BRIEF

CCD
Full Width Half Maximum - FWHM

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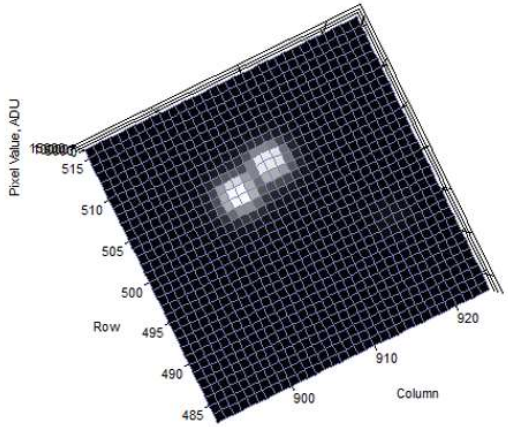
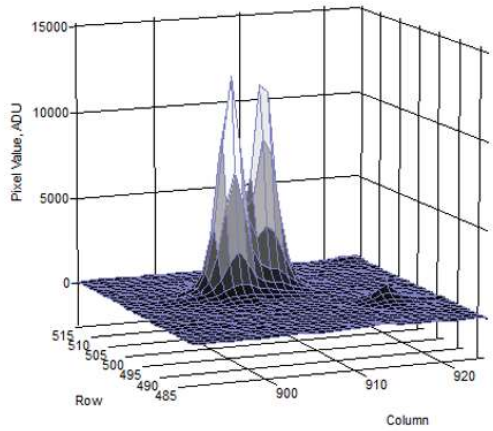
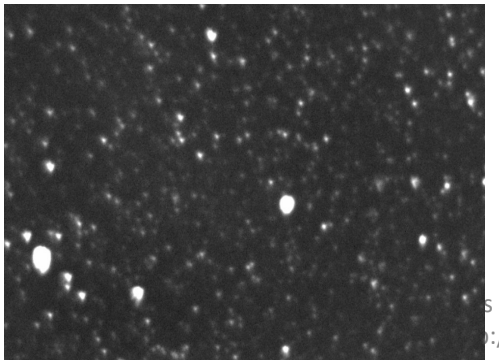
Overview – Stars on a CCD Image

Remembering from the CCD Overview lesson, each star:

- Is the same size on the focal plane - a Point Source
- Each point source has a specific shape and size at the CCD chip known as a Point Spread Function (PSF)
- PSF is mostly determined by Seeing
- Seeing is the smearing of a stellar object on the CCD chip due to atmospheric effects such as temperature and turbulence
- Overall, each star has the same shape and size on the CCD chip.







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Overview – Stars on a CCD Image

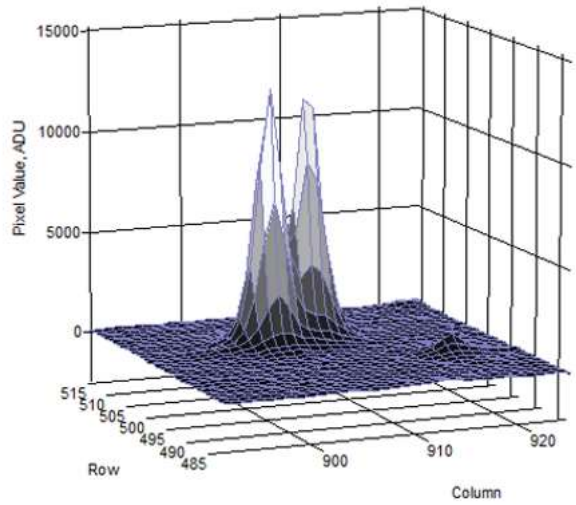
Looking at a star on a CCD image, it appears as a mountain peak base on the ADU (photon) count received during the exposure time.

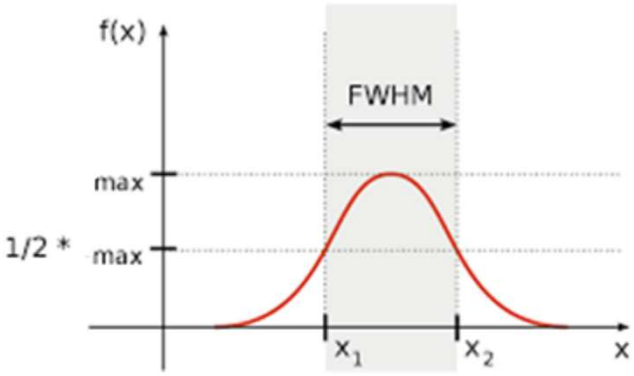
Measuring this peak, we employ Full-Width, Half-Maximum (FWHM).

Calculating this, start in the center and move out.

The horizontal bar between the two inner vertical lines is at the half-way point between maximum pixel value and the measured sky level (background).

For stars on a CCD image, the FWHM values are almost identical. Thus, the general shape stellar profiles is also very similar on a given image.





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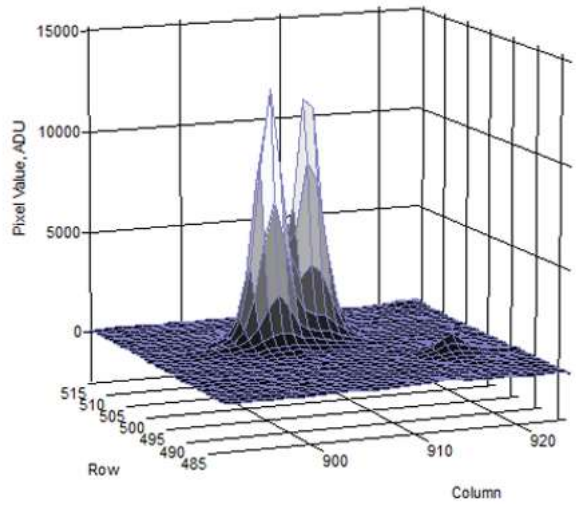
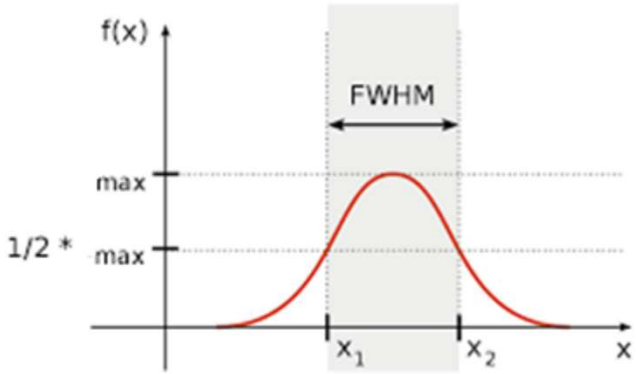
Overview – Stars on a CCD Image

This is true of all stars on the image, although the fainter ones appear smaller than the brighter stars.

They have the same shape on the image.

The reason the fainter objects appear smaller is because there are fewer pixels above a given level than with the brighter objects.





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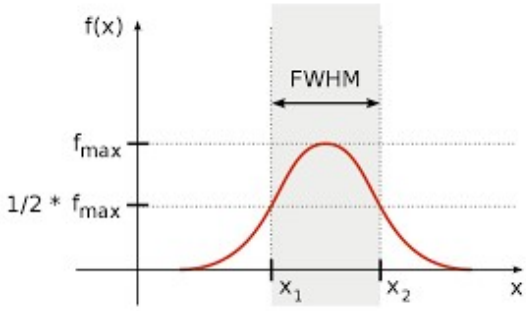
CCD - FWHM

Sampling



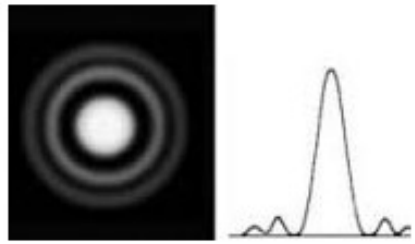
"Full–Width, Half–Maximum" (FWHM) is defined as the number of pixels that are filled to one–half the range between the background and the brightest (fullest) pixel in the star's image.

For the best image, we attempt to get the FWHM of the target's seeing disk to spread across two to three pixels.

This both optimizes the signal–to–noise ratio (SNR) and improves the accuracy of the measurements.

We measure this by taking a well–focused image of any random star field close to the zenith (straight above your head) and use software to measure the size (i.e. FWHM) of the seeing disk expressed in pixels.

This is the CCD system's sampling of the star image. 2-3 pixels is ideal.



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CCD - FWHM

Sampling

To determine whether the image is satisfactory for photometry, measure several stars around the center of the image that have a good SNR but are not saturated.

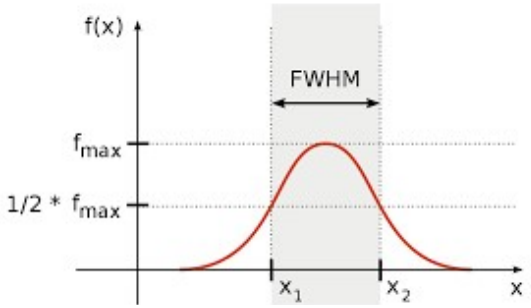
You are looking for an approximate number of 2–3 pixels per FWHM. 5-4 may be acceptable as well.

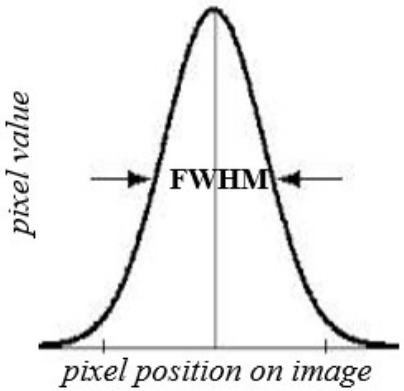
The atmospheric conditions might make this difficult as it is highly dependent on the seeing conditions, but you may be able to tweak it a little.

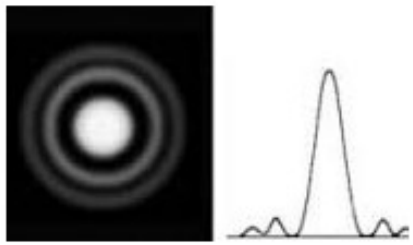
If you averaging a FWHM of less than 2 pixels, you are probably under–sampling.

If the FWHM of your seeing disk is more than 3 pixels in diameter, you may be over–sampling.

Either situation could pose problems for the accuracy of your photometry, though under-sampling is much worse than over-sampling.







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Summary

FWHM is used to determine the quality of your image. This is of particular importance in photometry and Exoplanet work.

The FWHM process, for BRIEF activities, is accounted for in the OSS Pipeline process.

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