

Test Mass Scattering Investigations

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Outline

- What I've completed thus far:

 - Calibration of Nikon D7100 (980nm and 1064nm)

- What I'm currently working on:

 - Photon absorption of camera sensor

- What else I'm going to try to accomplish:

 - Analyzing pictures coming from the test masses themselves

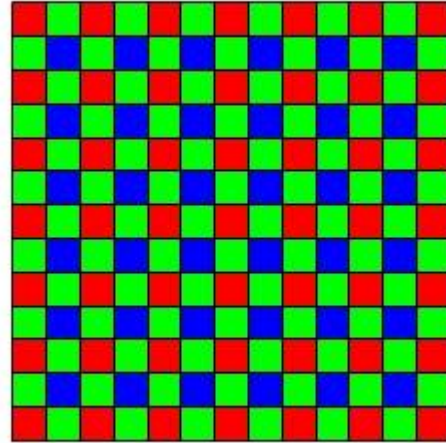
 - Calibration of other DSLR camera

What I've completed thus far: Camera Calibration

- Want to measure the energy scattering off the test masses
 - Scattered photons = leaving the beam path
- Pixel “counts” → energy (or power)
 - Continue work of CJ, 2016 SURF student

Camera Sensors

- Camera sensors are composed of millions of pixels
- Counts ~ Photons absorbed
 - Each of the pixels are made of 4 individual subpixels (usually R, B, G, G)
- Bayer filter



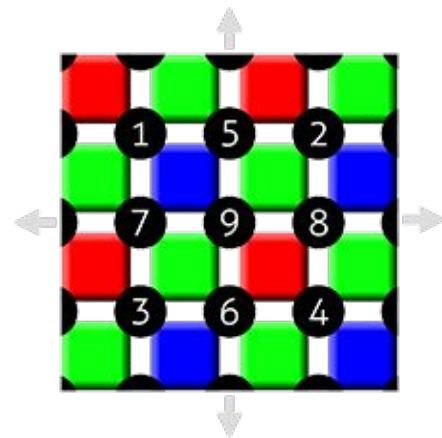
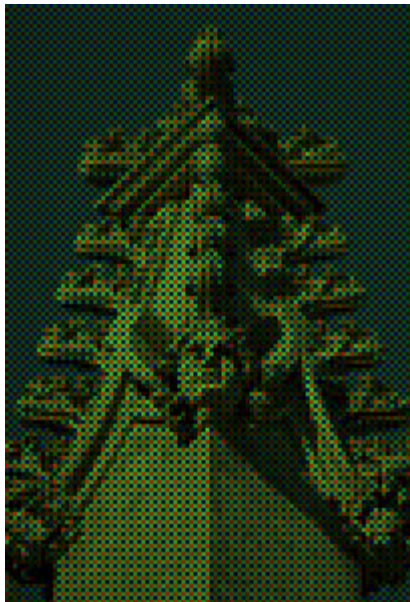
Bayer filter

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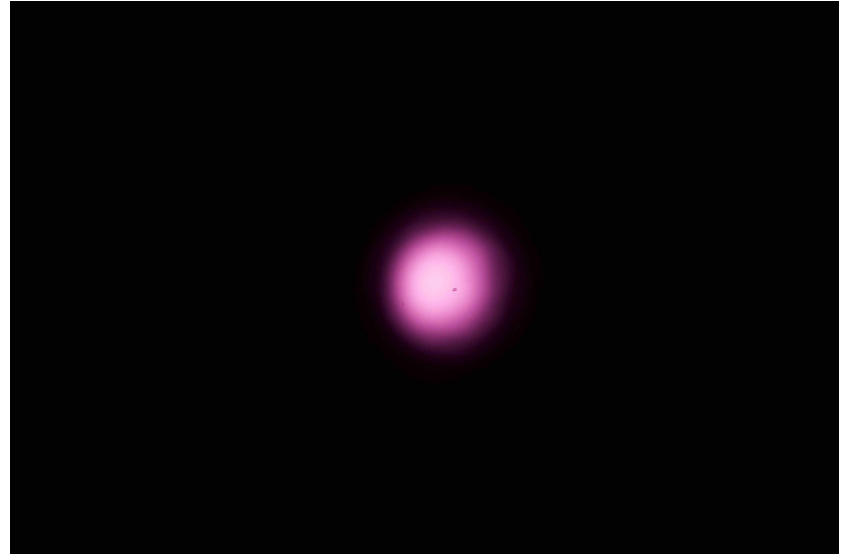
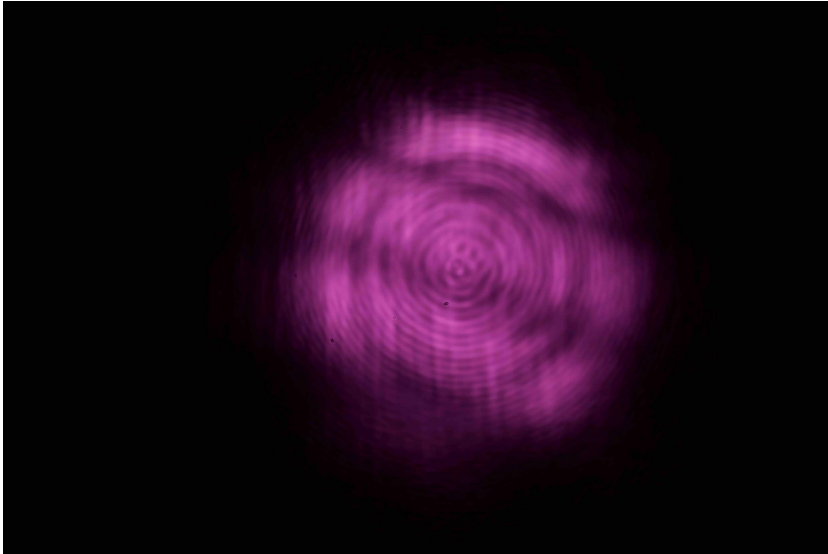
Image from HowStuffWorks
(<http://s.hswstatic.com/gif/digital-camera-bayer.jpg>)

Demosaicing and Other Image Adjustments

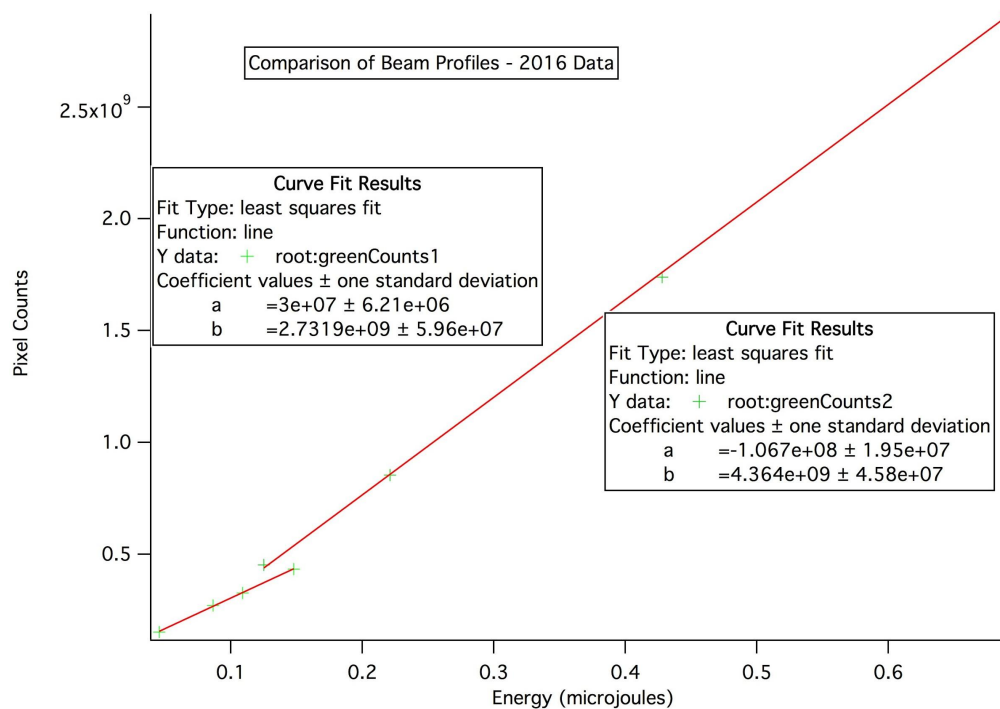
- JPEG, other image formats have been demosaiced (and altered in other ways)
- Interpolation, fancy algorithms, auto white balance, etc. destroy the data I'm interested in
- RAW camera files preserve the Bayer filter values



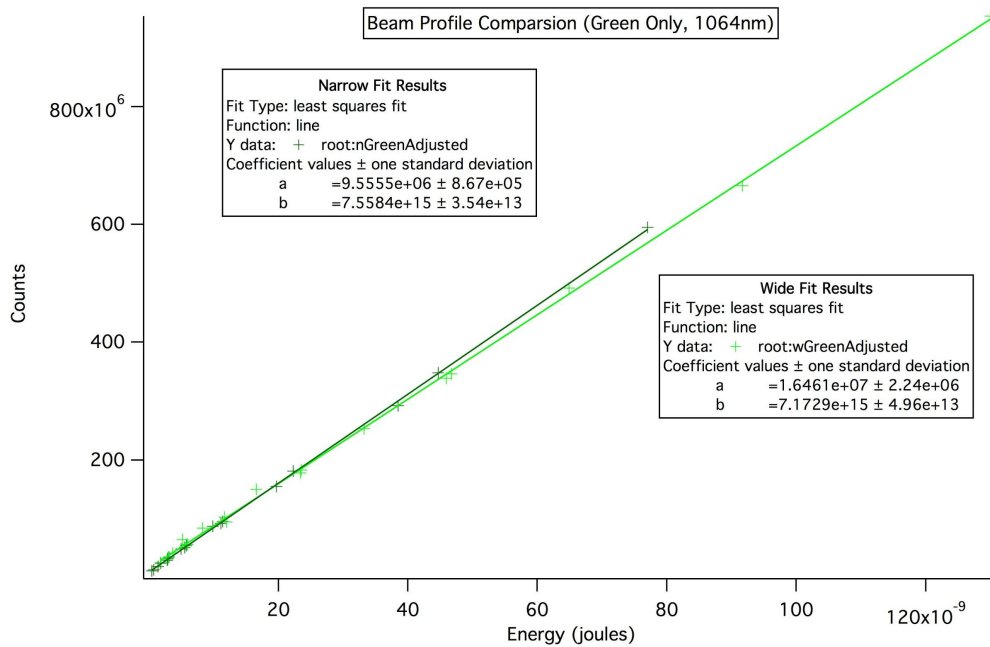
Beam Profile Investigation



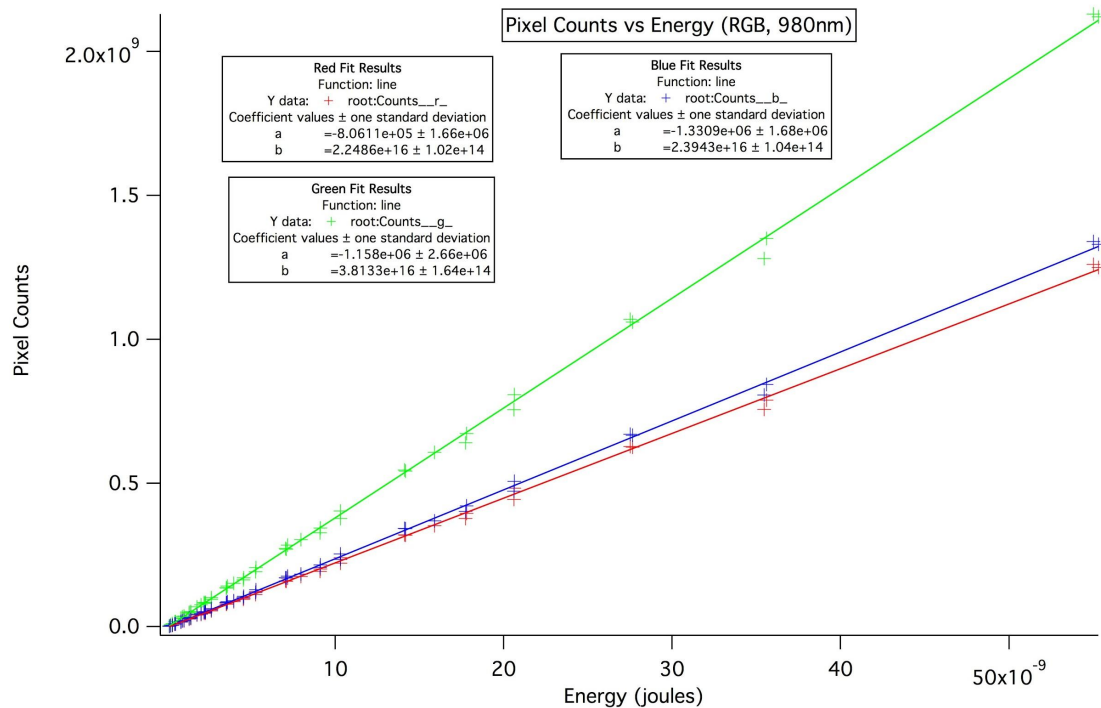
Beam Size Investigation



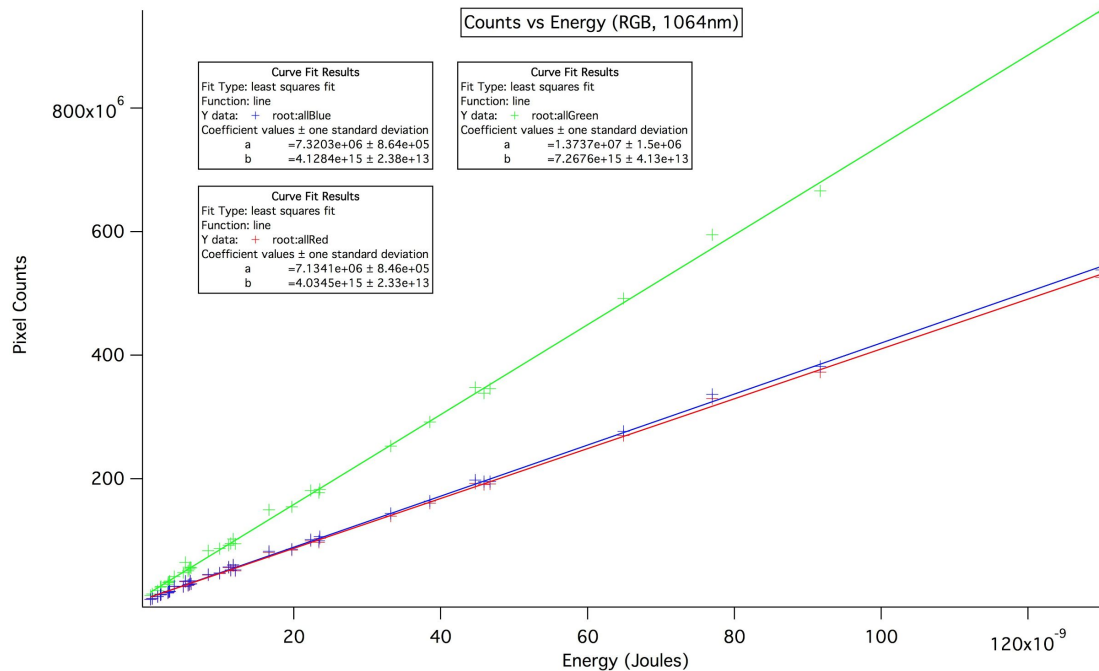
Beam Size Investigation



Calibration Results, 980nm



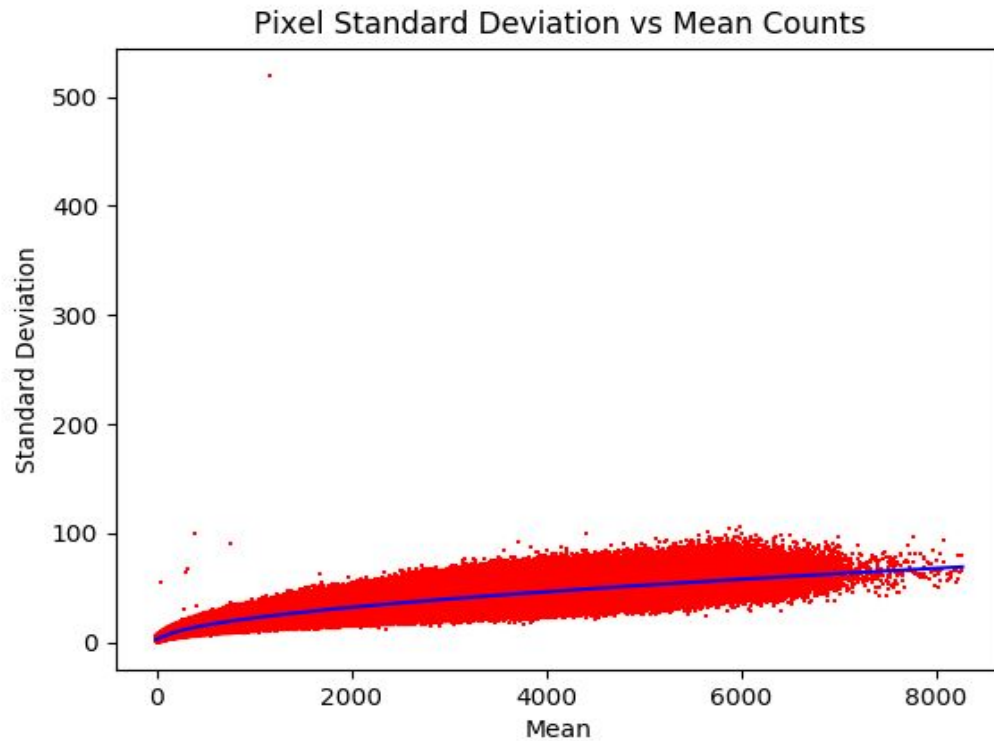
Calibration Results, 1064 nm



What I'm currently working on: Photon Absorption

- Better estimate of the error in the scattering measurements
- Simple case: Find standard deviation of a pixel -> find number of photons incident on that pixel
 - Shot Noise
 - Standard Deviation = $\sqrt{N_{\text{photons}}}$

Photon Absorption



Future Plans

- Complete photon absorption measurements

 - Issues with laser light source, large datasets

- Second DSLR Calibration

- Use results of camera calibration and absorption projects to analyze images of the test mass scattering