



# CCD IMAGING Image Reduction Overview





## CCD IMAGING - Image Reduction Overview

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### Overview

Each science image is subject to mechanical imperfections.

If these imperfections are not removed from each image, they will skew the data and provide erroneous measurements.

This class will talk about the basics of Image Calibration.

All images must be calibrated before they are to be used in any scientific process.



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### CCD Imaging Processing

Two fundamental steps:

1. Pre-Processing: When images are calibrated
2. Post-Processing: When images are digitally reduced: WCS Coordinates, removal of Cosmic Rays, Transformed, etc (This is the topic of another class)



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### **Calibration/Pre-Processing**

As reviewed in the CCD Basics class, CCD images are subject to imperfections. These imperfections have to be removed if the images are going to be scientifically useful.

The first step is to acquire three different types of images: Darks, Bias, and Flat-Fields

Once these three image types are removed from the science images, you have a calibrated frame



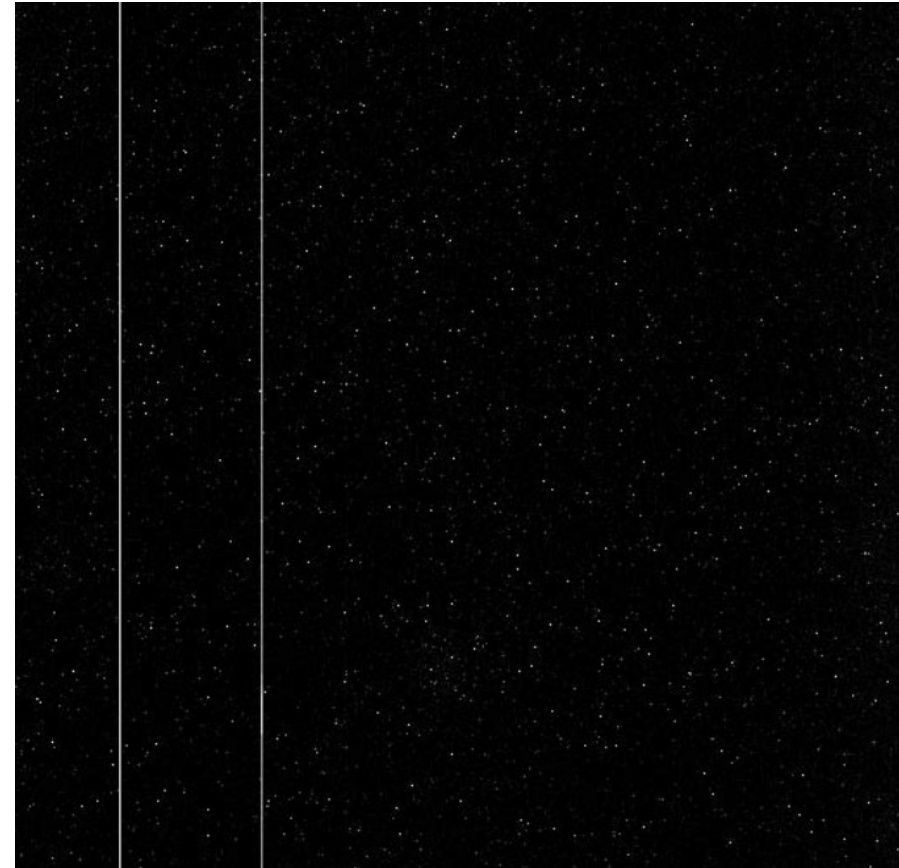
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### Dark Frame

A CCD image of equal time length and CCD temperature to that of your light exposure.

Recorded in complete darkness with the telescope covered or the CCD sensor covered so no ambient light can reach the chip.

This captures the thermal response and “hot” pixels inherent in the camera.





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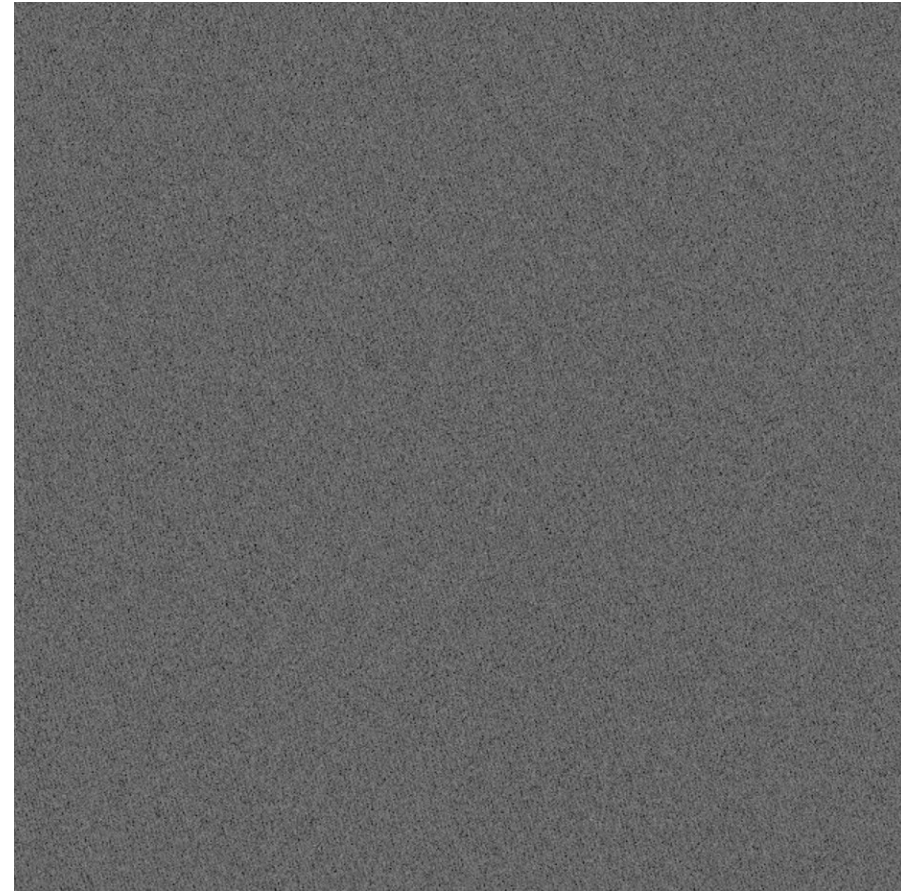
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### **Bias Frame**

This corrects for the noise level inherent in any CCD camera:  
Electronic Noise.

Created by recording a zero-length exposure with the shutter closed. This captures the noise produced by the camera.

Bias Frames are subtracted from Dark Frames.





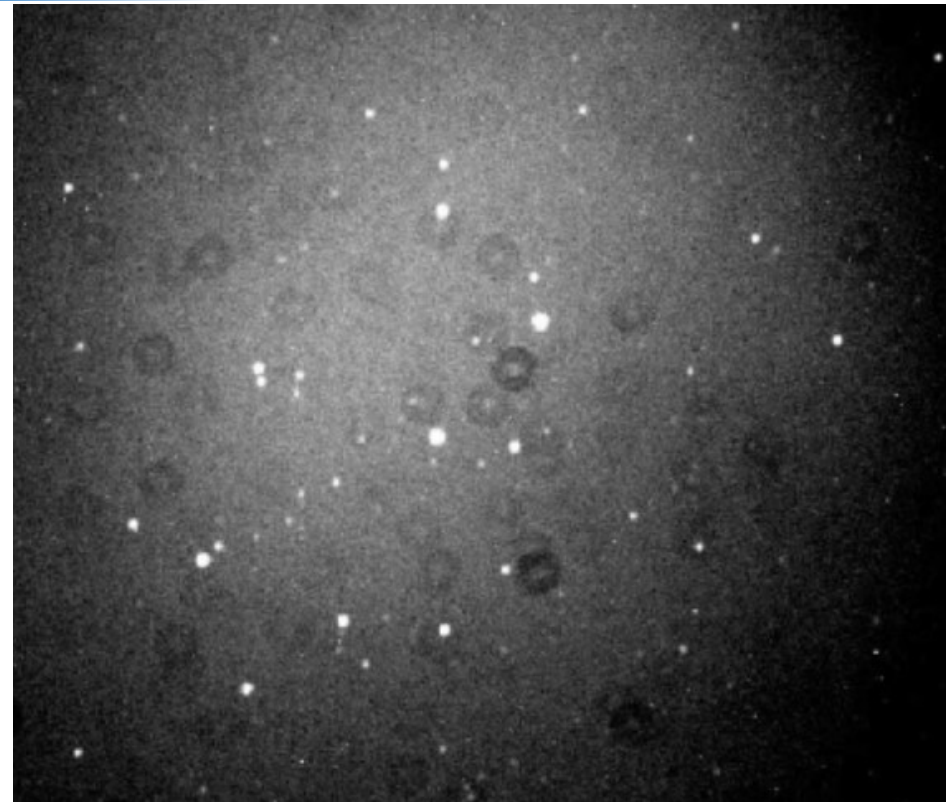
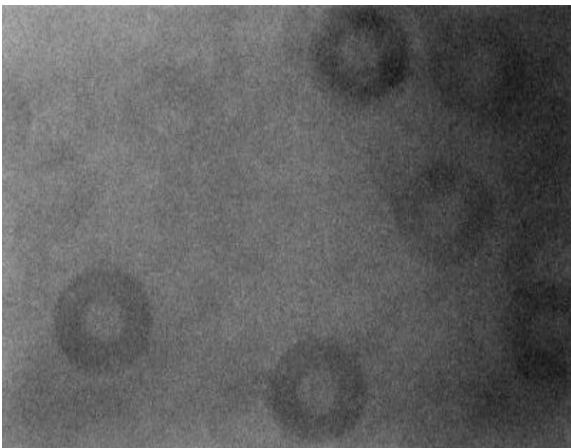
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### Flat-Field Frame

Obtained by having imaging a field of uniform light. Example would be a illuminated panel.

Corrects the science image file for mechanical defects like dust and Vignetting.

Flats neutralized the CCD image chip by “flattening” the variations that are inherent across the entire CCD chip.





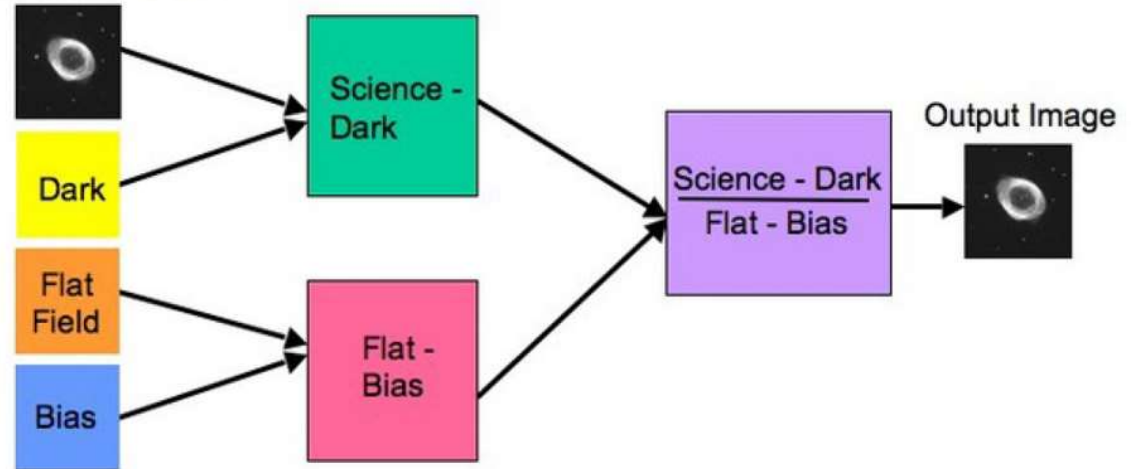
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### Master Frames

Having collected a number of Darks, Bias, and Flat-Field images, these will be combined to form Master Frames: Ex. Master Dark, Master Bias, and Master Flat.

The Master is developed by combining all images of each time into one single file. This master is then subtracted from the batch set of science images.

### Science Frame







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### Summary

CCD images are not free of imperfections.

In order to ensure that the science image is as pure as possible, we have to perform a series of calibrations to each image: Dark, Bias, and Flat.

In each of these categories, a “Master” file is created that is then “subtracted” from each image to produce a quality CCD science image.



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***Questions?***