

## Preparations

1. Check the wiring of the PMT in its box. Make a diagram of it in your notes. What HV will you have to apply: Positive or negative?
2. Hook up the LED and check that it is working. Again: Make a wiring diagram. Check with Jeter that your wiring is okay and corresponds to your diagram. Did you terminate your cable with the fast pulses from your pulser correctly?
3. Hook up the oscilloscope to the PMT output. Have Jeter check your wiring before you turn on the HV supply. When turning on HV: Always make sure that all dials are on zero. Never turn HV on or off with the main power switch. Be sure you read the PMT specs and know the maximum voltage rating!!! While turning on HV, watch the PMT output on the scope. Set up your oscilloscope before you start dialing up the HV: Highest sensitivity, lowest possible threshold so that you do trigger continually at the right polarity. Cross check your oscilloscope's settings. To check for dark noise you will need the shortest time base you can get on the scope. For the LED signal you will later have to change this time base to match the width of your LED signal. With the pulser off you should at some point see the dark noise hits from thermal electrons leaving the photocathode. Use the room lighting to check that your dark box is light tight: Compare dark noise rates with lights on and off. Some leakage is acceptable - use your judgment.
4. Turn on your LED pulser again: Use the oscilloscope to verify that pulses are coincident with your pulsing the LED. How do you set up your oscilloscope for that? Use frequencies between 1kHz to 10kHz and pulses of about 1 microsecond width.

5. Watch the PMT signal on the scope turn up the amplitude of your LED pulses. If necessary, reduce your HV setting on the PMT; LED signals should easily be seen with a voltage setting that allowed you to see the single electron noise signals.

## Measurements

1. At maximum LED amplitude measure PMT signal (what is easier: Pulse height or pulse area?) as a function of HV (remember the PMT's maximum voltage rating). Repeat for a total of 4 different LED light levels and compare the curves. Always graph your results immediately while you measure. You will notice if anything is wrong. Few people will catch abnormal behavior from just looking at columns of numbers. Prepare your graphs prudently: Will you need log scales on any axes? The scope has an average and an accumulation function, use it. Estimate the uncertainty of your measurement.
2. At which HV is it suitable to measure the PMT signal versus LED pulse amplitude. Try to determine the effective bias voltage for the LED. Plot PMT response versus LED amplitude on a linear scale.
3. Set your PMT to a reasonably high gain, and measure the PMT output as a function of pulser frequency. More than 10 kHz is okay now. Interpret your results.