**INTRO:**

During the 19th century it was observed that light incident on certain metals caused an electron to be emitted from its surface. This phenomena is known as the Photoelectric effect and the electrons emitted are called photoelectron. This occurs because photons carry energy in discrete packages, that is E = hf (make a reference to plancks constant and frequency. When a photon with the minimum required energy falls upon the metal, an electron is ejected from the surface.

In this experiment we analyzed the physical limitation with the detection of light. We used a photomultiplier tube (PMT), which utilizes photoelectric effect and amplifies the number of emitted photons, to collect photon samples and observed the collective statistical properties of our sample. Because light travels at 3\*10^8 meter per second, our reference time between photon events had to be comparable to such a high velocity. As result, we used a coincidence processor (CoinPro) to measures the interval between pulses from the PMT with sub-nanosecond resolution.

We observed that the data collected had statistical characteristics which could be analyzed. Our plots illustrate the statistics of photon counting, the Poisson distribution (and the Gaussian limit), histograms, descriptive statistics (mean and standard deviation), error propagation, and the standard error. Data are acquired using a PC equipped with a counter, and one-dimensional data sets (time series) are plotted and analyzed.

Finally, our analysis allowed us to understand how detectors, which operate under similar principles, are used in astronomy. The measurements that photon counting are precise

A photomultiplier and controllable source of low-level illumination are used to illustrate the statistics of photon counting, the Poisson distribution (and the Gaussian limit), histograms, descriptive statistics (mean and standard deviation), error propagation, and the standard error. Data are acquired using a PC equipped with a counter, and one-dimensional data sets (time series) are plotted and analyzed.

This lab introduces the linux operating system, files and file systems, and the elements of scientific computing.

**HOW THE COINCIDENCE PROCESSOR WORKS (COIN PRO)**

The digital interface uses a coincidence processor (CoinPro) designed and built by [Techne Instruments](http://techneinstruments.com/Other_Projects" \t "_blank). under a grant from [NIST](http://www.nist.gov/) to explore [quantum cryptography](http://en.wikipedia.org/wiki/Quantum_cryptography).

The CoinPro measures the interval between pulses, e.g., from a photomultiplier tube with sub-nanosecond resolution. Eight inputs are provided for digital signals—we will be using only one of these inputs.

The number in column 1 indicates that the pulse was detected in channel 2 and the large integer in column 2 is the number of 0.833 ns clock ticks elapsed since the previous event. Clock ticks are counted as a 32-bit signed integer, and hence runs from -231to 231-1, i.e., -2147483648 to 2147483647, hence the roll over of the counter after the second entry. The clock rolls over approximately once per hour (232 x 0.833 x 10-9 = 3.58 s) , so there is no ambiguity for counting event separated by intervals shorter than this.