Importing Rayfiles of LEDs from OSRAM OS

Application Note (Perliminary)

Introduction

Optical simulation software typically propagates light through an optical system by ray tracing. Light sources can be defined which emit rays from their surfaces or volumes. Many software packages accept rayfiles, which are virtual sources created from measured or calculated sources. Each ray in the file has a starting point, a direction, and associated power. OSRAM Opto Semiconductors provides rayfiles in several software formats. The properties of those rayfiles are described in this application note.

Rayfile Import Process

Rayfiles can be found at the OSRAM Opto Semiconductors product catalog website under “Application Support” at the following link:

http://catalog.osram-os.com

Under “Application Support”, select “Optical Simulation” and follow the links until you come to the desired LED product. You will come to the page labelled “Optical Simulation”, with the subtitle “Ray files/Distribution files”. There are links to a number of *.zip files. Each *.zip file contains:

- Rayfiles
- A file depicting the orientation of the rayfiles
- CAD files (for mechanical package study only)

There are several formats available. Click on the desired link, then “Save” the file to your computer. (These are large files and can take some time to download. Since the time to “Open” or “Save” is roughly the same, “Save” is recommended). When you open the *.zip file, you will see ray files of three different sizes: 100,000 (100k), 500,000 (500k), and 5,000,000 (5M) rays. If larger ray numbers are needed, contact your OSRAM OS representative.

Next, refer to the file depicting the orientation of the rayfiles (typically named *_orientation.pdf or *_info.pdf). You will see a mechanical drawing of the LED, with an (x,y,z) axis system superimposed. This shows the orientation and location of the LED when it was measured.

Before using the rayfiles in your software, consider the following:

- If an optic needs to be designed around the LED, the best focus location will need to be calculated. The procedure for doing this depends on the software package.
- The source lumens for most rayfiles are set to 1 lumen (the exception are rayfiles in SPEOS format).
- The OSRAM OS rayfiles are made such that the starting points of the rays in the rayfile must be in air.

Additional Considerations for White LED Rayfiles

The spectra of OSRAM OS white LEDs have two local maxima due to the specific generation principle of white light. The slope in the blue wavelength range has narrow width and a peak wavelength around 460 nm; the slope in the yellow wavelength range has a wide distribution with a peak wavelength around 570-590 nm, depending on the LED type.

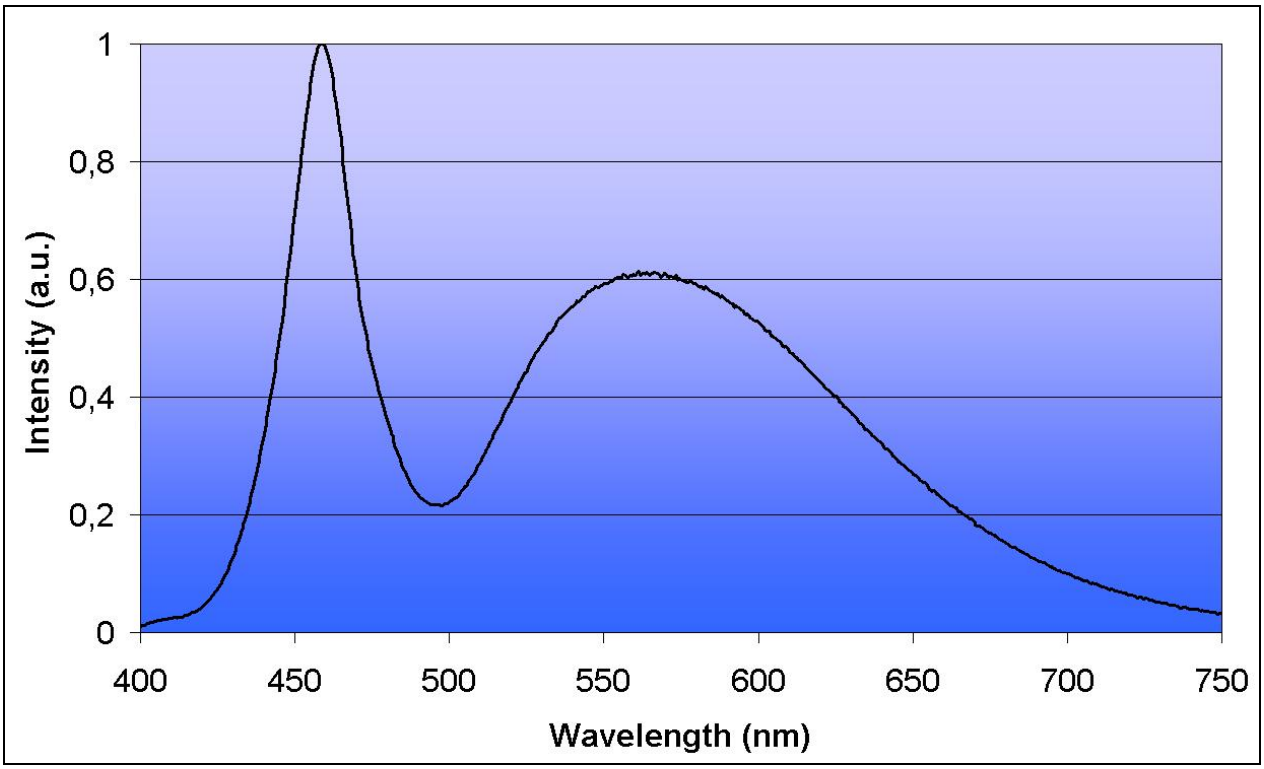

Figure 1: Typical radiometric spectrum for a white OSRAM LED.

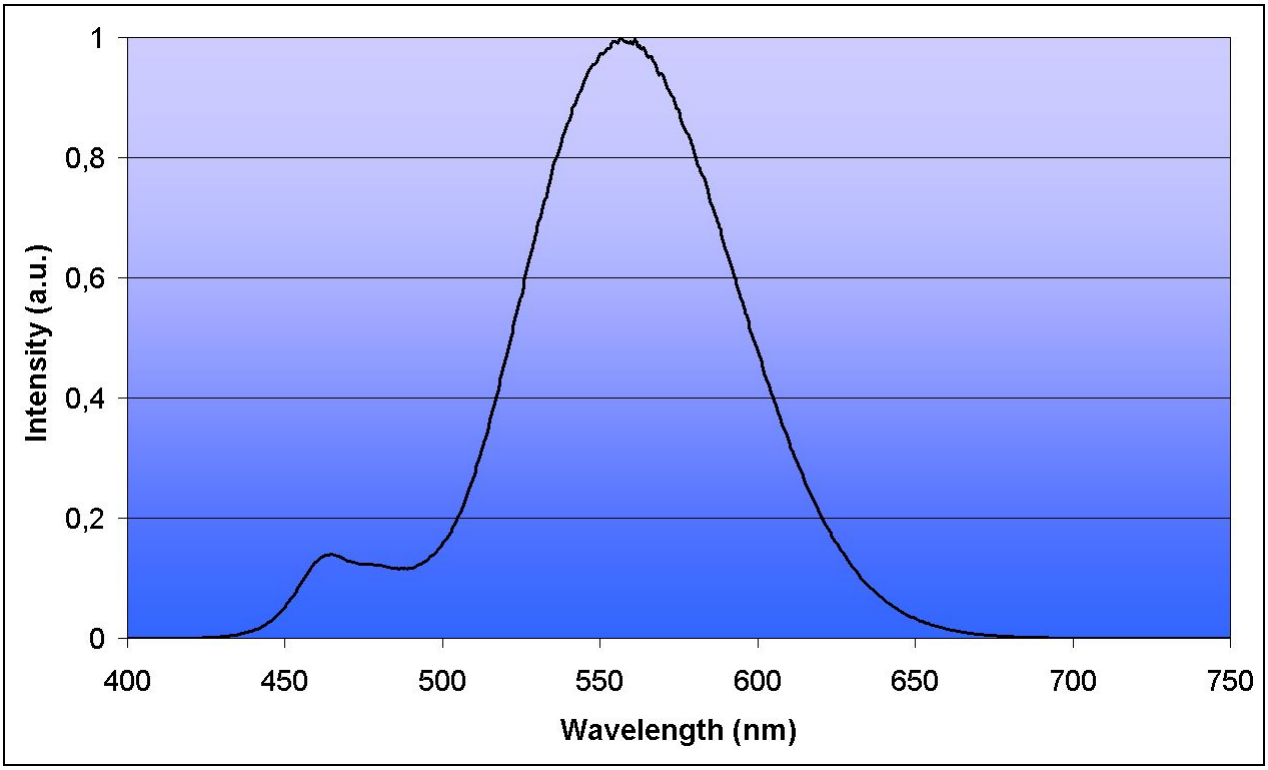

Figure 2: Typical photometric spectrum for a white OSRAM LED.

Due to the different angular characteristics of the rays in the “blue” and “yellow” parts of the spectrum, a separation of the ray model into two parts is recommended. Therefore, two rayfiles have been delivered with each white LED, one rayfile for the blue and one rayfile for the yellow part of the spectrum. Both rayfiles have the same global coordinate origin and must be placed in the simulation software at exactly the same (x,y,z) coordinates. To use the rayfiles in a simulation the user has to consider the following points:

- "blue" and "yellow" rayfiles must be placed at the same (x,y,z) coordinates
- simulation to be run simultaneously for the two rayfiles, like two overlapping sources
- luminous flux contributions of both rayfiles must be set appropriately

The luminous flux ratio between yellow and blue is slightly different for warm white, standard white and ultra white LEDs. The table below summarizes the typical ratios.

The flux ratio for a specific color bin will differ slightly from the typical value. Contact your OSRAM OS representative for more information.

If an optic needs to be designed around the LED, the best focus location will need to be calculated. The procedure for doing this depends on the software package. Again, both rayfiles need to be traced.

Spectral Data

While spectral data is not currently included with the rayfiles, spectral curves can be found in the LED datasheets. Please contact your OSRAM OS representative if you require further assistance.

In the case of a white LED, the full spectrum needs to be split into two:

- one part for the blue rayfile

and

- one part for the yellow

Instead of having a sharp division between the spectra (see Figure 3), it is advisable to add a slight overlap (Figure 4).

Some optical design software packages do not support the simulation of the complete color spectrum, but only single wavelengths. In that case, it is recommended to use the peak wavelength. For a white LED, the peak wavelength of the blue part of the spectrum should be used for the blue rayfile, and the peak wavelength of the yellow part of the spectrum should be used with the yellow rayfile.

COLOR	FLUX RATIO			
	Photometric		Radiometric	
	Yellow	Blue	Yellow	Blue
Ultra White	0,91	0,09	0,64	0,36
Standard White	0,9	0,1	0,68	0,32
Warm White	0,95	0,05	0,87	0,13

Table 1: Typical flux ratios for various LEDs.

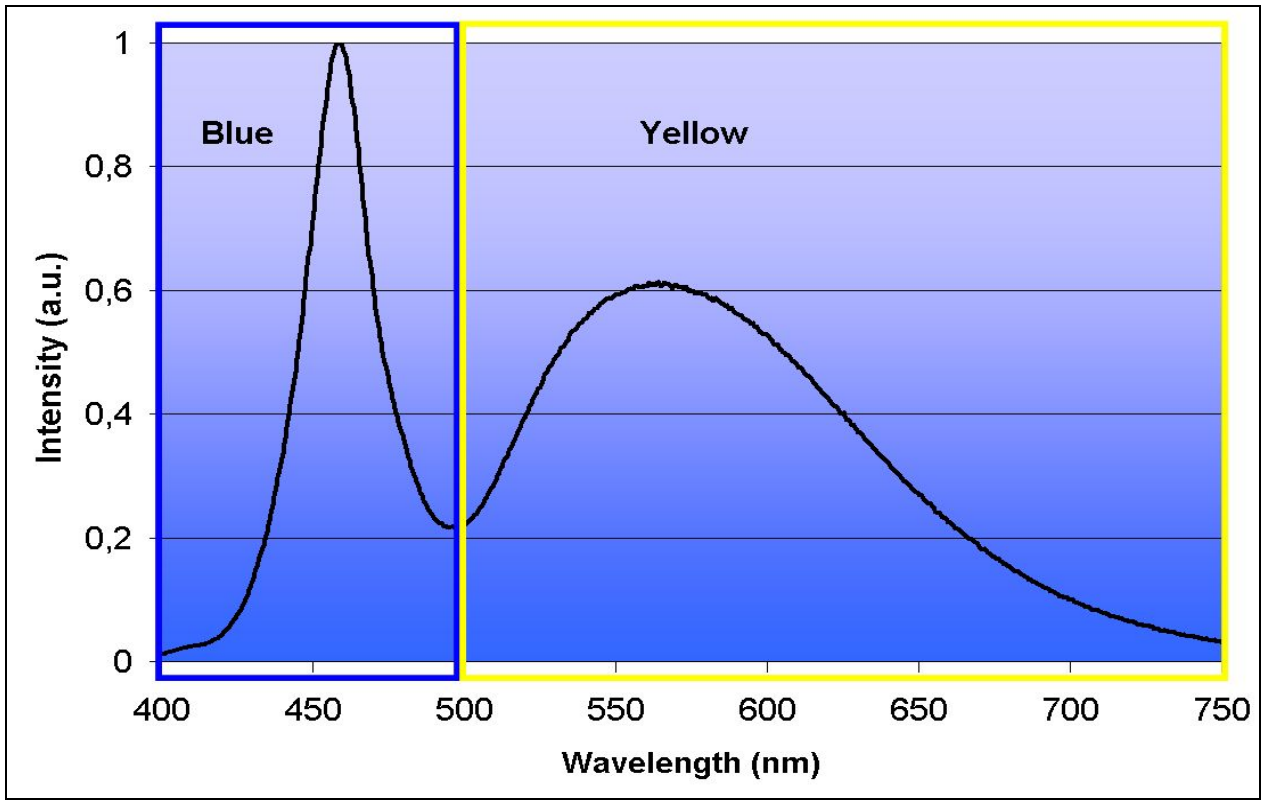

Figure 3: Sharp division of the radiometric spectrum for a white OSRAM LED into blue and yellow parts.

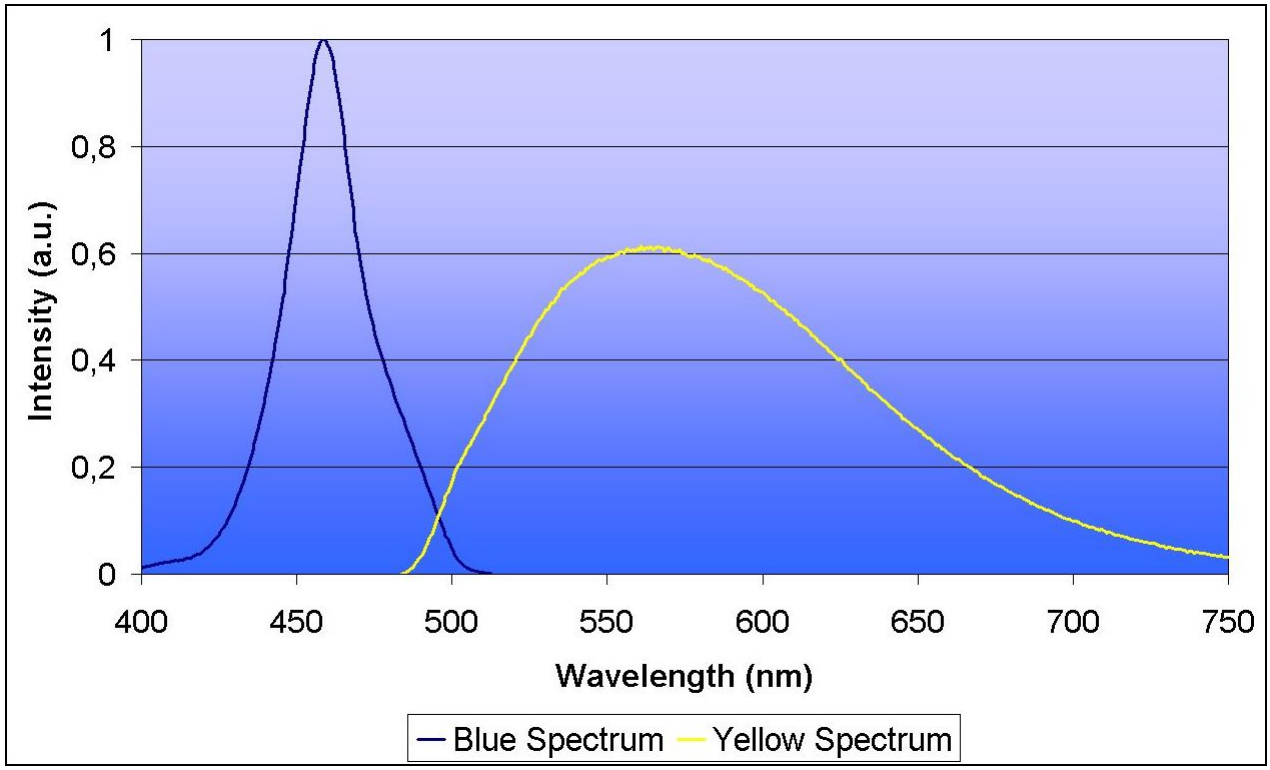

Figure 4: Recommended division of blue and yellow spectra for a white OSRAM LED.

Import Procedure Summary

1. Download *zip file with rayfiles and supporting documentation from Osram website.
2. Confirm the origin and orientation of the rayfiles from the orientation file.
3. Import the appropriate rayfiles into your optical software. (If using a white LED, import a blue and a yellow file with the same number of rays).
4. Set the source lumens to desired value. (If using a white LED, set the lumen ratio of yellow to blue).
5. Enter appropriate spectral information.
6. To find the virtual focus of the LED, trace rays and use the “best focus” function in your software to find its (x,y,z) coordinates.

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About OSRAM Opto Semiconductors

OSRAM Opto Semiconductors GmbH, Regensburg, is a wholly owned subsidiary of OSRAM GmbH, one of the world’s three largest lamp manufacturers, and offers its customers a range of solutions based on semiconductor technology for lighting, sensor and visualization applications. The company operates facilities in Regensburg (Germany), Santa Clara (USA) and Penang (Malaysia). Further information is available at www.osram-os.com.