

**NERC FSF
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Cosine diffusers for the GER1500

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Introduction

This report examines the performance of 4 different diffuser attachments used with the GER1500 in terms of how the data collected with the attachment conforms to the distance squared law. This states that irradiance decreases with distance from an irradiance source in proportion to the square root of the distance.

The four attachments are as follows:

1. The GER diffuser which attaches directly to the standard optic.
2. Macam diffuser 1 which incorporates a mirror and attaches to the fibre optic cable.
3. Macam diffuser 2 which attaches directly to the standard optic.
4. Under Water Housing (UWH) diffuser which

Methods

For each cosine attachment/sensor configuration, the ratio of the mean of 30 measurements obtained at a distance of 25cm from the irradiance source to the mean of 30 measurements obtained at a distance of 50cm distance from the source is obtained. This ratio is referred to as the Actual ratio in Figures 1 to 4. The figures also show the expected ratio (Calc_ratio). This varies for each diffuser configuration and usually deviates from a value of 4.0 (which would be its value for measurements at exactly 25cm and 50cm). The reason for this is that the plane of the entrance aperture of the diffuser/sensor arrangement (i.e. the point to which the source/sensor distance must be measured) is difficult to determine/unknown and must be provisionally estimated. Estimating the position introduces an offset error into the measurement of the source/sensor distance. This is later corrected when the true position is recovered based on the measurements of key components (e.g. thickness of diffuser) and the ratio of the signal from the two distances in the centre of the spectral array. This procedure means that the calculated and actual ratios converge, at least over the central region of the spectrum. Deviation of the actual ratio from the calculated at other wavelengths may be due to a variety of causes including spectral variation in the transmission properties of the diffuser material. The degree of deviation is taken to indicate the suitability of the diffuser/sensor configuration as an irradiance measuring system.

Results

Figure 1:
The GER diffuser

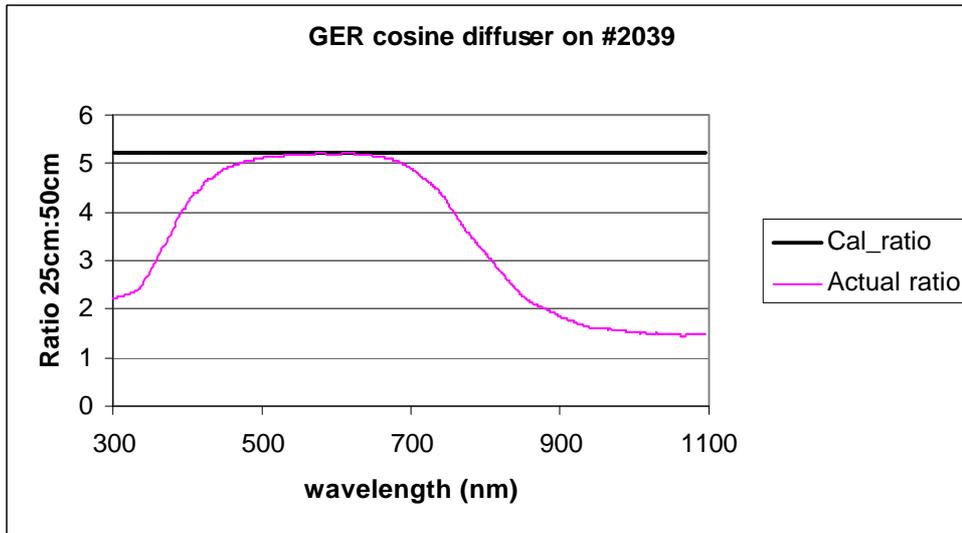


Figure 2:
Macam Diffuser 1 (incorporating mirror) for attachment to a fibre optic.

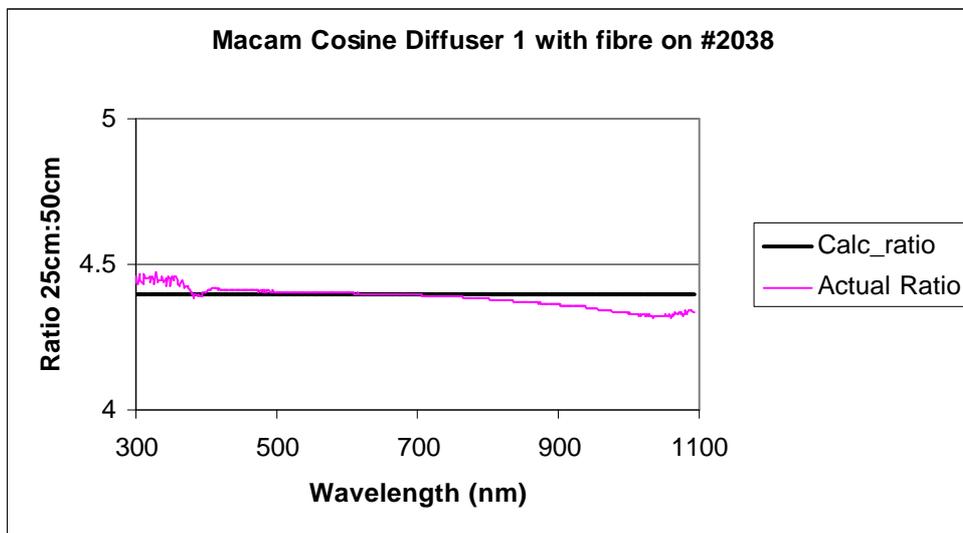


Figure 3:
Macam diffuser 2 for attachment onto standard optic

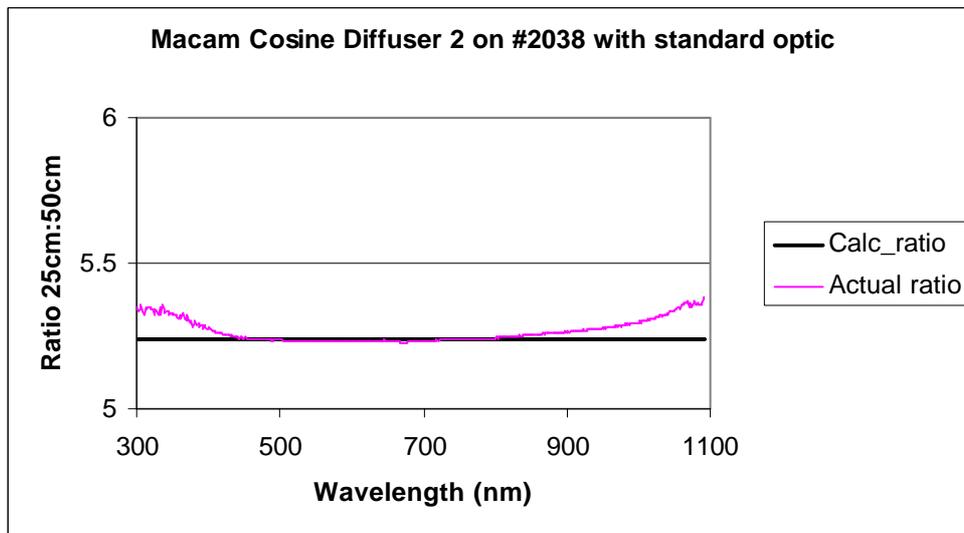
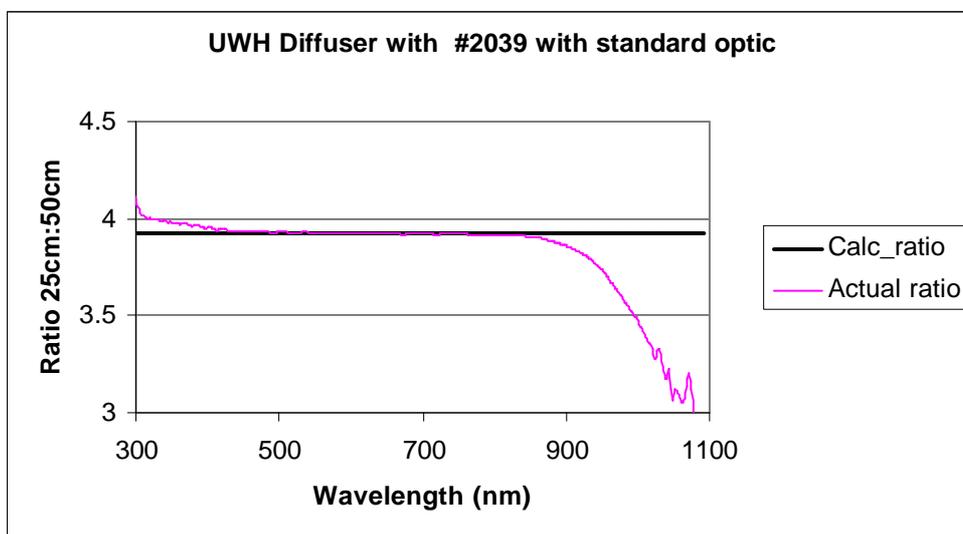


Figure 4:
Diffuser in upward window of Under Water Housing for GER1500



Discussion:

1. The two Macam diffusers appear to have a much better performance than the GER diffuser, which satisfies the d^2 law over a very restricted spectral range (550nm to 680nm).
2. The diffuser in the UWH also appears to be satisfactory. The fall off at wavelengths greater than 900nm may be due to the properties of the port window rather than the material itself.
3. For the Macam diffusers, it is difficult to determine the extent to which the poorer results for wavelengths below 400nm and above 900nm result from decreased detector sensitivity towards the ends of the array.

Figure 5 compares the irradiance calibration functions calculated for the two Macam diffusers. Both are similar in the 300 to 380nm range suggesting there is no advantage in terms of sensitivity at these wavelengths, of Macam 2 over Macam 1.

Figure 5:

Irradiance calibration of GER1500 #2038 with Macam1 diffuser plus fibre and Macam 2 diffuser.

