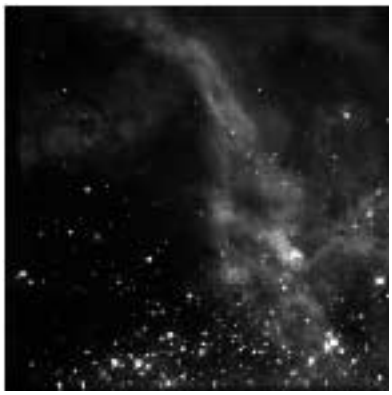
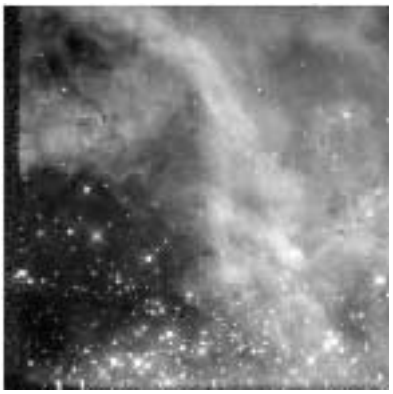
Image scaling renders maximum visible detail

Full data range
Black: -207
White: 16143

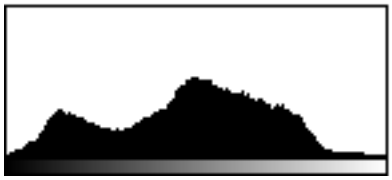


Clipped
Black: 0
White: 600

Clipped
Black: 0
White: 150



Logarithmic scale
Black: 5
White: 550



R136 (30 Doradus), F555W (V), WF2
HST • WFPC2

Automatically setting the smallest image value to be black and the highest value to white can force important areas of the image to be rendered invisible.

By selecting a minimum and maximum data value to render as black and white, repsectively, (clipping) the significant regions of the image can be made visible.

Clipping the bright end to a lower pixel value shows some detail, but fainter details still may not visible.

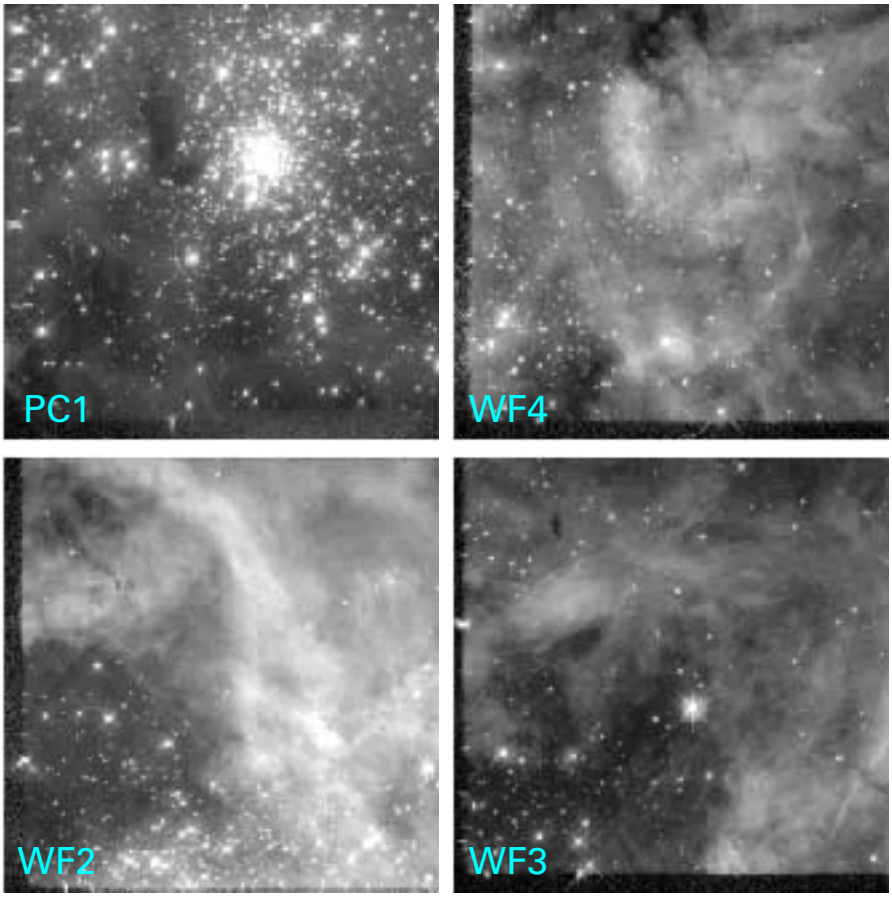
Clipping to still lower levels brings out fainter details but "saturates" (forces larger areas to be white) the bright regions.

Applying a non-linear (log, square root, etc.) transformation can compress the dynamic range so that more detail becomes visible. Fainter details can become visible without saturating the brihgtest regions.

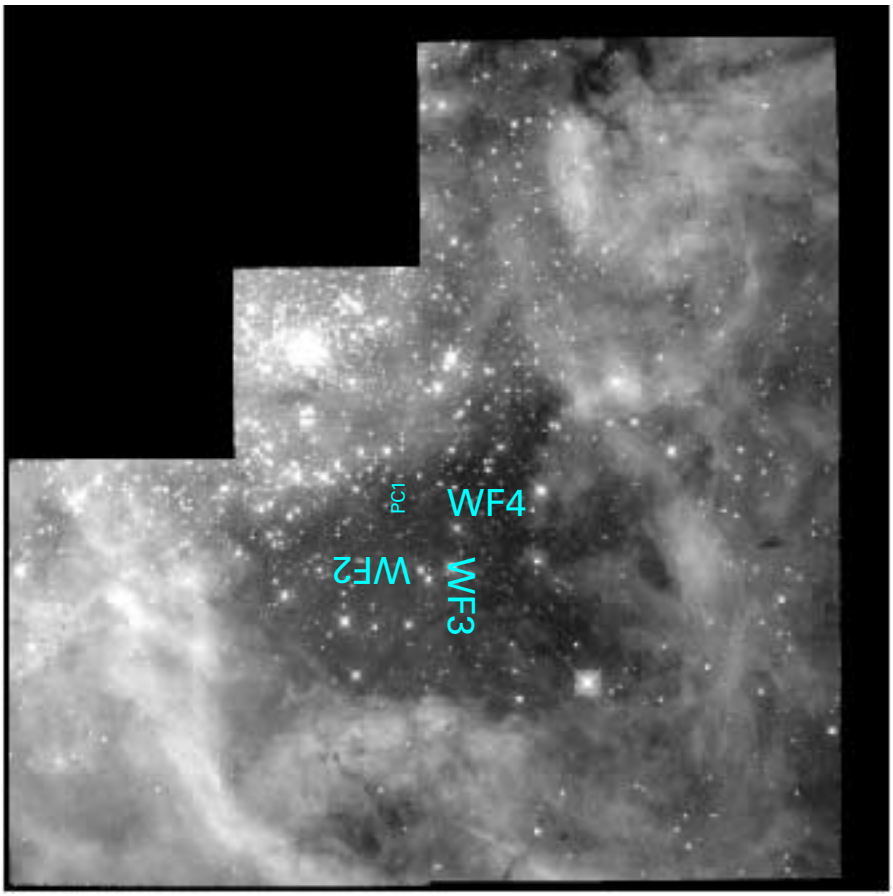
Histograms–plots of the numbers of pixels at each brightness value, showing the relative distribution of intensities–can be useful to guide the selection of clipping and intensity scaling.

A flatter histogram reflects more detail visible in all intensity levels. Intense peaks indicate a concentration of values at a particular brightness.

WFPC2 consists of four cameras



Individual WFPC2 Chips



Mosaic Image

R136, 30 Doradus F555W (V)
HST • WFPC2

HST's WFPC2 instrument contains four CCD detectors ("chips"), each producing an image 800x800 pixels. Three "wide-field" (WF) chips have a field of view of 2.5 minutes of arc. The fourth "planetary camera" (PC) chip sees an adjacent, narrower field of 35 seconds.

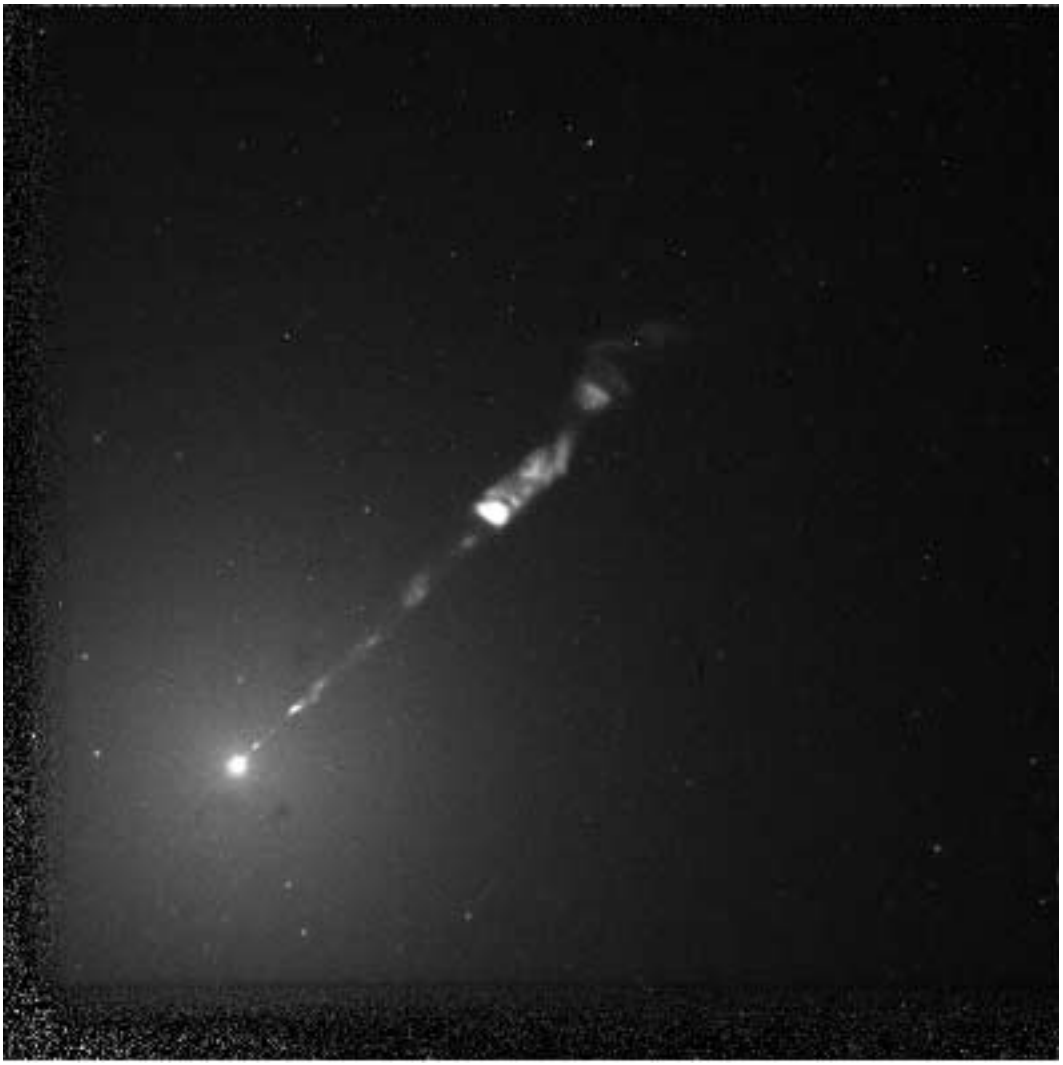
Because of the optical path, the resulting images are rotated with respect to each other. The separate images must be rotated and scaled to the same pixel scale before being combined into a mosaic.

The fields overlap somewhat but "seams" remain in the resulting mosaic images.

Cosmic Ray Removal

Individual “CR split” images

Resulting combined image



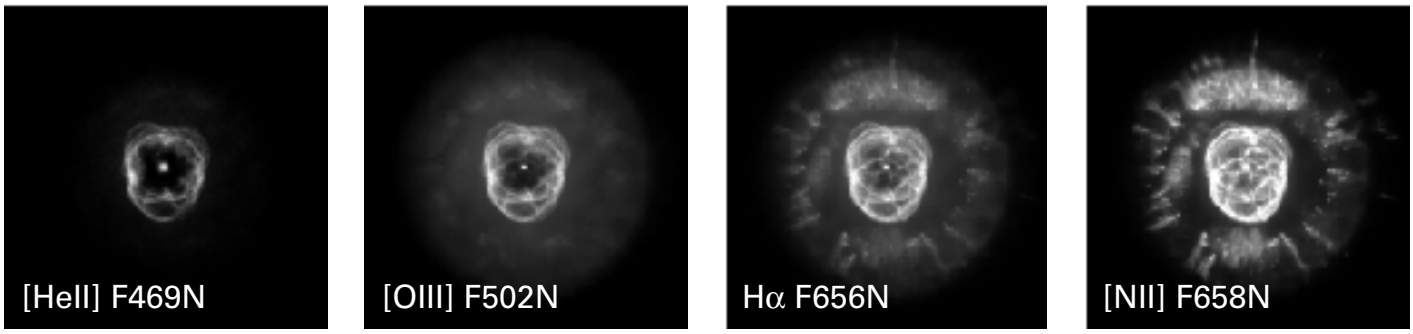
Bright, sharp spots and streaks from cosmic rays appear on every HST exposure. Multiple exposures at the same pointing allow the randomly-appearing noise to be removed relatively easily, as long as nothing else changed in the meantime (easier for non-variable deep space targets such as nebulae and galaxies rather than closer fast-moving solar-system targets).

“Good” pixels from one exposure replace “bad” (cosmic ray) pixels from another exposure in a combined image. Otherwise, the exposures add together exactly as if it were one longer exposure.

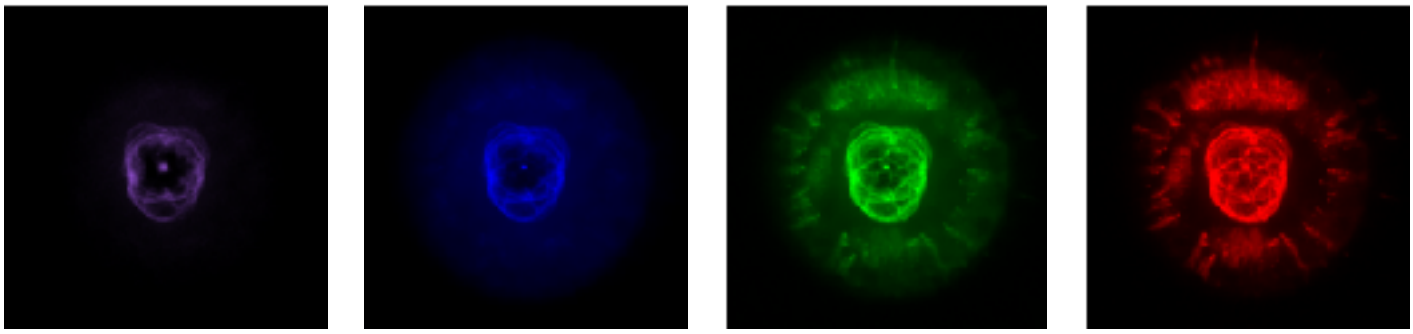
Combining separate exposures to produce a color image

Separate filter images

Grayscale



Colorized

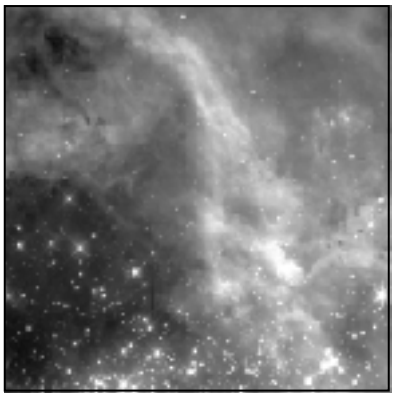


Resulting color composite

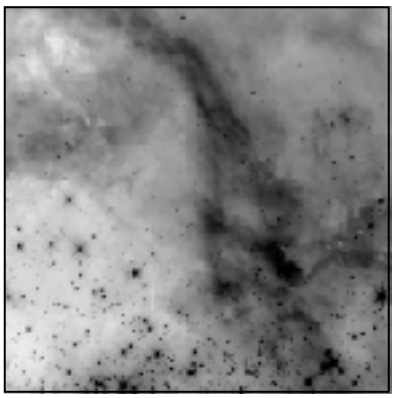
Separate images are exposed through different color filters. The resulting black and white or "grayscale" images are assigned a color that can be viewed or reproduced (that may or may not be the color of the filter used for the exposure). The separate images are combined in color image "channels" that together produce a full range of hues.

Using filters that match the eye's response can result in a natural or "true" color image. Otherwise, the colors are enhanced or shifted from what we would be able to see.

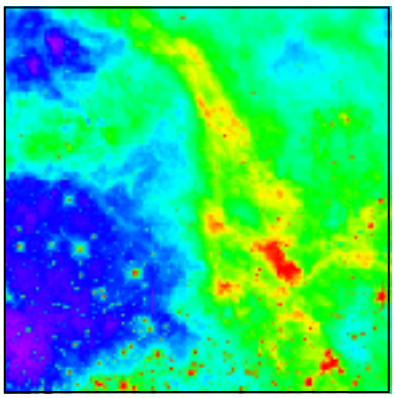
Color-mapped images

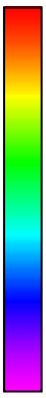


Positive black and white (grayscale)

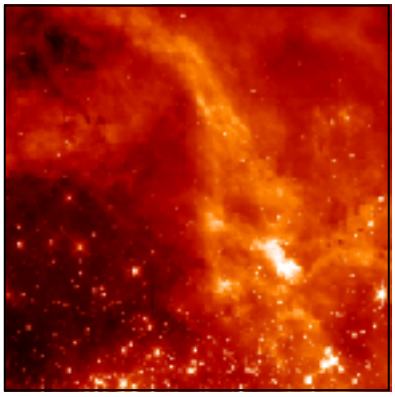


Negative black and white (grayscale). Features are often easier to see in black against a lighter background.



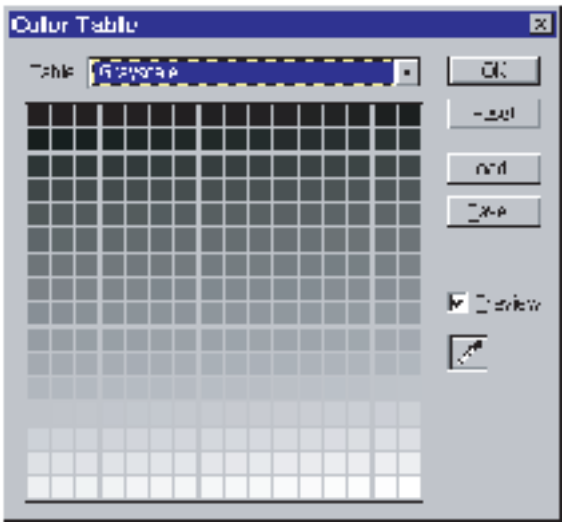


Color-mapped, variations in hue.



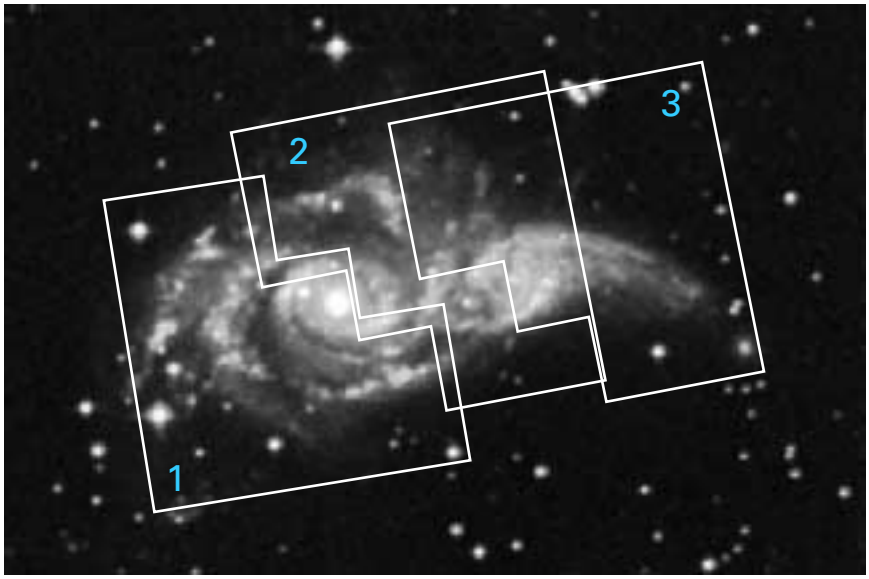
8 bit images contain 256 different values that may be represented by 256 shades of gray or 256 arbitrary colors.

Color Table Dialog



Combining multiple images to produce a wider field

Ground-based image with location of WFPC2 pointings



The relatively narrow field of view of the WFPC2 camera means that many targets overfill the image. Several carefully aimed exposures ("pointings") may be used to cover the image but must be combined afterward.

Overlapping areas can be cut around or combined. The resulting images retain the resolution of the individual WFPC2 fields.

WFPC2 images from separate pointings

Resulting composite panorama

IC 2163 and NGC 2207 • HST/WFPC2