

Shot Noise Pre-Lab

1. First, read the short file “Fourier Analysis” and then watch the youtube video “Power Spectra Tutorial.” What are the units of power spectral density in an electrical system?
2. Read the shot noise Guide, notes.pdf, sections 8-10 of “MIT experiment” and “Sources of Noise” web page.
3. Since shot noise is a random Poisson process, what is the functional dependence of the shot noise RMS current fluctuations (electron counting error) on the electrical DC current?
4. Using dimensional analysis what is the functional dependence of shot noise RMS current fluctuations on the measurement bandwidth in Hz? Hint: a current is a rate of electrons per unit time.
5. Since light is composed of discrete particles, photons, light exhibits shot noise. Does the shot noise in light depend on wavelength, intensity, or both? Derive the appropriate relation.
6. Sky light exhibits fluctuations. Describe the amplitude of these fluctuations and the dependence on sky brightness. Suppose you do an experiment where you collect sky light (at night) with a camera and photoelectric detector. What happens to the DC output and the AC RMS noise out of your detector if the sky becomes twice as bright?
7. Read and understand the instrument manuals. You will be using this equipment on your first day.