

Comparison of two methods for spectral irradiance scale transfer

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Abstract.

In the past at MSL transfer of spectral irradiance scales have been made via a commercial spectroradiometer. This resulted in large uncertainties in the ultraviolet region due to temporal instability of the spectroradiometer and low S/N ratios. More recently, and to meet the requirements of users in New Zealand measuring small changes in atmospheric solar ultraviolet irradiance levels, the calibrations have been transferred to a dedicated, double monochromator based system. This move warranted a closer examination of two options for input optics to the monochromator that have been used extensively at several NMIs to achieve smaller transfer uncertainties (Wilkinson, 1998, Walker et al, 1987), especially in the ultraviolet wavelength range.

This paper will outline these two options, being an integrating sphere and a flat diffusing plate, and the transfer methodologies that enable direct comparison of spectral irradiance sources via a common monochromator (Kostkowski, 1997). The main sources of possible error and uncertainty considered for each of these are: S/N, geometrical effects and source uniformity. These will be described and compared and the achievable uncertainties in transferring a scale of spectral irradiance in the ultraviolet wavelength region with each methodology compared. The usefulness and applicability of each method is then highlighted.

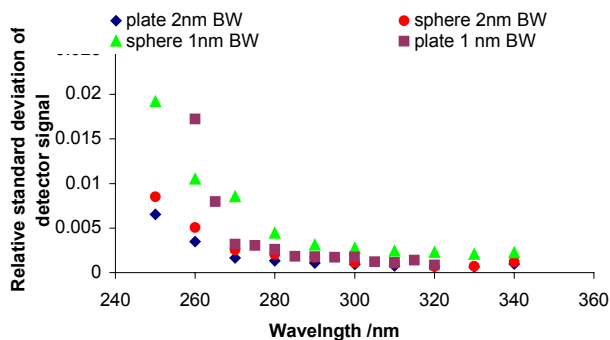


Figure 1. Relative standard deviation of the output current from the photomultiplier tube (PMT), mounted at the exit slits of the monochromator, detecting the irradiance source. The 2 nm bandwidth measurements for both the plate and the sphere methods used an Oriel 57860 solar blind filter for stray light reduction and a PMT voltage of 1000 V. In the case of the 1 nm bandwidth measurements the sphere method used the previously mentioned stray light filter however, the plate method measurements used a UG11 stray light filter which had much lower transmittance than the Oriel filter below 270 nm; the PMT voltage was 1100 V for the sphere method and 800 V for the plate method.

Optical Layout of Lamp Comparator Facility

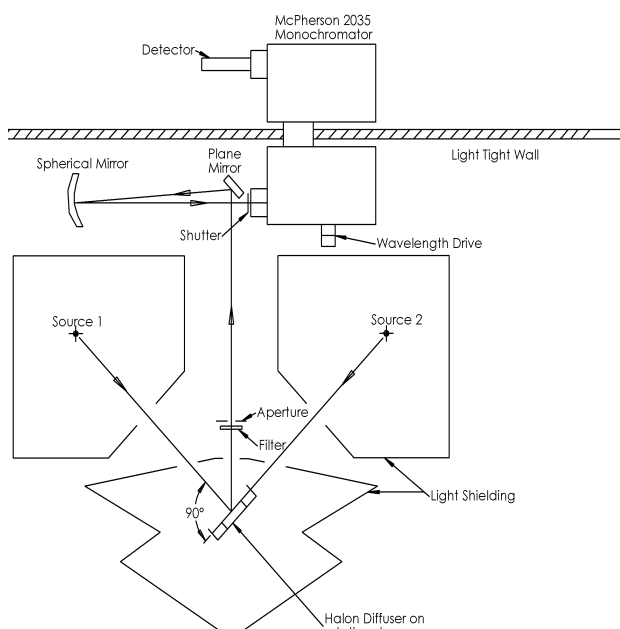


Figure 2. Arrangement for the flat plate diffuser comparator. Each source is mounted normal to the diffuser with the diffuser at 45° to the entrance optics of the monochromator. For a given calibration a repeat measurement is made with the lamps alternated between positions Source 1 and 2.

In the case of the integrating sphere method the sphere replaces the diffuser with its exit port normal to the entrance optics of the monochromator. The entrance port of the sphere is at 90° to exit port; the sphere rotates 180° about the entrance optics axis. The Source 1 and 2 positions are located either side of the sphere normal to the entrance port.

Acknowledgements

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References

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