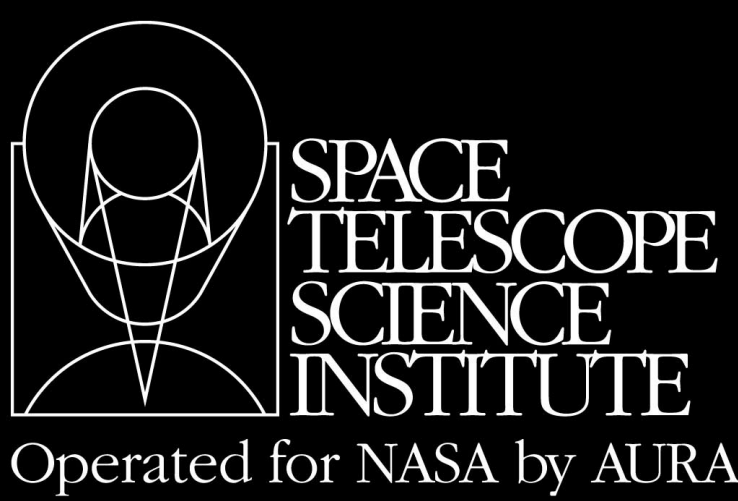# AstroDrizzle:  A Guide to Creating HST Mosaics

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**Abstract:** AstroDrizzle is a new tool for combining HST images and removing geometric distortion. It is part of a suite of tasks in the new package DrizzlePac, *now available* from STScI. Using these new tools, we demonstrate a strategy for creating mosaics from HST images when very little overlap exists between tiles.

**Observations:** As part of the WFC3 Early Release Science observations (Prop ID 11360), a 2-point mosaic of M83 was obtained in 15 filters. Within each tile, 3 images with small dithers were obtained, to fill the gap between the two UVIS chips and to allow for rejection of cosmic rays and detector artifacts.

| Position | Date | Orient | Image | Dither (arcsec) |
|---|---|---|---|---|
| Tile 1 | Aug 2009 | 350 deg | 1 A | 0.00, 0.00 |
| | | | 1 B | 1.45, 2.93 |
| | | | 1 C | -1.45, -2.93 |
| Tile 2 | Mar 2010 | 175 deg | 2 A | 0.00, 0.00 |
| | | | 2 B | 1.45, 2.93 |
| | | | 2 C | -1.45, -2.93 |

## Summary of Steps:

1. <u>T</u>weakReg - improve the alignment for images in a given tile (filter)

2. <u>A</u>stroDrizzle - combine images in a given tile

3. <u>T</u>weakReg - improve the alignment between tiles using high S/N drizzled frames

4. <u>T</u>weakback - propagate the "tweaked" solutions back to the original input files

5. <u>A</u>strodrizzle - create final mosaic, aligned to < 0.1 pixel accuracy

6. Repeat for additional filters
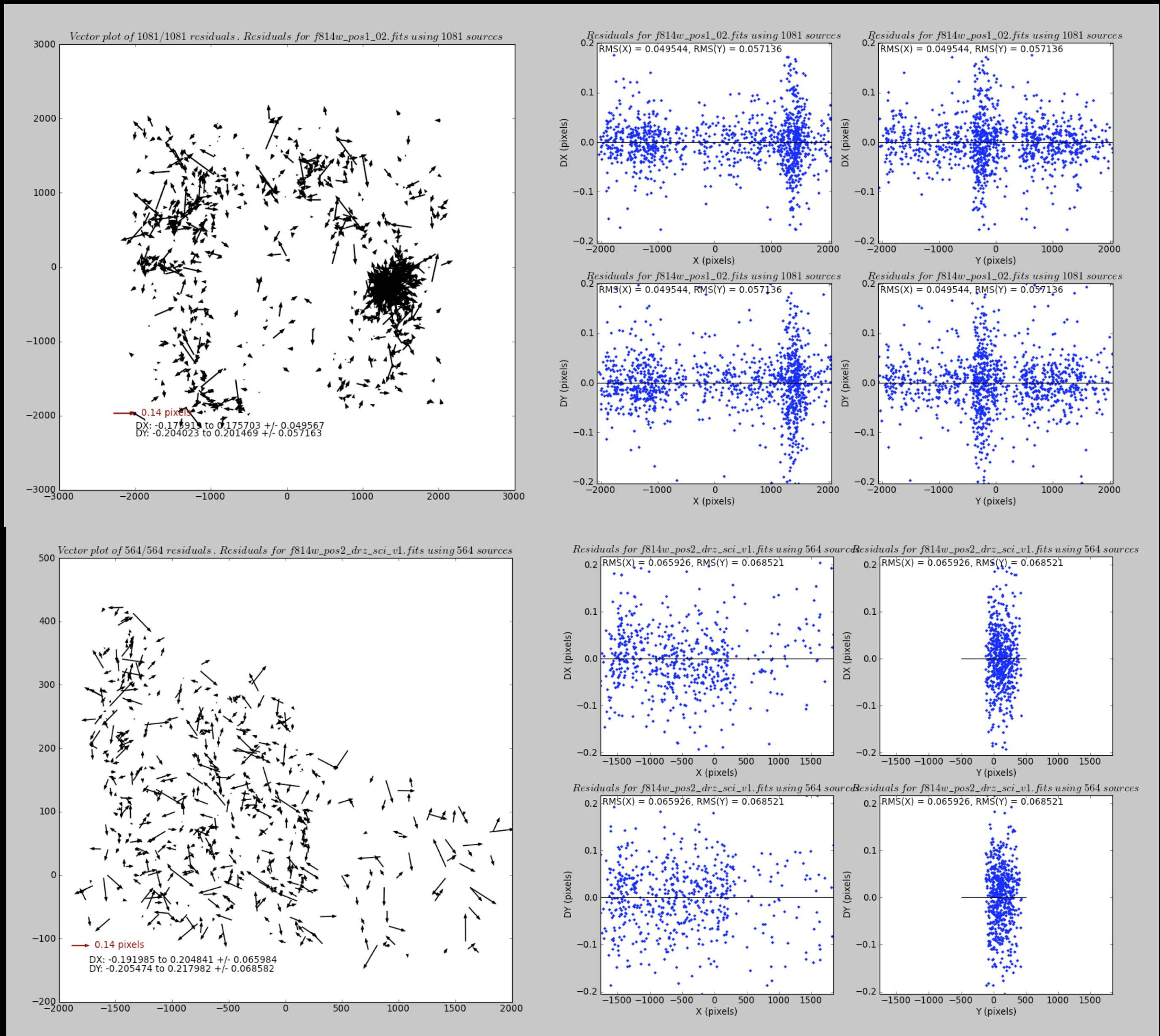
**For more examples, see the DrizzlePac Webpage**

**drizzlepac.stsci.edu**

**Tweakreg** provides an automated interface for computing <u>residual offsets</u> between exposures corresponding to <u>pointing differences</u> after applying the WCS information from the image headers.

**AstroDrizzle** automates the process of <u>aligning</u> images, removing <u>distortion</u> and <u>cosmic-rays</u>, and <u>combining</u> frames to form a high S/N composite. When dithering was part of the observing strategy, the <u>resolution</u> of the drizzled image can usually be improved.



F438W    F657N    F814W
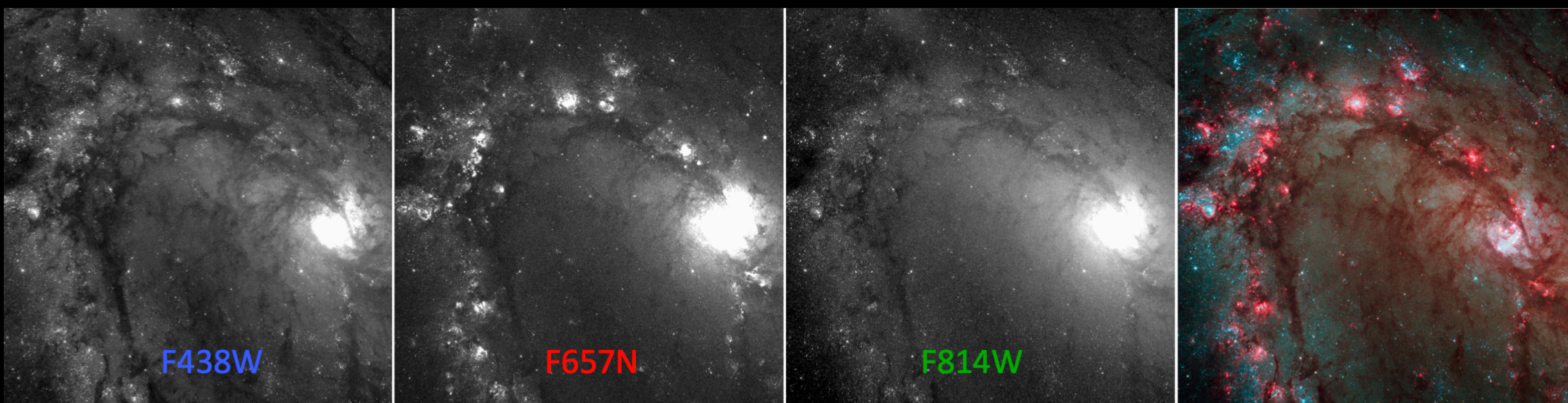
**Single Tile Alignment:**   M83 was observed in 15 filters (both WFC3 UVIS & IR detectors). The individual filters were aligned with TweakReg and then combined with AstroDrizzle. A subset of 5 filters were then used to create this color composite of the central portion of the galaxy (Tile 1 in the mosaic).

## AstroDrizzle: Final Mosaic & Weight Image



**Single Tile Alignment:**

(Same visit → tiny residuals)
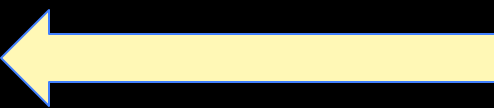
| Image | dX, dY (pixels) | dROT (degrees) | Fit rms |
|---|---|---|---|
| 1 A | 0.00, 0.00 | 0.0000 | 0.000, 0.000 |
| 1 B | -0.06, -0.08 | 0.0001 | 0.050, 0.057 |
| 1 C | -0.05, -0.02 | -0.0002 | 0.045, 0.054 |

**Tile-to-Tile Alignment**

('Triangular' overlap region
Different visits → large residuals)
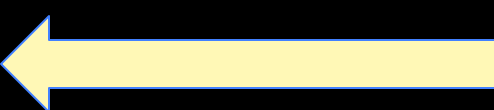
| Tile | dX, dY (pixels) | dROT (degrees) | Fit rms |
|---|---|---|---|
| 1 | 0.00, 0.00 | 0.0000 | 0.000, 0.000 |
| 2 | -0.06, -0.08 | -0.0161 | 0.066, 0.069 |

**TweakReg vector plot :**  shows the location of matched sources, with the size and direction of the fit residuals.

**TweakReg astrometric residuals :**  show the *x* and *y* components of the fit residuals vs. position (useful for spotting alignment issues.)

**F**inal drizzled mosaic of M83 in F438W. The two tiles are aligned to 0.07 pixels. The sky background has been manually computed to match between tiles, but future versions of AstroDrizzle will allow for automatic sky matching.

**Weight image** : an effective exposure time map, showing the number of images contributing to each pixel. The gap dither is seen, as well as pixels with DQ flags and cosmic rays which were rejected. The tiles were aligned using stars in the overlap region.