Chemistry 243 Winter Quarter 2017.
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Problem Set #1

A. Photodiodes and Photomultipliers

1. You have selected a silicon photodiode for a spectroscopy experiment at 850 nm with the following characteristics:

Radiant Sensitivity (Responsivity) at 850 nm: 0.355 Amps/Watt
NEP: 8.0 x 10E-13 Watts (for a measurement with a frequency bandwidth of 1 KHz)

a) What is the Quantum Efficiency of this photodiode at 850 nm?

b) What is the photocurrent that you will measure when you illuminate this photodiode with 10.0 picowatts of light at 850 nm?

c) What is the total current that you will measure from this photodiode, assuming that all of the NEP is due to dark current?

2. You are interested in using a photomultiplier tube (PMT) in an emission spectroscopy experiment, and have chosen a PMT with the following specifications:

Wavelength of Peak Response: 537 nm
Anode Radiant Sensitivity at 537 nm: 2.3 x 10E5 Amps/Watt
Anode Dark Current: 3.0 x 10E-9 Amps

What is the rms average shot noise current associated with the dark current of this PMT? Assume a frequency bandwidth of 1 KHz for the measurement.

3. On the web, find a photodiode for optical measurements at the near infrared wavelength of 1500 nm. Report the following: Maker and Model Number, photodiode material (e.g. Si), detector size (area), Sensitivity at 1500 nm, dark current, NEP and response time. And maybe a price if you can get one!

B. Igor Pro

4. Go to the Chem 243 web site and pick up the following data file:
http://unicorn.ps.uci.edu/243/psets/fdata.txt

Time time axis is in nanoseconds. This noisy data can be fit with the equation: $A + B \exp(-C(t - D))$. Try to fit this data and recover the parameters A through D. Also report the fluorescence lifetime (1/C), in nanoseconds. Try to use the Igor Pro program

to do this analysis.