**MONDAY, 4/22/2019**

- **Overscan** is a region where you include the black band going down the center of the whole image
- **Image** is a region where it is only white or no difference in color

**Poisson Distributions**

- How many times does an event occur?
- Ex. how many pennies will I encounter on my walk home?
- Ex. Home many products will I sell after airing a new television commercial?
- Photon → independent (quantized)
- Probability of their arrival → Poisson
- Lots of photons (flat) → approaching gaussian(ish)

**Gaussian Distributions**

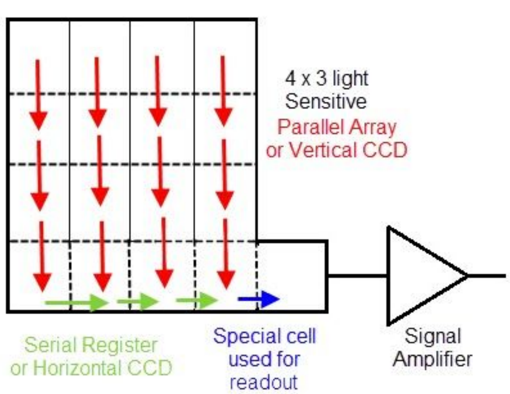
- All distribution functions approximate a gaussian for a large enough sample
- They might be offset, they don't look super smooth but the more points you have the more smooth the distributions look like
- Variations in the CCD readout/electronics will cause a normal distribution around the bias level
- You can also calculate the read noise and gain from this histogram

**Bias/Overscan**

- Bias: zero second image, the read out from the individual pixels
- Overscan: imaginary pixels

**CCDs (and other detectors)**

- A detector will mean a device used to detect/measure/count electromagnetic radiation
- In CCDs, we have a technique called charge transfer
    - The way CCDs work, we have one read out amplifier, can only read out one pixel at a time, so we have to transfer the charge from pixel to pixel until it gets to the read out amplifier
    - The complication with this, you use electricity used to transfer the pixels to each well, so you're losing charge as part of your transferring
        - This is why it's important to understand the path of your charge

- Readout
    - 

**Key Features**

- CCDs are linear (to a point), increase in electrons means an increase in photons
- Pixels can saturate
- Gain in intrinsic
- Responsive in the optical (with some ability to extend). Fundamentally a materials issue
- CCDs have become commercially viable (so relativity cheap)

**Activity: Detectors**

- CMOS (detectors you probably have in your cell phone camera)

**Signal to Noise**

- Noise sources in a CCD
    - Shot noise
    - Thermal noise/dark current
        - We cool CCDs to improve quantum efficiency, but there is still noise generated. This noise is a function of time (so when removing the effects of dark current, we need darks which match the length of time of our exposures)
        - You want our dark to be the same length as the data you're working with
    - Read noise
        - Variations in the CCD readout/electronics will cause a normal distribution around the bias level
        - You can also calculate the reda noise and gain from a histogram
        - Electrons will swamp your signal so you want to remove them if you have a lot of electrons
    - Bias
    - $n_{tot} = \sqrt{(n_{phot})^2 + (n_{dark})^2 + (n_{bias})^2 + (n_{read})^2}$

Today we did a lab! I was able to finish section 1: Emission tubes and slits and was able to look through a spectroscope and view cool looking light tubes. Through the spectroscope, I was able to determine which colors came up and described the width and if the colors blended, etc.

I also finished section 2: Emission tubes and spectra! This time we looked through a different type of spectroscope but it had spectra lines that would help us in determining the identity of the gas. I looked through a pink tube, a peachy tube and a light blue tube. I got the elements hydrogen, sodium and mercury! :)

**WEDNESDAY, 4/24/2019**

We just finished up the last section! I looked through different color films in front of a flashlight and wrote down what I saw visually. That's about it.

**FRIDAY, 4/26/2019**

Today, we went over how to pull up a catalog into pandas and actually make it look nice and readable in the table form.