

CCD Characteristics Worksheet

Observational Astronomy

6/6/07

Why is an electric potential maximum a potential well for electrons?

The ST-8E's CCD chip is 1020×1530 pixels. What is the maximum number of times a charge would have to be transferred? What percentage of this charge reaches the output amplifier for a CTE of 99% per transfer? How about for 99.999% per transfer?

Why does dark subtraction increase the overall noise level? Why would averaging dark frames mitigate this effect? (Think in terms of propagation of errors.)

Read Noise

Record the CCD temperature.

°C

Record the size of your measurement region and the standard deviation of the counts within it.

pixels

ADU

Has the added constant affected the standard deviation? Would it affect the mean?

Calculate the read noise.

ADU

Why did you divide the standard deviation of the differenced image by $\sqrt{2}$ to find the read noise?

Dark Current

Record the CCD temperature.

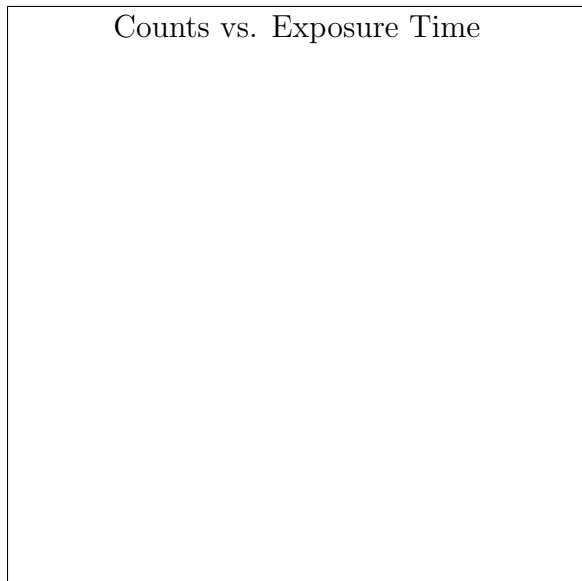
°C

Record the size of your measurement region. For each exposure time, record the mean of the counts within it.

pixels

Time (s)	μ (ADU)
30	
60	
90	
120	
150	
180	
210	
240	
270	
300	

Sketch your plot of mean counts versus exposure time.



Record the parameters of your linear fit.

$$a_0 = \text{ADU}$$

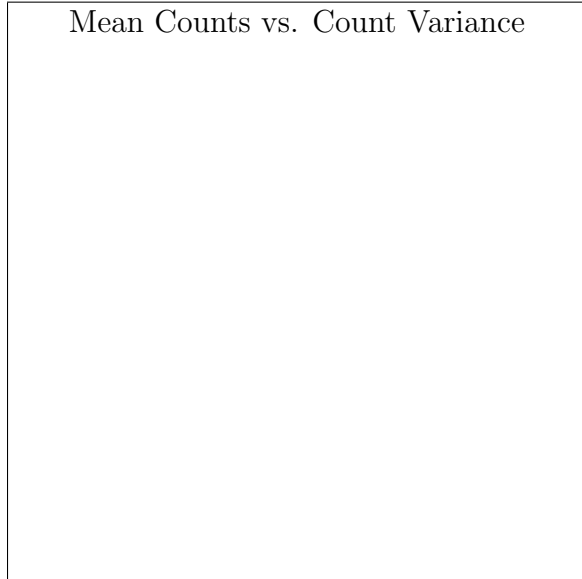
$$a_1 = \text{ADU/sec}$$

Linearity & Gain

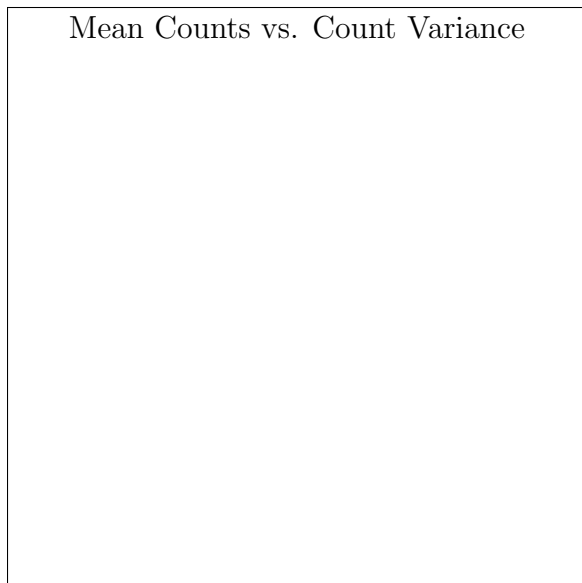
Record the VARIAC setting.

$$\text{volts}$$

Sketch your plot of mean counts versus count variance.



Sketch your plot of mean counts versus count variance for the linear regime.



Record the parameters of your linear fit.

$a_0 =$

$a_1 =$

Record the gain.

electrons/ADU

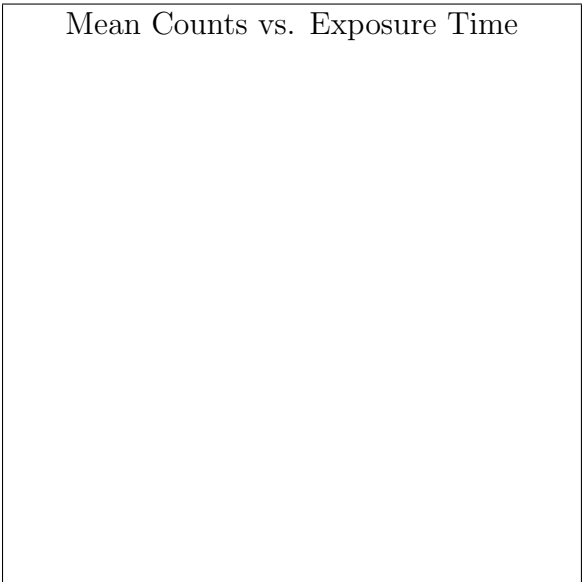
Now, you can convert your result for read noise from counts to electrons.

electrons

Now calculate the dark current using the gain and your previous results.

electrons/sec

Sketch your plot of mean counts versus exposure time.



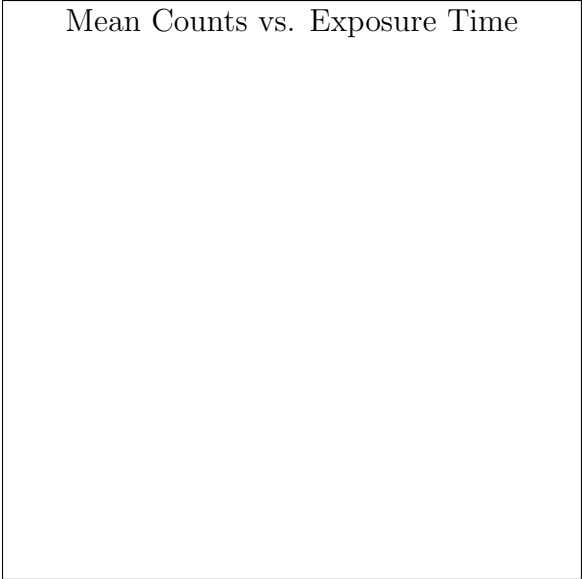
Estimate the saturation count and calculate the full well capacity.

ADU electrons

How large is the linear regime compared to the full well capacity?

%

Sketch your plot of mean counts versus exposure time for the linear regime.



Record the parameters of your linear fit.

$a_0 =$

$a_1 =$

Signal-to-Noise Ratio

In the CCD Equation, why is N_{read} squared while the other noise terms are not? (Think about how Poisson noise is found and how uncertainties add.)

For high signal levels, how does the signal-to-noise ratio scale with time?