



CCD FITS Files





CCD FITS Files

Overview

FITS stands for 'Flexible Image Transport System' and is the standard astronomical data format endorsed by both NASA and the IAU.

FITS is more than an image format (ex. PNG, JPG, or GIF). It is primarily designed to store scientific data sets consisting of multi-dimensional arrays (1-D spectra, 2-D images or 3-D data cubes) and 2-dimensional tables containing rows and columns of data.

FITS files are the end product of a CCD image of an astronomical object.



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CCD Image Example

A digital image, a FITS file, is a 2-D array of numbers where each number represents the amount of light captured.

All pixels will have a value due to light captured from the object and the sky background light with a max of 65,536.

Each entry is called an ADU – Analog-to-digital Unit, which is an arbitrary conversion of voltage, from an inbound photon, from each pixel in the CCD to a value.

The values are called Pixel Counts. Software, MaxImDL or any other FITS viewer, converts these Pixel Counts into a grayscale image

```
88  98 107 145 126  67  93 154 223 155 180 232 250 242 207 201
29  72 159 159 131  76  99 245 211 165 219 222 181 161 144 131
99 157 138  97 106  55 131 245 202 167 217 173 127 126 136 129
100 156 110 114  91  70 128 321 296 208 193 191 145 122 135 138
```



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FITS Headers

The “header” contains metadata.

Each header unit consists of any number of 80-character keyword records which have the general form: KEYNAME = value / comment string

Metadata is essentially data about the data:

- Data about the observation
- Date
- Time
- Position in the sky
- Telescope location
- Time
- And more.....

```
SIMPLE = T /FITS header
BITPIX = 16 /No.Bits per pixel
NAXIS = 2 /No.dimensions
NAXIS1 = 1059 /Length X axis
NAXIS2 = 1059 /Length Y axis
DATE = '18/09/98 ' /Date of FITS file creation
ORIGIN = 'CASB -- STScI ' /Origin of FITS image
PLTLABEL= 'E1593 ' /Observatory plate label
PLATEID = '07VR ' /GSSS Plate ID
REGION = 'XE173 ' /GSSS Region Name
DATE-OBS= '08/04/56 ' /UT date of Observation
UT = '09:25:00.00 ' /UT time of observation
EPOCH = 1.9562687988281E+03 /Epoch of plate
PLTRAH = 13 /Plate center RA
```



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Then what?

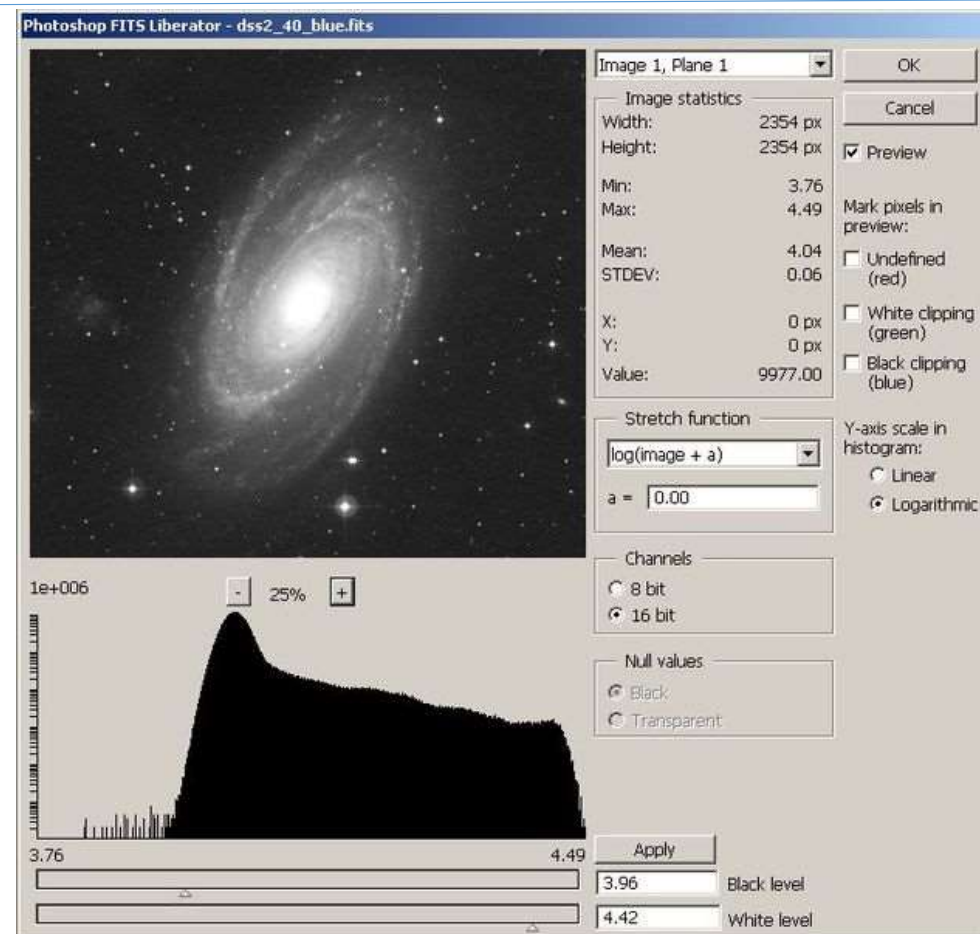
Once a FITS file has been obtained from a camera, through software, they can be processed:

- Into color images through the use of filters (set before taking the exposure)
- Scientific image for measure
- Reduced: Flats, Darks, Bias
- Have WCS coordinates inserted
- Additional FITS Header lines inserted



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Sample: FITS Liberator



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Summary

In the course of astronomical studies and imaging, you will hear FITS headers discussed and referenced.

There is a significant amount of data contained in these headers.

Beyond the headers, the FITS files is simply a collection of the photon counts from a CCD camera.

FITS files are essential to astronomical imaging.



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Questions?