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LBNL Xenon lamp light source (DRAFT, INITIAL RESULTS)

In order to measure the reflectivity of PTFE panels and WLS materials, we have designed and commissioned a 172 nm low intensity light source and PMT inside a vacuum chamber. The light source is a common short arc Xenon microscope lamp with a Suprasil envelope; these bulbs typically have a needle shaped cathode and a blunt shaped anode. We reverse the voltage and place an LED (near UV) close to the bulb, shining on the blunt cathode at 45 deg. to liberate electrons via a photo electric effect. The bulb currents initiated produce no visible light; we collimate the bulb and place a 172nm bandpass filter between the collimator and the PMT; the result is a strong signal, indicating the production of 172 light. Fig. 1 shows the experimental setup.

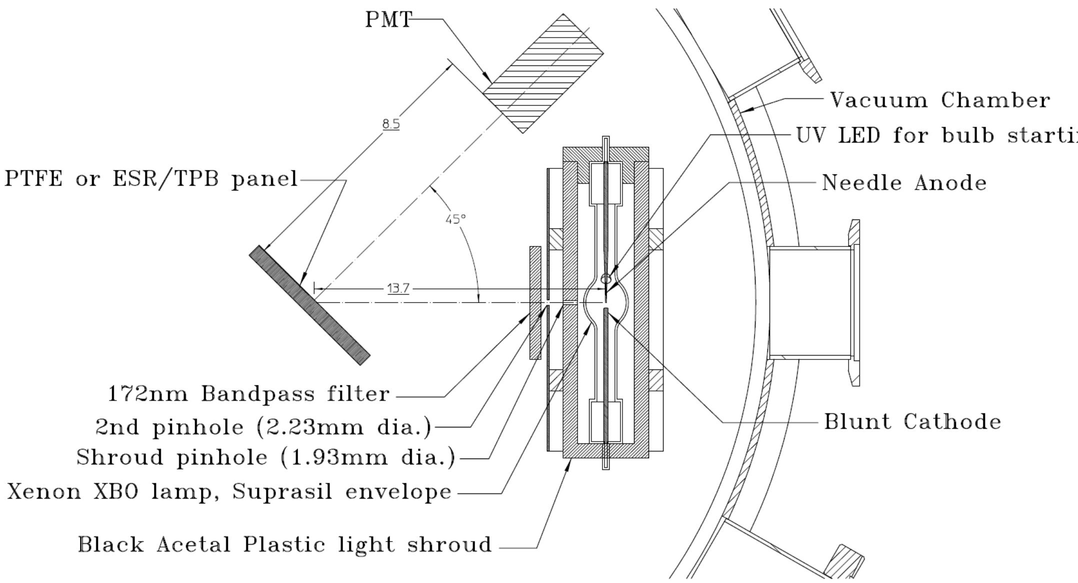

Fig. 1 Diffuse reflectivity measurement set up

We first turn on the LED to an applied voltage of 4 V, current is 102 mA. then apply a high positive voltage (9-11 kV) to the blunt electrode, until 0.1-0.2 nA bulb current is initiated. Raising the voltage further, the bulb current will increase up to 2.0 nA, and will remain stable at any current in this range, however if the LED is turned off, this curent will immediately drop back to zero. So, keeping the LED on and raising the bulb voltage (~10-11kV) at this point) bulb current will suddenly jump from 2 nA to ~20 nA. Raising bulb voltage further, this bulb current can be increased up to 132 nA, whereupon sparking will occur with any further voltage increase. Currents in this range are not stable, bulb voltage must be slowly increased to maintain a given current. However, the LED may be turned off, as it has no aparent effect; this mode of operation is self-sustaining, given continuous voltage adjustment. Without voltage adjustment, the bulb current will slowly fall off over the course of a few minutes until 20-25 nA is reached, whereupon the bulb current self-extinguishes. It will reinitiate, if the LED is turned on.

The PMT signal is amplified and sent to a discriminator; discriminator pulses are then counted (in frequenscy mode. Discriminator pulses were first verified to assure pulses are all from good single photoelectron pulses.. Below are PMT counts, in kHz (first column) with bulb current (nA) in second column

PMT facing beam (no panel, no second pinhole), PMT 2.1 cm away from source (needle tip), bandpass filter in place, (as in all subsequent runs). This measurement is to capture as much light as possible from the source, which may be a modestly collimated beam or may be rather diffuse.

$$\text{f\_dat} := \begin{pmatrix} 2500 & 75 \\ 1970 & 60 \\ 1800 & 60 \\ 400 & 25 \\ 500 & 20 \end{pmatrix} \qquad f := \overrightarrow{\frac{\text{f\_dat}^{\langle 0 \rangle}}{\text{f\_dat}^{\langle 1 \rangle}}} \qquad f = \begin{pmatrix} 33.333 \\ 32.833 \\ 30 \\ 16 \\ 25 \end{pmatrix}$$

$$\text{mean}(f) = 27.433$$

$$\text{stdev}(f) = 6.4374$$

Baseline PMT pulse rates:

no bulb voltage, LED off: 10-25 Hz

no bulb voltage, LED on: 1.2kHz

PMT facing beam (no panel), second pinhole (.089" dia.) added, PMT 10.5 cm away from source (needle tip). This measurement is to measure the beam at the location of the panel, and to compare with the first measurement above.

$$\text{f\_0\_dat} := \begin{pmatrix} 1450 & 70 \\ 1200 & 60 \\ 750 & 50 \\ 750 & 50 \\ 500 & 40 \\ 2700 & 120 \\ 1070 & 60 \\ 800 & 50 \\ 3500 & 150 \\ 2900 & 120 \\ 1650 & 80 \\ 1000 & 60 \\ 770 & 50 \\ 550 & 40 \\ 350 & 30 \\ 200 & 20 \end{pmatrix} \qquad \text{f\_0} := \overrightarrow{\frac{\text{f\_0\_dat}^{\langle 0 \rangle}}{\text{f\_0\_dat}^{\langle 1 \rangle}}} \qquad \text{f\_0} = \begin{pmatrix} 20.714 \\ 20 \\ 15 \\ 15 \\ 12.5 \\ 22.5 \\ 17.833 \\ 16 \\ 23.333 \\ 24.167 \\ 20.625 \\ 16.667 \\ 15.4 \\ 13.75 \\ 11.667 \\ 10 \end{pmatrix}$$

$$\text{mean}(\text{f\_0}) = 17.197$$

$$\text{stdev}(\text{f\_0}) = 4.1658$$

Baseline PMT pulse rates:

no bulb voltage, LED off: 80-110 Hz

no bulb voltage, LED on: 450-500 Hz

Bare PTFE (Cuflon) panel 7x7 cm, beam incident angle 45 deg, PMT view angle 0 deg,

$$f\_1\_dat := \begin{pmatrix} 6.3 & 90 \\ 5.8 & 80 \\ 4.9 & 70 \\ 4.2 & 60 \\ 3.7 & 50 \\ 2.9 & 40 \\ 2.2 & 30 \end{pmatrix} \qquad f\_1 := \overrightarrow{\frac{f\_1\_dat^{\langle 0 \rangle}}{f\_1\_dat^{\langle 1 \rangle}}} \qquad f\_1 = \begin{pmatrix} 0.07 \\ 0.073 \\ 0.07 \\ 0.07 \\ 0.074 \\ 0.073 \\ 0.073 \end{pmatrix}$$

$$\text{mean}(f\_1) = 0.072$$

$$\text{stdev}(f\_1) = 0.0016$$

Baseline PMT pulse rates:

no bulb voltage, LED off:
40-70 Hz

no bulb voltage, LED on:
130-160 Hz

TPB coated ESR panel 7x7 cm, beam incident angle 45 deg, PMT view angle 0 deg,

$$f\_2\_dat := \begin{pmatrix} 2.4 & 100 \\ 2 & 80 \\ 1.5 & 60 \\ 1.27 & 50 \\ 1.05 & 40 \\ 2 & 90 \\ 1.75 & 70 \\ 1.5 & 60 \\ 1.3 & 50 \\ 1.1 & 40 \end{pmatrix} \qquad f\_2 := \overrightarrow{\frac{f\_2\_dat^{\langle 0 \rangle}}{f\_2\_dat^{\langle 1 \rangle}}} \qquad f\_2 = \begin{pmatrix} 0.024 \\ 0.025 \\ 0.025 \\ 0.025 \\ 0.026 \\ 0.022 \\ 0.025 \\ 0.025 \\ 0.026 \\ 0.028 \end{pmatrix}$$

$$\text{mean}(f\_2) = 0.025$$

$$\text{stdev}(f\_2) = 0.0013$$

Baseline PMT pulse rates:

no bulb voltage, LED off:
40-60 Hz

no bulb voltage, LED on:
100-160 Hz

Preliminary Conclusion:

TPB coated panels show a (relative to PTFE) diffuse reflectivity (including fluoresence) of:

$$\frac{\text{mean}(f\_2)}{\text{mean}(f\_1)} = 35\,\%$$