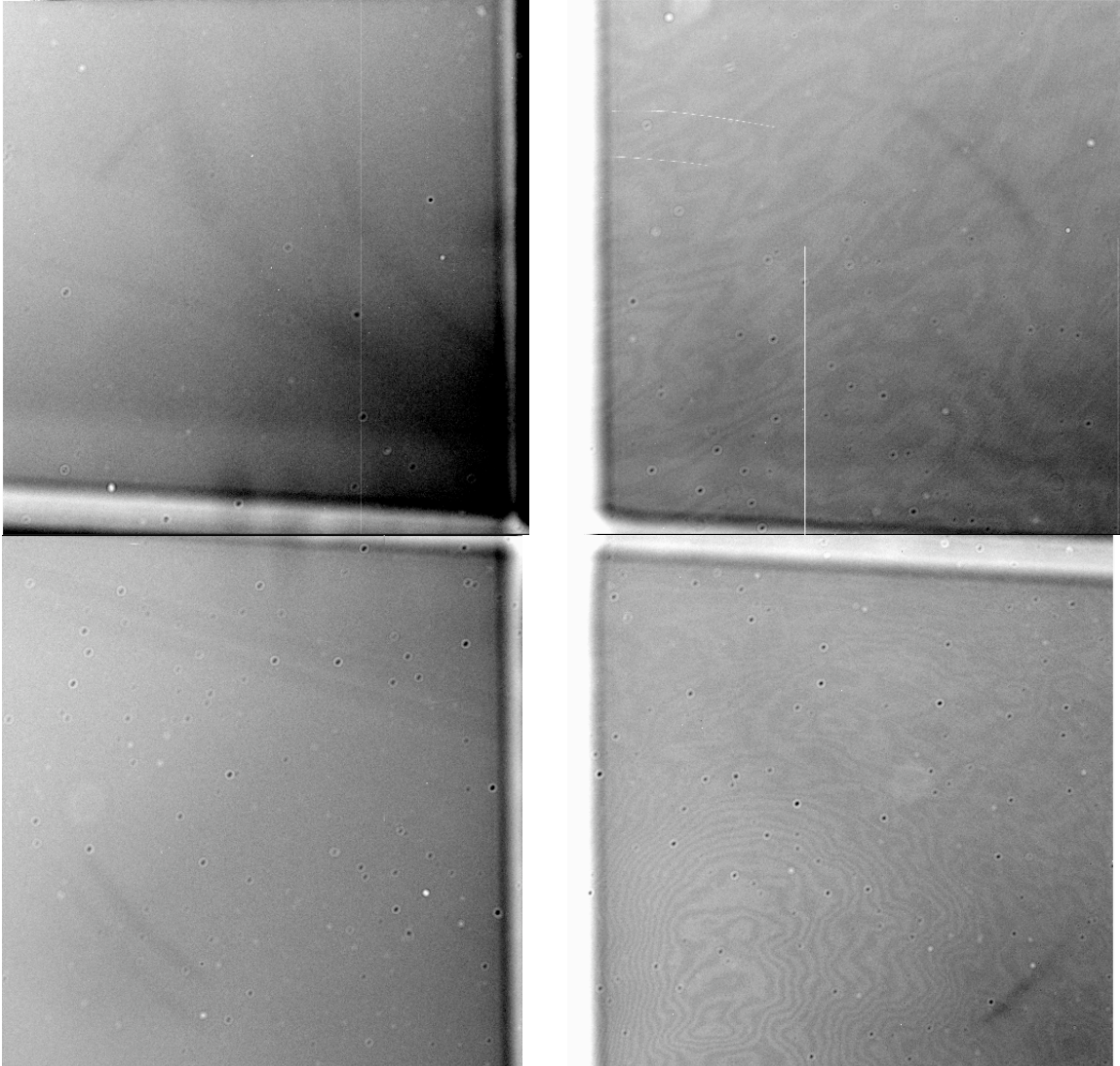
Figure 12: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfields for the quad4 filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ619N filter, filter FQ750N is in quadrant B, FQ634N and FQ727N are shown in quadrant C and D respectively

References

Sabbi, E. "UVIS CASTLE Photometric Filter Flat Field Atlas", ISR 2008-12, June 2008