



CCD Binning





CCD - Binning

Overview

Binning is a method of combining pixels on a CCD chip into one “super” pixel.

This provides some advantages and disadvantages. These will be discussed in this lesson.



CCD Imaging Basics

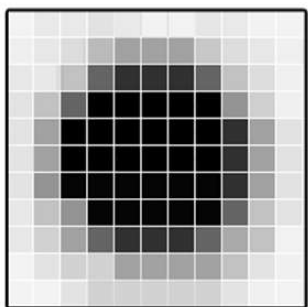
Binning

Allows merging of several pixels into a single super pixel.

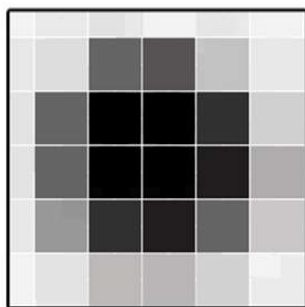
Binning can be done in the vertical, horizontal, or both.

The goal of binning is to achieve a FWHM of 3-5 pixels.

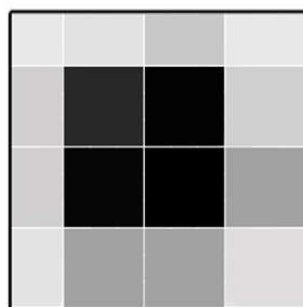
May need to defocus but ensure that a nearby star does not begin to blend into the target.



1 x 1 Binning

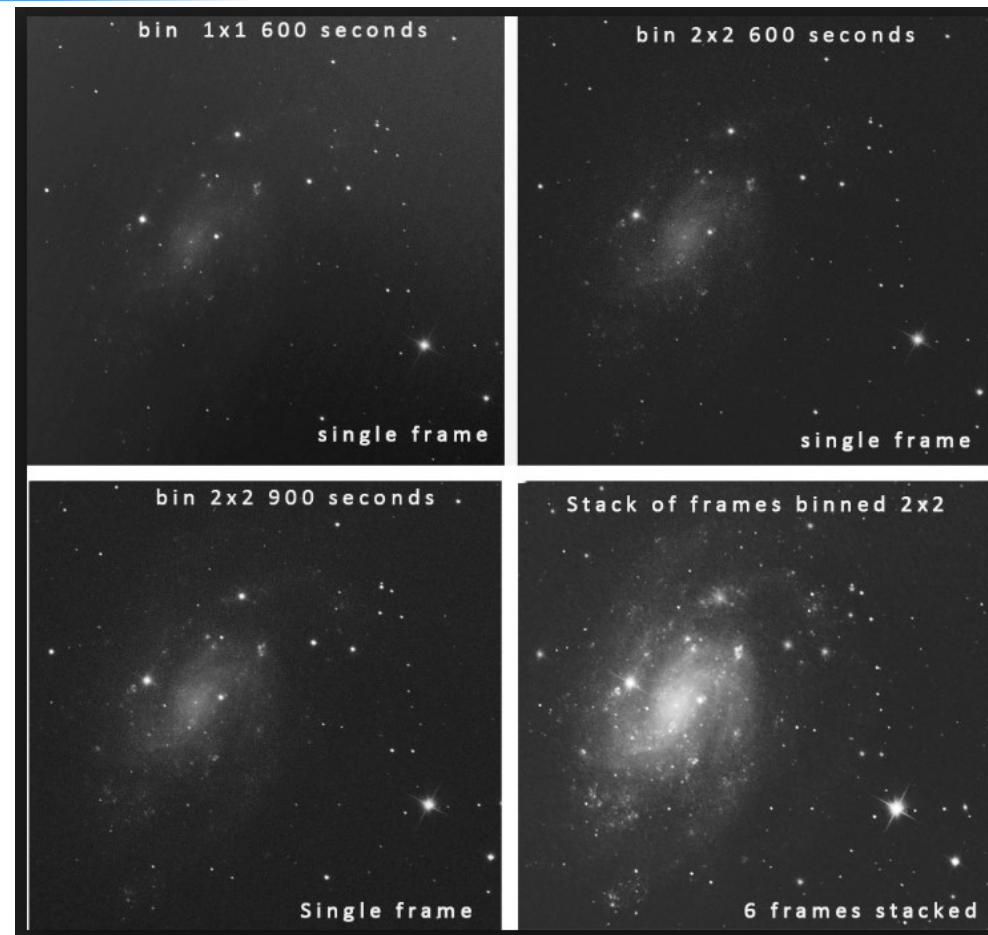


2 x 2 Binning



3 x 3 Binning

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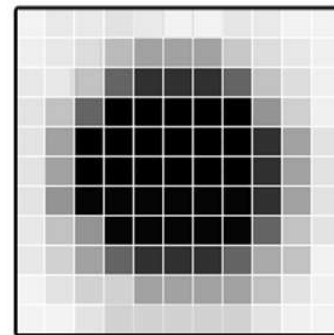


Binning

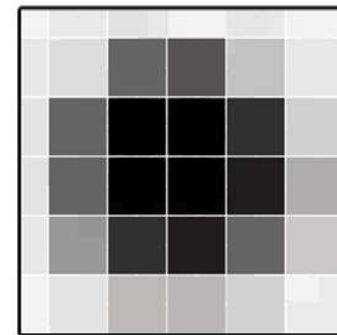
Binning increases the effective pixel size by grouping pixels together: for example, binning by a group of 2 pixels by 2 pixels makes those four pixels act as one.

This comes at a tradeoff as resolution will be lost. Here are the cautions to this method:

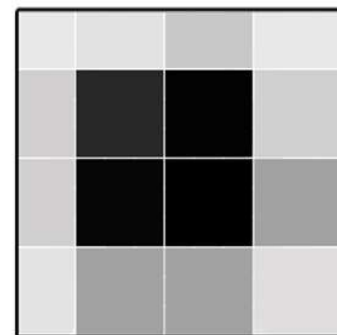
- Ensure the star images have not blurred together with other nearby stars
- If one of the four pixels in the group is saturated (full), the accuracy will suffer.
- The calibration frames (Darks, Flats, Bias) must also be binned to the same degree.



1 x 1 Binning



2 x 2 Binning



3 x 3 Binning



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Thought Process on Binning

Seeing, the blurring of stars as seen through a turbulent atmosphere, has the most impact on whether to Bin or not to Bin.

Seeing will cause an image to be blurred when viewed at 1x1 binning. If the Seeing is 2 arcseconds, binning at 2x2 would clean the image and allow the final picture to be clearer.

When Binning is desired, the most effective method is to accomplish this on the CCD chip.

Binning on chip allows this “super” pixel to be counted as one pixel when the CCD image is “read out”. This significantly reduces any noise in the image.

As an example, if you have a CCD chip that is 1024x1024 and you bin 2x2, your final image size will be 512x512 pixels.





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Advantages to Binning

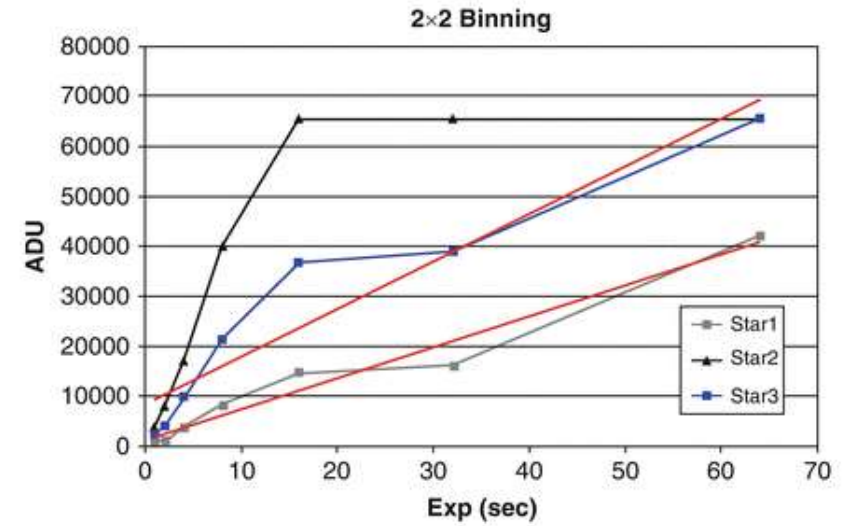
- Read noise in the CCD is reduced to what it would have been for a single pixel.
- Improves SNR.
- Can be downloaded faster since image sizes are smaller.
- Can match pixel size to the current seeing conditions.



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Disadvantages of Binning

- Could reach non-linearity faster than with a single pixel.
- Lower resolution





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Summary

Binning allows the creation of “super” pixels that help to overcome imperfections in the atmosphere.

Most scientific images should not be binned. If a particular night has poor seeing, perhaps waiting until a different night for better conditions. If this is not possible, being aware of the linearity issues and understanding the current seeing conditions, are keys to success.

Binning can be accomplished vertically, horizontally, or both.

Most applications bin simultaneously in both axis. Spectroscopy commonly bins in one direction or the other.



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Questions?