NATIONAL PHYSICAL LABORATORY
Teddington Middlesex UK TW11 0LW Telephone +44 20 8977 3222

Certificate of Calibration

UKAS CALIBRATION
0478

HELIOS RADIANCE SOURCE ID 0318163649
ABSOLUTE SPECTRAL RADIANCE

FOR: NERC Field Spectroscopy Facility (FSF)
University of Edinburgh
Grant Institute
James Hutton Road
Edinburgh
EH9 3FE

DESCRIPTION: The source was a Helios radiance source, model USLR-D12L-NMNN, manufactured by Labsphere. It consisted of a sphere, a 75 W lamp, a 35 W lamp and a 150 W lamp with a variable baffle. For this measurement only the 75 W lamp was to be used. It was supplied with a control unit including power supplies and laptop computer.

IDENTIFICATION: The ID number 0318163649 was marked on the rear of the source. The ID number 0318163649 was also marked on the control unit.

DATES OF CALIBRATION: 22 March 2017 to 29 March 2017

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a coverage probability of approximately 95 %. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Reference: 2016020157/RB1-17

Date of issue: 15 June 2017

Checked by: SSH

Signed: **(Authorised Signatory)**

Name: R Winkler

on behalf of NPLML

MEASUREMENTS

The radiance source was positioned with the sphere port vertical, and perpendicular to the measurement axis. The unit was operated from the control unit provided, using the manufacturer's software. The current was set on the software before being supplied for calibration and was not changed during measurement. On each occasion of operation the 75 W lamp in the radiance source was run for at least 60 minutes before measurements commenced.

The absolute spectral radiance of the source was measured for a central area of the sphere port not exceeding 7 mm wide by 17 mm high. Spectral radiance measurements were made over the range 350 nm to 1000 nm with an instrument bandwidth of approximately 4.4 nm (FWHM) and from 1010 nm to 2500 nm with an instrument bandwidth of approximately 8.8 nm (FWHM), against a series of NPL Reference radiance sources calibrated against the NPL spectral radiance scale.

Ambient temperature during measurement was in the range 22 °C ± 2 °C.

RESULTS

The Table on pages 3 to 6 gives values for the spectral radiance in mW m^{-2} sr^{-1} nm^{-1} at 10 nm intervals over the wavelength range 350 nm to 2500 nm.

UNCERTAINTIES

The total expanded uncertainty of the absolute spectral radiance calibration was estimated not to exceed the value given in the table on pages 3 - 6 for each individual point.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a coverage probability of approximately 95 %.

The results and uncertainties quoted refer to on-the-day values, and no allowance has been made for subsequent drift.

Helios Sphere, 75 W Lamp, ID 0318163649

Wave-length	Absolute Spectral Radiance	Uncertainty	Wave-length	Absolute Spectral Radiance	Uncertainty
nm	mW m^{-2} sr^{-1} nm^{-1}	%	nm	mW m^{-2} sr^{-1} nm^{-1}	%
350	15.45	4.0	680	616	1.7
360	21.25	3.5	690	635	1.7
370	27.30	3.0	700	652	1.7
380	34.2	2.6	710	669	1.7
390	42.6	2.8	720	685	1.7
400	50.4	2.8	730	701	1.8
410	64.1	3.3	740	716	1.8
420	81.5	3.5	750	730	1.8
430	97.8	3.0	760	741	1.8
440	113.2	2.8	770	754	1.9
450	130.1	2.7	780	764	1.9
460	147.8	2.4	790	774	2.0
470	166.3	2.3	800	782	2.0
480	185.9	2.3	810	789	2.2
490	206.2	2.3	820	796	2.0
500	227.6	2.2	830	802	2.0
510	249.0	2.2	840	808	1.9
520	271.2	2.2	850	813	1.9
530	293.9	2.3	860	818	1.8
540	317	2.3	870	824	1.8
550	340	1.9	880	826	1.8
560	363	1.9	890	830	1.8
570	386	1.9	900	831	1.8
580	409	1.8	910	834	1.8
590	433	1.8	920	837	1.8
600	455	1.7	930	836	1.8
610	477	1.7	940	836	1.8
620	498	1.7	950	831	1.8
630	520	1.7	960	836	1.8
640	541	1.7	970	837	1.8
650	561	1.7	980	836	1.8
660	580	1.7	990	834	1.8
670	598	1.7	1000	830	1.8

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Wave-length	Absolute Spectral Radiance	Uncertainty	Wave-length	Absolute Spectral Radiance	Uncertainty
nm	mW m^{-2} sr^{-1} nm^{-1}	%	nm	mW m^{-2} sr^{-1} nm^{-1}	%
1010	831	1.8	1340	607	1.8
1020	824	1.8	1350	582	1.8
1030	821	1.8	1360	542	2.2
1040	817	1.8	1370	542	1.8
1050	815	1.8	1380	531	1.8
1060	808	1.8	1390	530	1.8
1070	803	1.8	1400	518	1.8
1080	798	1.8	1410	518	1.8
1090	793	1.8	1420	517	1.8
1100	785	1.8	1430	518	1.8
1110	781	1.8	1440	512	1.8
1120	764	1.8	1450	511	1.8
1130	760	1.8	1460	508	1.8
1140	758	1.8	1470	497	1.8
1150	748	1.8	1480	493	1.8
1160	743	1.8	1490	489	1.8
1170	740	1.8	1500	485	1.8
1180	730	1.8	1510	477	1.8
1190	722	1.8	1520	471	1.8
1200	716	1.8	1530	464	1.8
1210	711	1.8	1540	457	1.8
1220	704	1.8	1550	449	1.8
1230	695	1.8	1560	445	1.8
1240	687	1.8	1570	437	1.8
1250	679	1.8	1580	431	1.8
1260	672	1.8	1590	423	1.8
1270	664	1.8	1600	415	2.0
1280	656	1.8	1610	414	2.7
1290	650	1.8	1620	403	2.8
1300	641	1.8	1630	393	2.6
1310	630	1.8	1640	387	2.5
1320	622	1.8	1650	379	2.6
1330	616	1.8	1660	369	2.6

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Wave-length	Absolute Spectral Radiance	Uncertainty	Wave-length	Absolute Spectral Radiance	Uncertainty
nm	mW m^{-2} sr^{-1} nm^{-1}	%	nm	mW m^{-2} sr^{-1} nm^{-1}	%
1670	358	2.6	2000	166.6	2.7
1680	346	2.6	2010	159.4	3.8
1690	337	2.7	2020	147.5	3.0
1700	336	2.6	2030	137.5	2.8
1710	330	2.8	2040	129.3	2.6
1720	323	2.7	2050	123.0	2.6
1730	321	2.8	2060	118.4	2.6
1740	318	2.7	2070	113.9	2.8
1750	314	2.7	2080	108.6	2.9
1760	318	2.9	2090	104.1	2.7
1770	313	2.6	2100	98.5	2.9
1780	303	2.6	2110	93.7	3.2
1790	300.0	2.9	2120	88.2	2.7
1800	289.1	2.7	2130	84.7	3.0
1810	282.0	2.6	2140	81.4	2.7
1820	267.1	2.9	2150	82.0	2.8
1830	259.1	3.1	2160	84.8	2.9
1840	243.7	2.9	2170	90.7	2.7
1850	240.7	2.8	2180	96.4	2.8
1860	238.3	2.7	2190	101.5	2.8
1870	223.0	3.1	2200	106.0	2.6
1880	233.8	2.7	2210	108.3	2.7
1890	230.0	2.7	2220	109.4	2.8
1900	214.5	2.9	2230	106.7	2.6
1910	217.3	2.8	2240	105.7	2.7
1920	210.8	2.7	2250	101.7	2.7
1930	210.0	2.6	2260	97.9	2.7
1940	207.2	3.0	2270	94.9	2.6
1950	208.9	2.6	2280	90.3	2.6
1960	201.7	2.8	2290	86.3	2.6
1970	195.7	2.5	2300	82.3	2.9
1980	184.7	2.7	2310	80.9	2.7
1990	176.8	2.6	2320	76.5	2.6

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Wave-length	Absolute Spectral Radiance	Uncertainty
nm	mW m^{-2} sr^{-1} nm^{-1}	%
2330	72.6	2.6
2340	67.6	2.8
2350	64.3	2.8
2360	63.4	2.9
2370	60.8	3.1
2380	60.0	3.6
2390	58.8	3.5
2400	57.5	3.2
2410	55.6	7.3
2420	54.0	5.1
2430	52.2	5.6
2440	54.9	5.8
2450	53.4	5.4
2460	52.4	7.3
2470	47.7	10.0
2480	48.4	8.4
2490	51.3	7.3
2500	48.9	12.2