Mini PL 110 Detection System

In order to optimally use the Mini PL 110, it is important to understand how the Mini PL 110 physically operates. Since it uses a monochromator and not a spectrograph, we generate a spectrum by detecting each spectral increment separately and sequentially. Before taking a spectrum the user can select the spectral step size between spectral increments and can change the number of laser pulses which are averaged at each spectral increment to obtain the desired signal to noise ratio (SNR). The user can also change the spectral resolution. This is not done via software, but by changing the entrance slit to the monochromator inside the Mini PL 110 instrument.

The detector in the Mini PL 110 system is a PMT detector with computer controlled gain. The detection is synchronized with the pulsed deep UV laser within Mini PL 110 using a gated boxcar integrator and averager. As a result, the detection system has very low noise and has very large dynamic range, over 7 decades, which is far more than CCD array detectors. The Mini PL 110 instrument also has an automatic gain control that computes the number of photons detected for each spectral increment while automatically adjusting all detection factors to ensure detection is in the optimal control range. This enables detection from a few photons to nearly 100 million photons during each laser pulse. Each Mini PL 110 instrument has a unique algorithm and look-up-table to provide this computation in real time.

The PMT detector is far less expensive than CCD array detectors, especially due to the fact that deep UV detection with CCD arrays requires significant levels of thermoelectric cooling. Our use of the gated PMT detector is not sensitive to ambient temperature. These factors are the major reasons for the low cost of the Mini PL 110 system compared to any comparable system working in the deep UV. Our unique deep UV lasers are the second major reason for this low cost.

Due to this detection method, the photon count does NOT change when averaging over numbers of pulses for each spectral resolution element, but the SNR does. Every time you double the number of laser pulses averaged, the noise goes down and the SNR goes up by about 40%. So, depending on how weak the sample fluorescence, luminescence, or Raman emissions are, more or less numbers of pulses need to be averaged to get the desired SNR. This is very different from a CCD array, where the longer the integration time, the higher the photon count and the higher the baseline noise, depending on the level of cooling of the detector.

When using the Mini PL 110 system it is beneficial to limit the spectral range to only the region of interest, to use wider spectral step size, and not use too many laser pulses averaged since these factors can dramatically affect the time it takes to obtain a spectrum of interest.