UVIS CASTLE Photometric Filter Flat Field Atlas

E. Sabbi
June 09, 2008

ABSTRACT

During WFC3 thermal-vacuum (TV3) testing in 2008, the UVIS20 procedure, "UVIS Flat Fields", was executed under thermal-vacuum conditions.
CASTLE flat field images in all the UVIS channel filters have been acquired. This report presents an atlas of the most recent flat fields for all the UVIS photometric filters with the aim to present the characteristics illumination patterns and features.

Introduction

Reference flat fields — images taken while the detector is uniformly illuminated — with every UVIS photometric filter have been obtained at Goddard Space Flight Center under thermal vacuum environmental (TV3) conditions, as part of the WFC3 calibration plan, between February and April 2008. The CASTLE Optical Stimulus (OS) system was used to provide flat field illumination. The flight detector used in the original 2004 TV tests (UVIS-1) was rebuilt to replace its thermoelectric cooler, and subsequently renamed UVIS-1'. UVIS-1' is currently installed in the instrument, replacing the spare detector in use during 2007 (UVIS-2).

The acquired flat fields will be used for initial on-orbit calibration, to identify cosmetic defects in either filters or CCD detectors, and generate reference images for the WFC3 calibration pipeline.

Here we present an atlas of all the UVIS tungsten, Xenon, and Deuterium flat fields to show the typical structures of each photmetric 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 wavelengths a quilt pattern is visible in both the CCDs, flat fields become more homogeneous at wavelengths longer than $\lambda \sim 500$ nm. Around $\lambda \sim 600 - 700$ nm a diffuse dark spot appears in quadrant D; this is a QE feature, due to chip thickness rapidly changing in this area. Narrow band filters redder than $\lambda > 600$ nm are affected by fringing. The effect is particularly evident in the F953N filter (Figure 15).

The longest wavelength broad band flat fields show vertical striping, similar to piano keys.

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

UVIS CASTLE Flat Field Characteristics

The UVIS CASTLE flat fields presented were drawn from the UVIS20 TV program, i.e. image names are distinguished by the first four characters iu20.

The flat fields were full-frame, unbinned, nominal gain setting (1.5 e⁻/DN), default bias offset (setting 3, ~2500 DN), four-amp readouts. The majority of CCD images were taken at -81C. All images were processed through calwf3 pipeline, performing the obverscan 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 Figures 1. Images are presented in increasing wavelength.
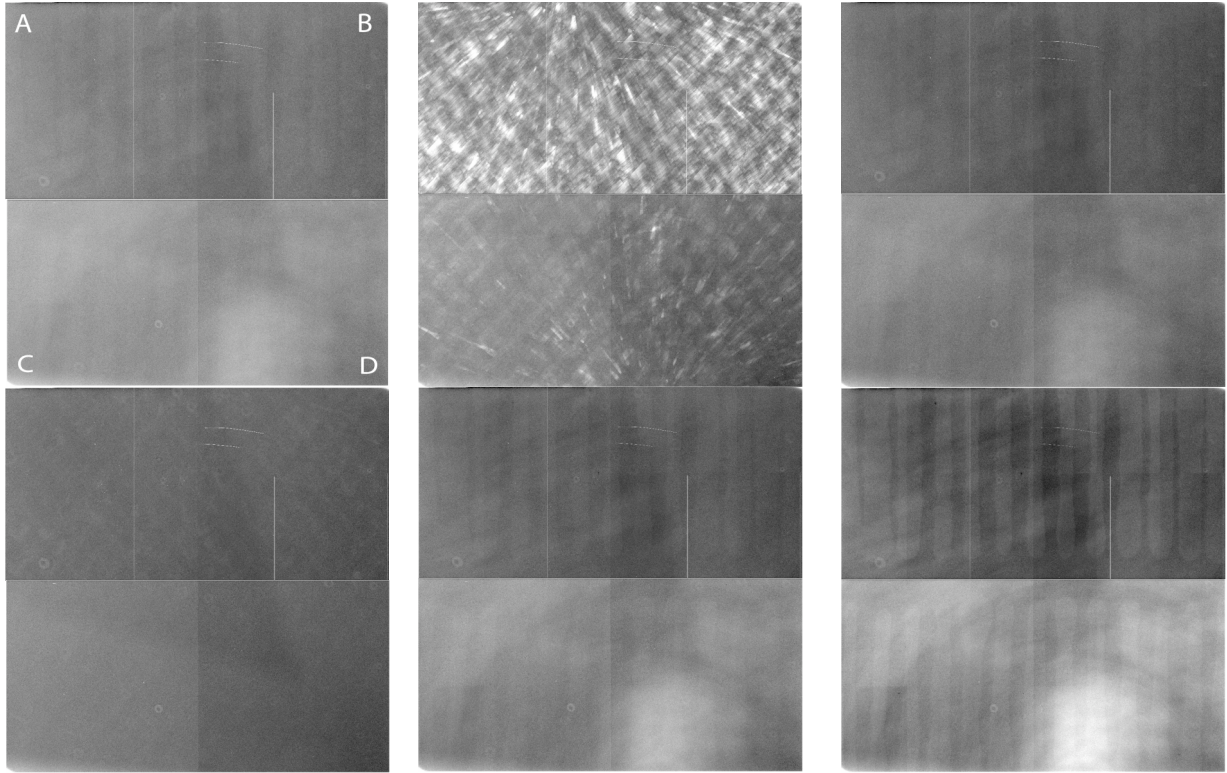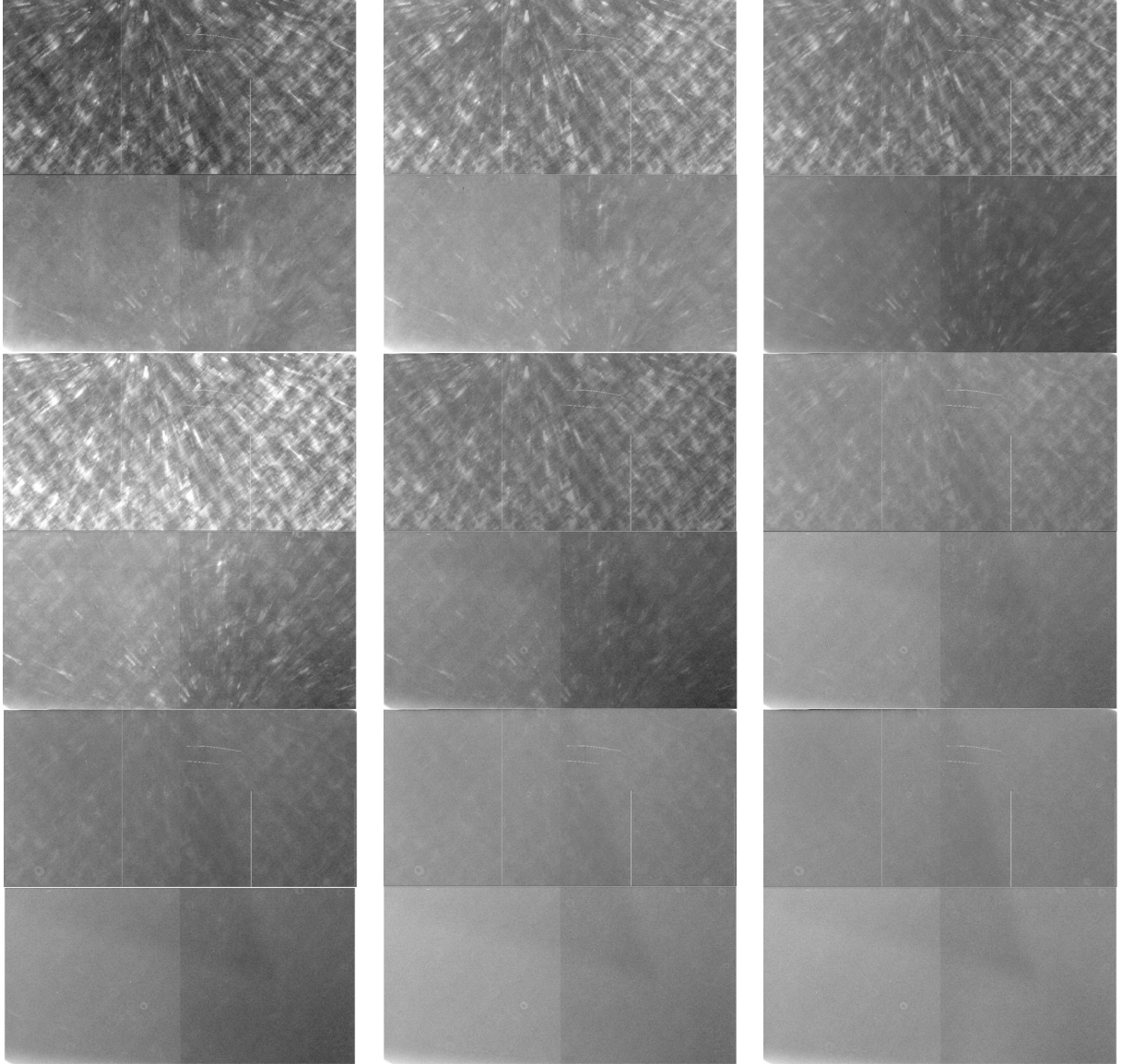

Figure 1: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfield in F200LP, F300X, F350LP, F475X, F600LP and F850LP,shown with stretch +/-10% with inverted greyscale.

Wide band filters

Typical UVIS flat fields for wide band photometric 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 CASTLE flatfield in F218W, F225W, F275W, F336W, F390W, F438W, F475W, F555W and F606W. All flat fields are shown with stretch +/-10% with inverted greyscale, with the exception of F225W (stretch +/-20%).
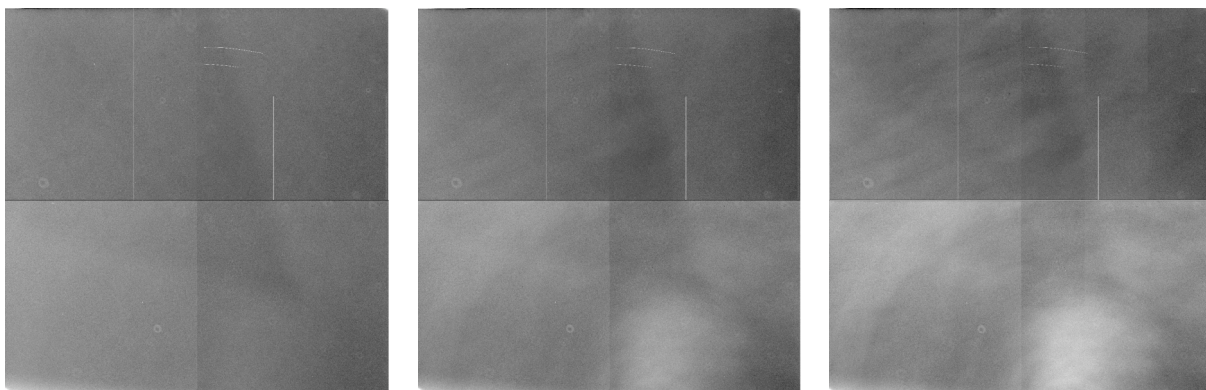
Figure 3: From left to right: Full-frame, four-amp readout CASTLE flatfield in F625W, F775W, and F814W, shown with stretch +/-10% with inverted greyscale.

Medium band filters

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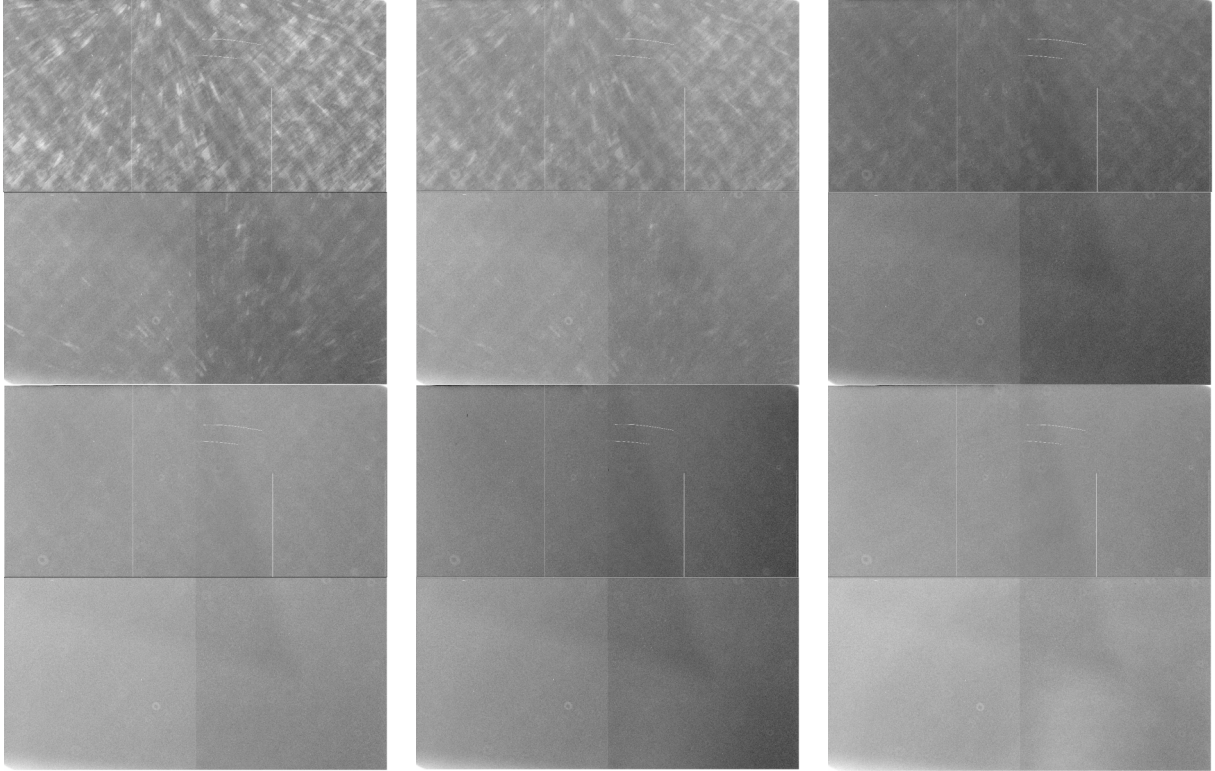

Figure 4: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfield in F390M, F410M, F467M, F547M, F621M and F689M, shown with stretch +/- 10% with inverted greyscale.
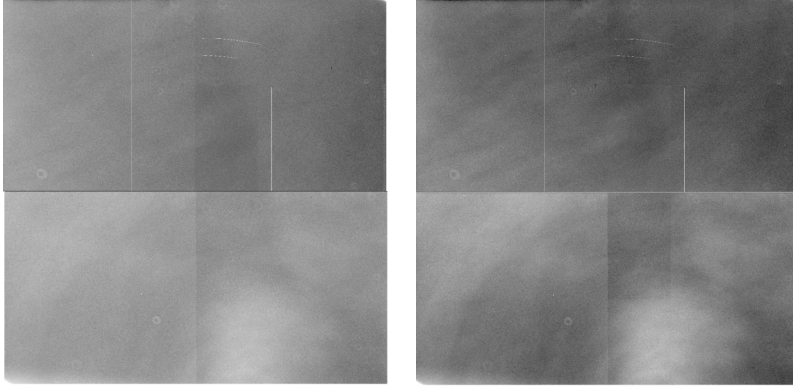
Figure 5: From left to right: Full-frame, four-amp readout CASTLE flatfield in F763M, and F845M, shown with stretch +/-10% with inverted greyscale.

Narrow band filters

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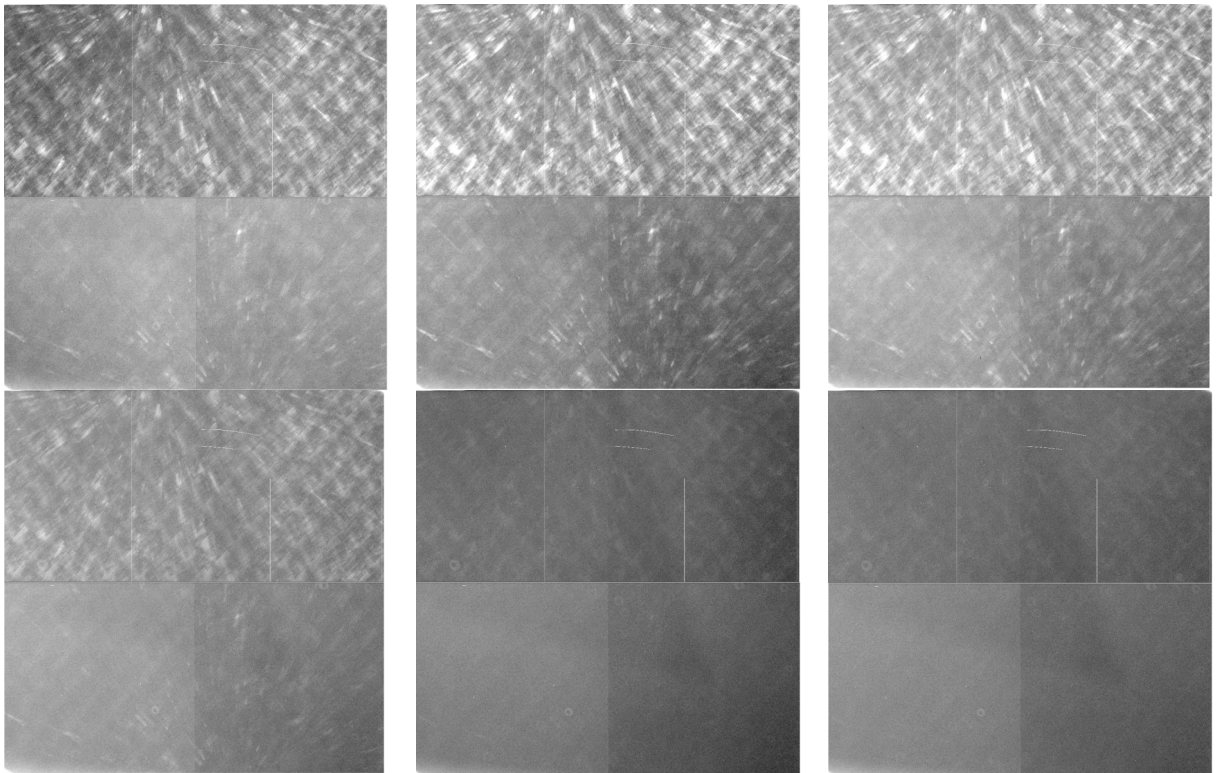

Figure 6: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfield in F280N, F343N, F373N, F395N, F469N, and F487N, shown with stretch +/-10% with inverted greyscale
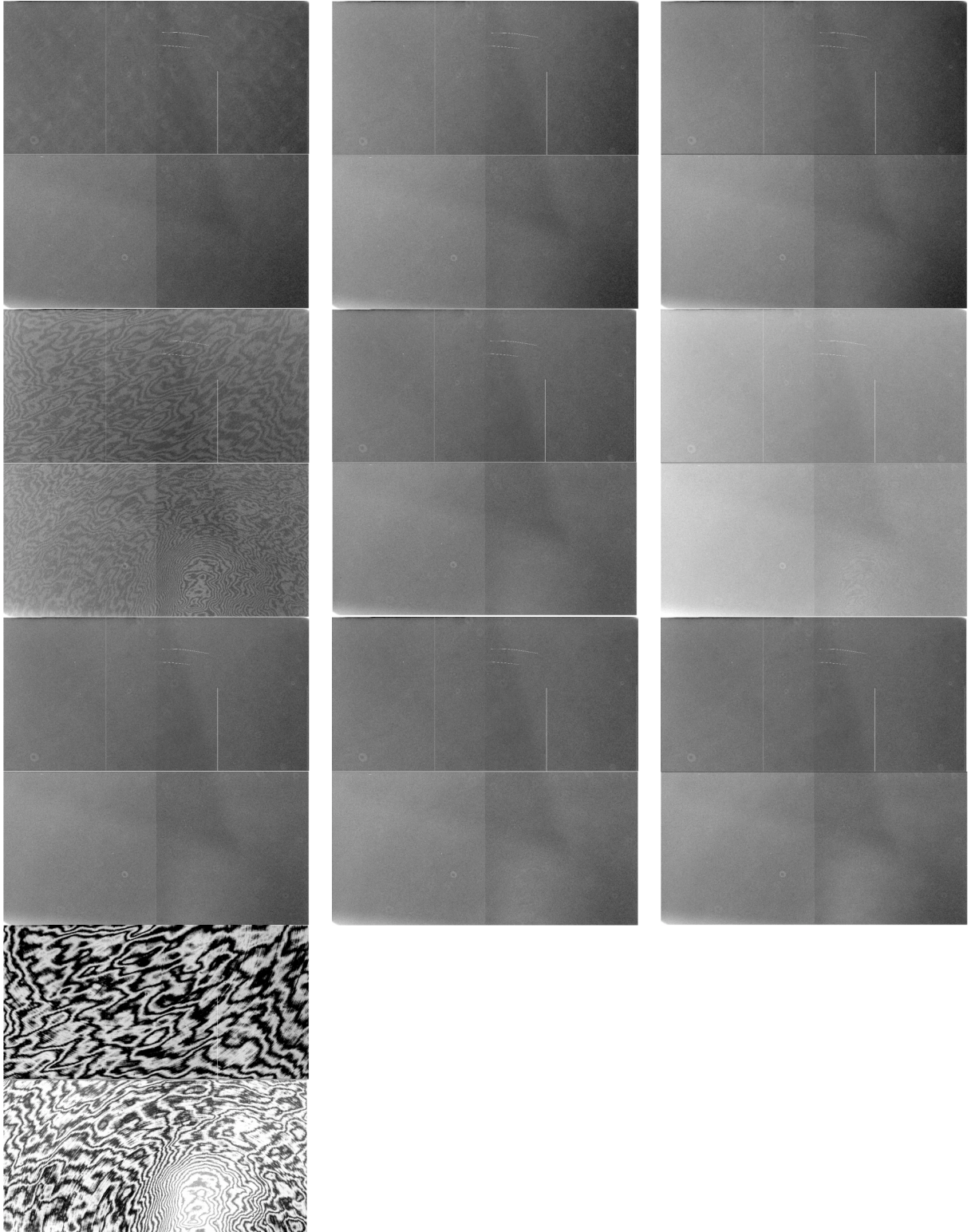
Figure 7: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfield in F395N, F469N, F487N, F502N, F631N, F645N, F656N, F657N, F658N, F665N, F673N, F680N, and F953N, shown with stretch +/-10% with inverted greyscale.

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.
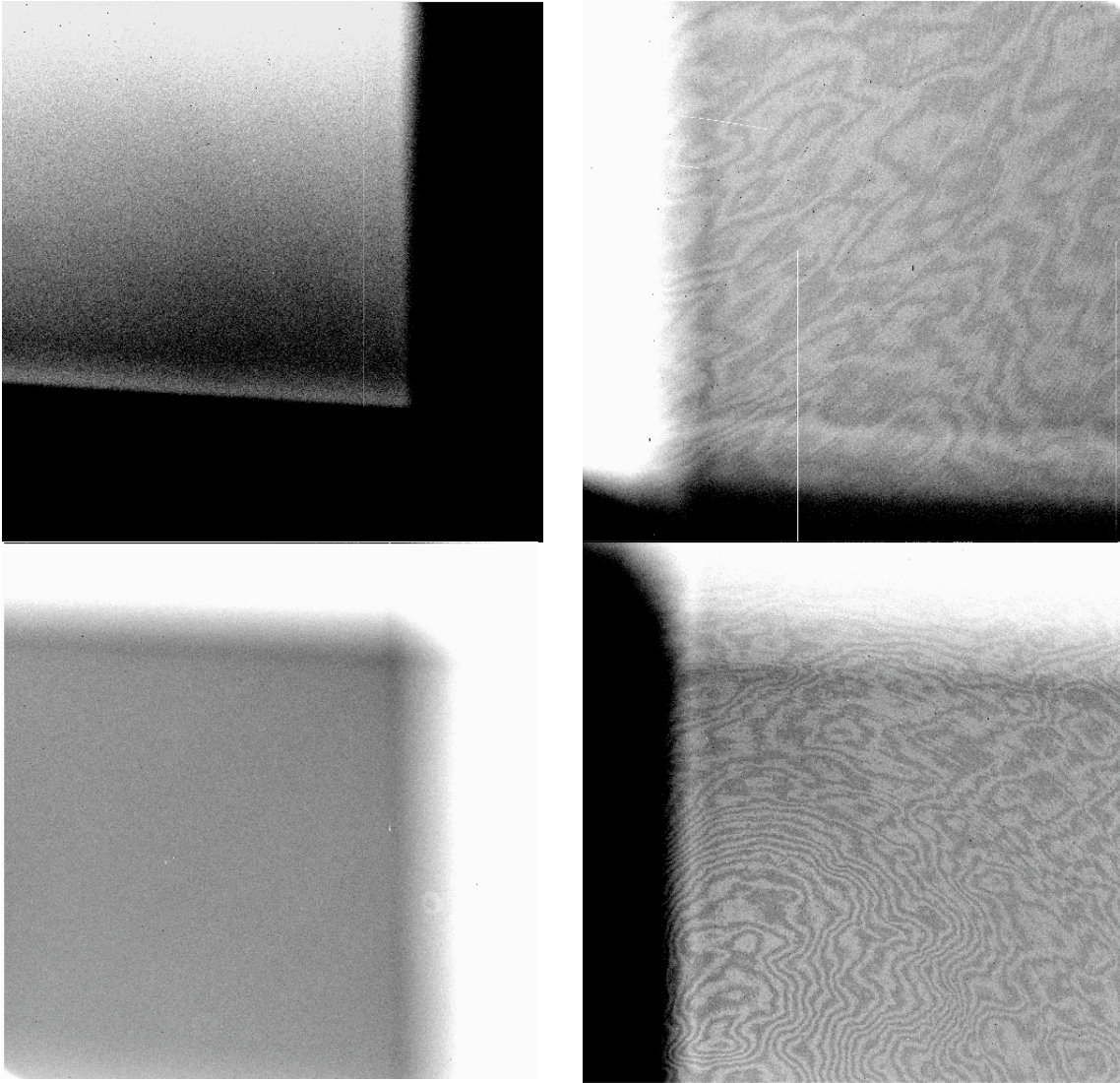

Figure 8: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfields for the quad filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ508N filter, filter FQ674N is in quadrant B, FQ575N and FQ672N are shown in quadrant C and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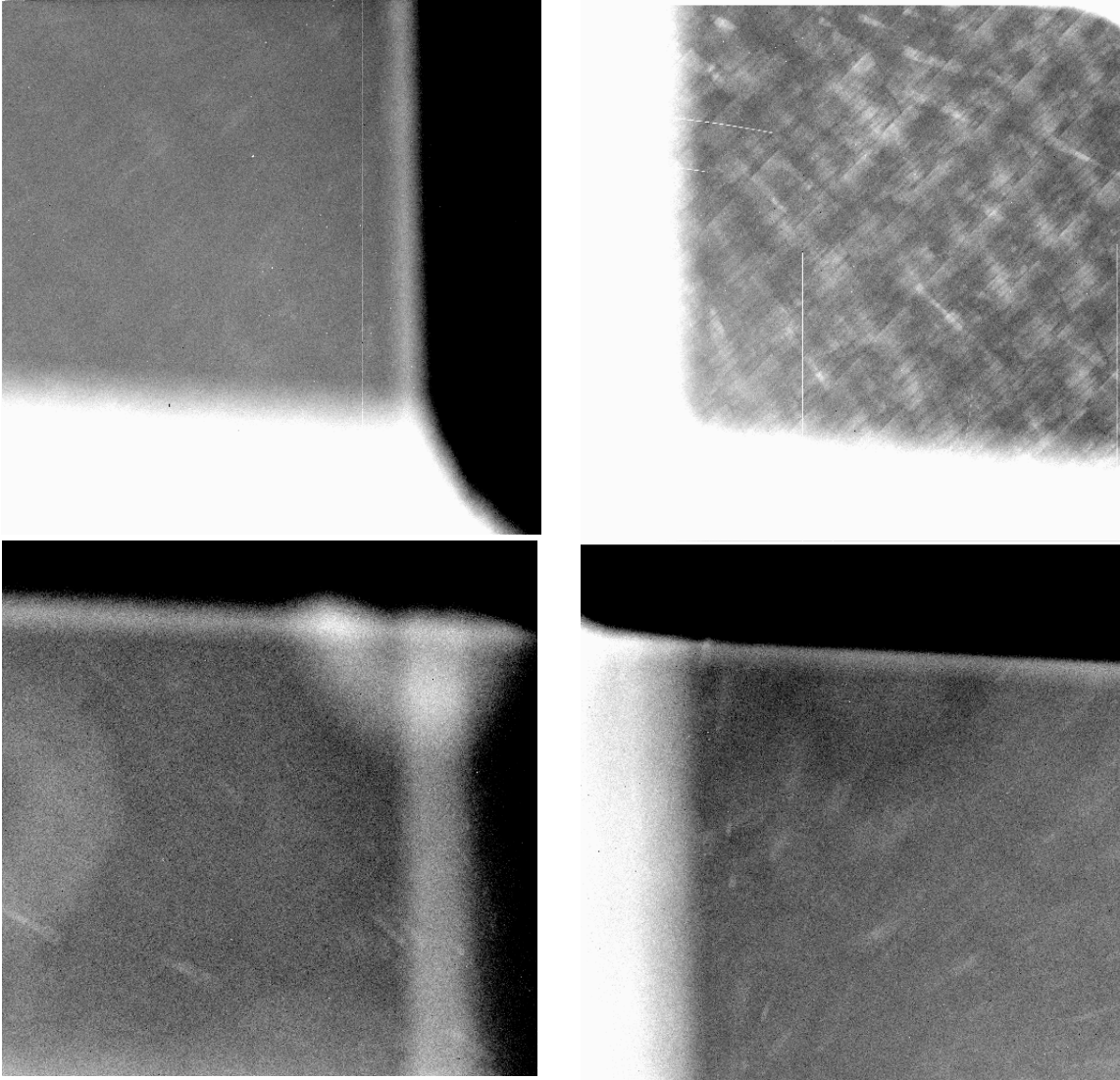
Figure 9: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfields for the quad1 filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ437N filter, filter FQ378N is in quadrant B, FQ232N and FQ243N are shown in quadrant C and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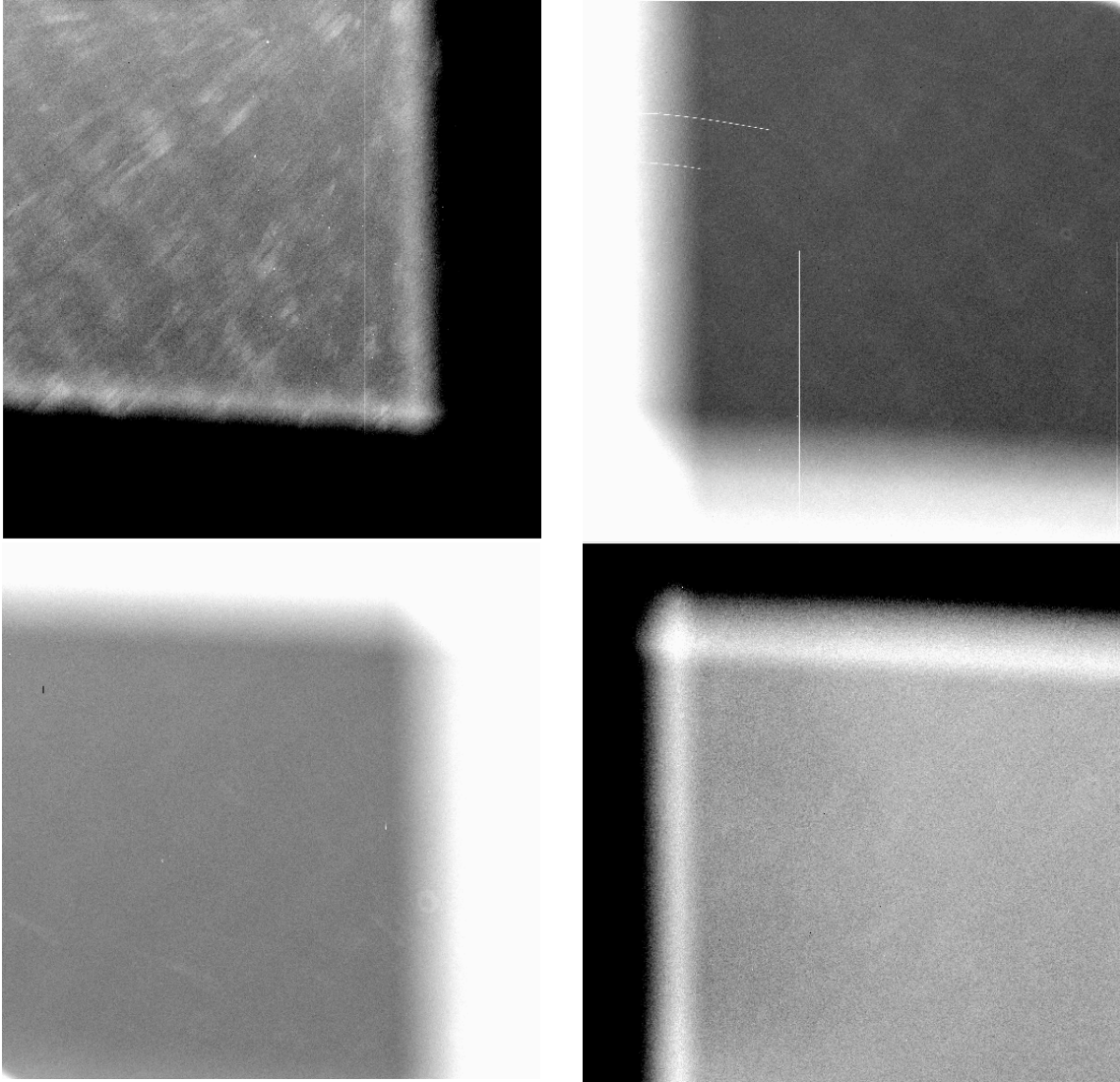
Figure 10: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfields for the quad2 filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ387N filter, filter FQ492N is in quadrant B, FQ422M and FQ436N are shown in quadrant C and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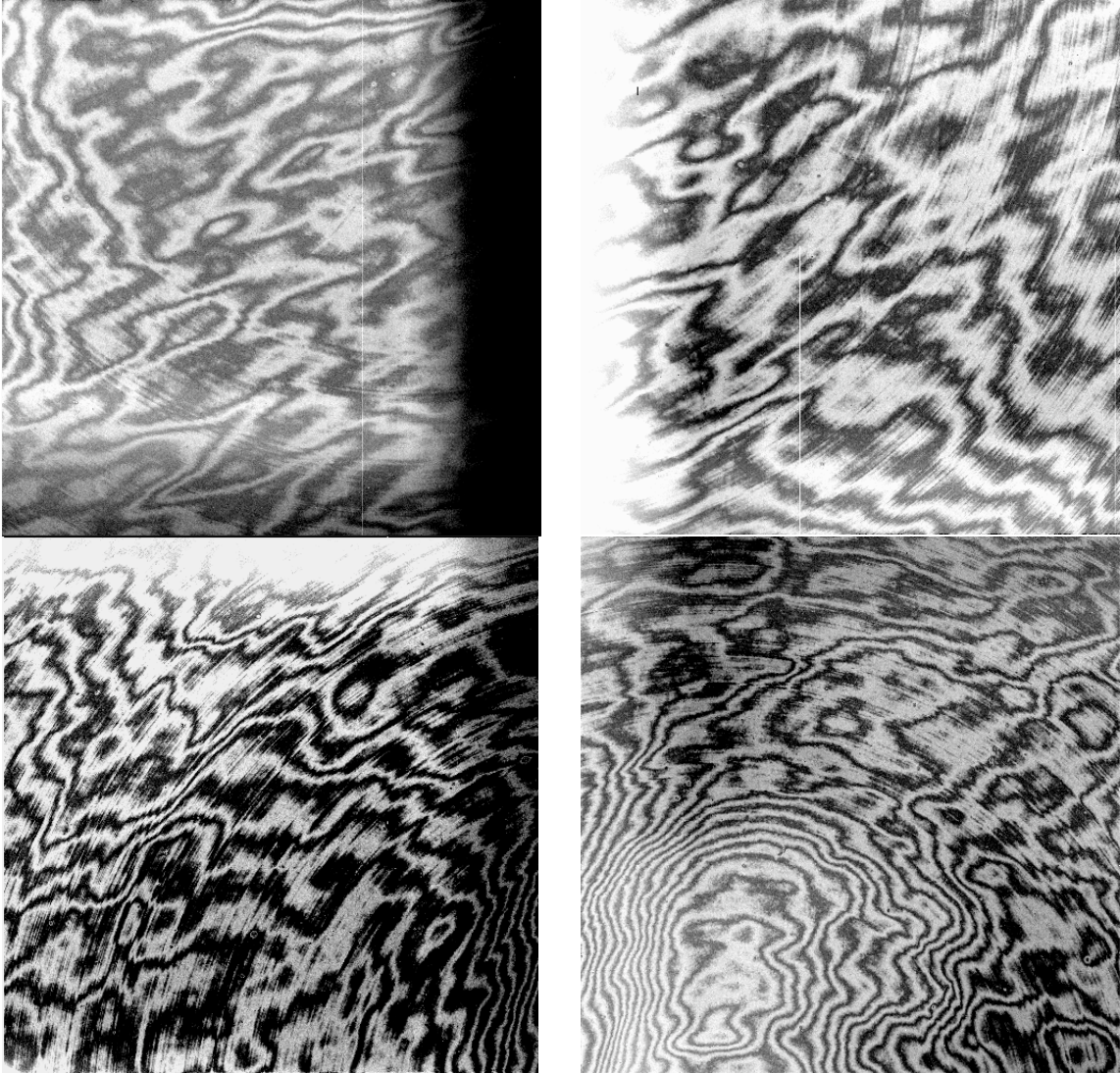
Figure 11: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfields for the quad3 filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ889N filter, filter FQ937N is in quadrant B, FQ906N and FQ924N are shown in quadrant C and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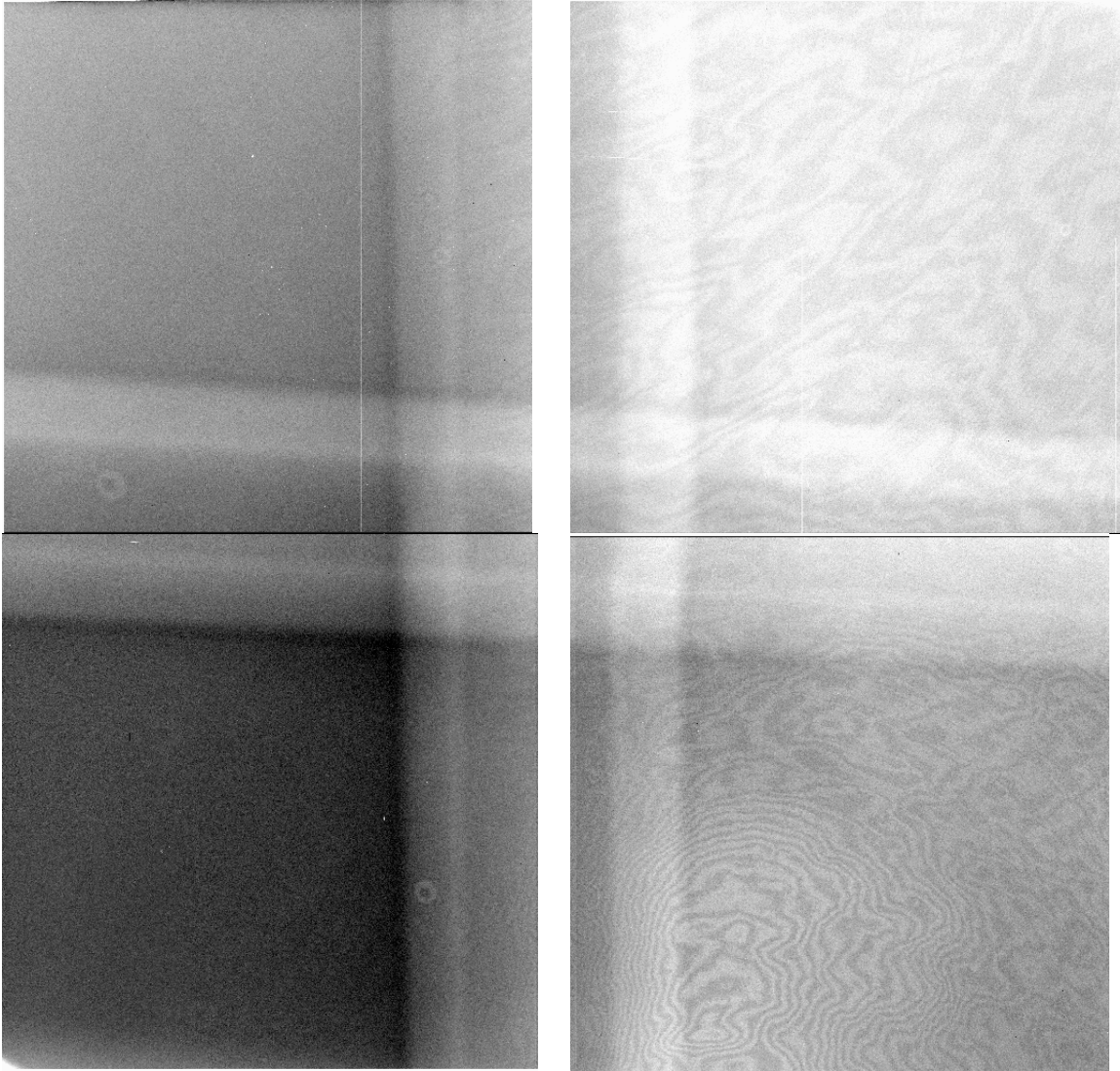
Figure 12: From left to right, from top to bottom: Full-frame, four-amp readout CASTLE flatfields for the quad4 filter. Flat fields are shown with +/-20% stretch, with inverted grey scale. Quadrant A shows the FQ619N filter, filter FQ750N is in quadrant B, FQ634N and FQ727N are shown in quadrant C and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