International Commission on Illumination
Commission Internationale de l'Eclairage
Internationale Beleuchtungskommission

Userguide to the Equivalent Daylight (D65) Illuminance Toolbox

This Userguide relates to EDI Toolbox beta version E1.05 for Eindhoven Workshop

Tutorial on CIE S 026 - Use and application of the new metrology for ipRGC-influenced responses to light - 15 March 2019, Eindhoven

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Toolbox main features

- CIE S 026 calculations and conversions

  Weighted and unweighted quantities, α-opic equivalent daylight (D65) illuminance = EDI, etc.

- Irradiance or radiance geometry

  Illuminance or luminance, α-opic equivalent daylight (D65) illuminance or luminance, etc.

- Built-in illuminants

  A, D65, E, F11, LED-B3

- User-defined Test spectrum

  Choice of resolution (1, 2, 4 or 5 nm) and SI prefixes (E,P,T,G,M,k, ,m,µ,n,p,f,a) / (,c,m)^2

Toolbox optional features

- Glossary and spectral weighting charts

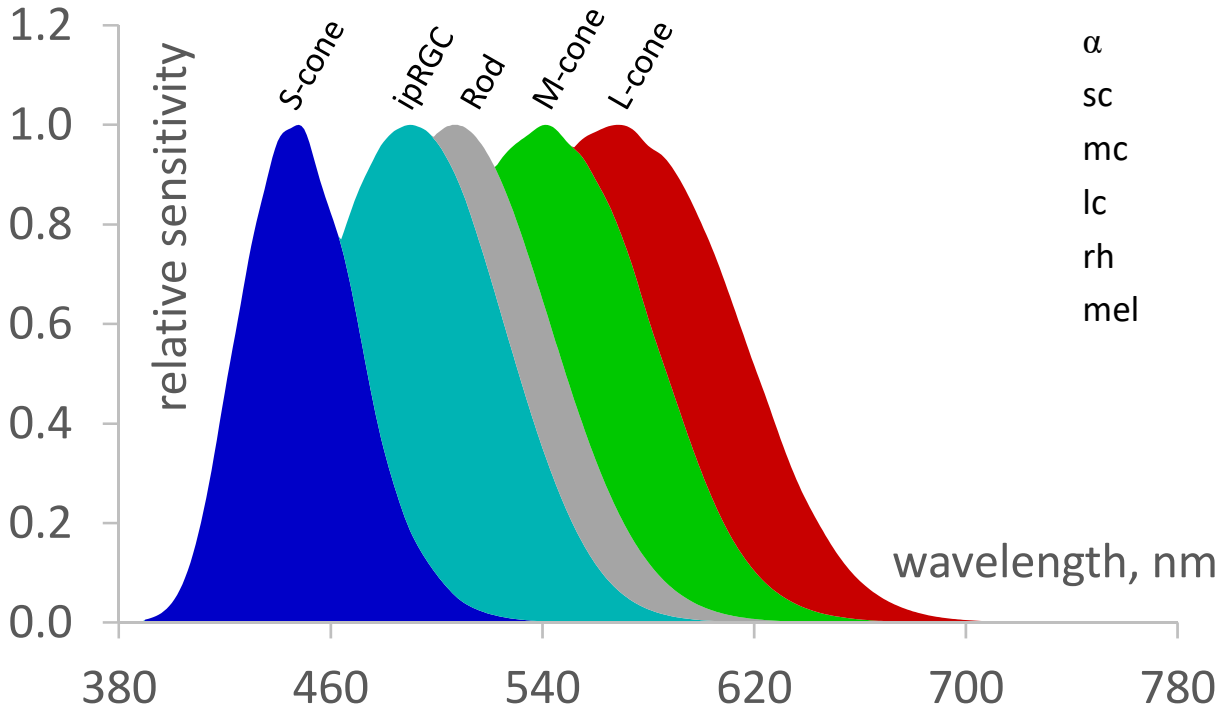
  Version will be operational until 30 June 2019, when a final version is expected to be available.

The Equivalent Daylight (D65) Illuminance Toolbox and Userguide were designed by the International Commission on Illumination ("CIE") to enable calculations and conversions of measured quantities related to the non-visual effects of light, following the international standard *CIE S 026/E:2018. System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light. CIE, Vienna*.

This beta version (v1.05X) has been designed for early release and feedback from the participants of the *Tutorial on CIE S 026. Use and application of the new metrology for ipRGC-influenced responses to light. 14-15 March 2019, Eindhoven*. It is an important disclaimer that the user of the Toolbox should always check the results against manual calculations according to the standard.

After the 30 June 2019, a final version of the Toolbox is expected to be freely available. As a result, this beta version is programmed to stop working after this date. Considered feedback or enquiries about the Toolbox should be sent to Luke.Price@phe.gov.uk and l.j.m.schlangen@tue.nl who will endeavour to answer any questions as quickly as possible. The purpose of the toolbox is to support the usage of CIE S 026 but is not part of the official International Standard.

Five photoreceptors: Five α-opic action spectra



α	pigment (receptor)
sc	S-cone-opic
mc	M-cone-opic
lc	L-cone-opic
rh	rhodopic (rods)
mel	melanopic (ipRGCs)

Examples of α-opic quantities

α-opic can be: S-cone-opic; M-cone-opic; L-cone-opic; Rhodopic; Melanopic

Quantity	Formula	Meaning	Unit
α-opic radiant flux	$\Phi_\alpha = \int \Phi_{e,\lambda}(\lambda)\, s_\alpha(\lambda)\, d\lambda$	weighted spectral power distribution (SPD) integrated over wavelength	W
α-opic irradiance	$E_\alpha = \int E_{e,\lambda}(\lambda)\, s_\alpha(\lambda)\, d\lambda$	weighted SPD integrated over wavelength per area	W/m^2
α-opic radiance	$L_\alpha = \int L_{e,\lambda}(\lambda)\, s_\alpha(\lambda)\, d\lambda$	weighted spectral radiance integrated over wavelength	$W/(m^2 \cdot sr)$
α-opic efficacy of luminous radiation	$K_{\alpha,v} = \Phi_\alpha / \Phi_V$	quotient of α-opic radiant flux, Φ_α, and luminous flux, Φ_v	W/lm
α-opic equivalent daylight (D65) illuminance	$E_{v,\alpha}^{D65} = \frac{E_\alpha}{K_{\alpha,v}^{D65}}$	Illuminance level of daylight D65, producing an equal α-opic irradiance as the test source	lx

Physical Measurement of Radiation & Light

- By definition, light can only be measured using the photometric system

Photon system	Radiometric system	Photometric system
Unbounded	Unbounded	Bounded between 360 nm and 830 nm
Physical weighting Conserved property = number	Physical weighting Conserved property = energy	Psychophysical weighting $V(\lambda)$ Conserved property = brightness

Conversion factors

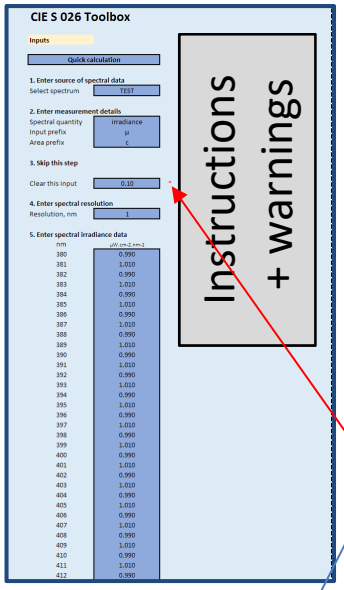
→ $(hc/\lambda).n_a(\lambda)$ → $K_{cd}.V(\lambda)$

where $K_{cd} = 683$ lm.W^{-1}

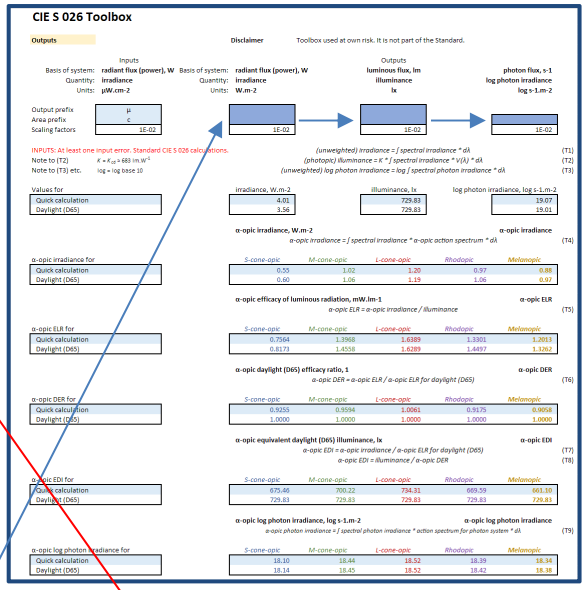
CIE S 017/E:2011 is also freely available in a searchable electronic format at eilv.cie.co.at.

Toolbox Orientation

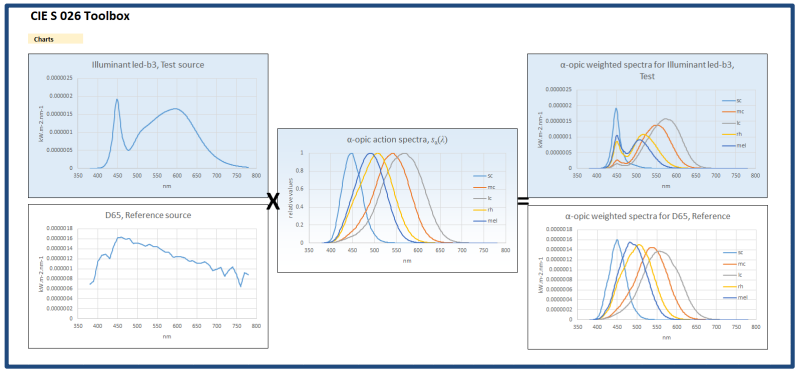
Inputs



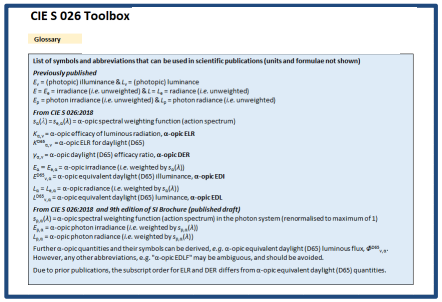
Outputs



Charts



Glossary



Dark blue = data entry

* = Error indicators

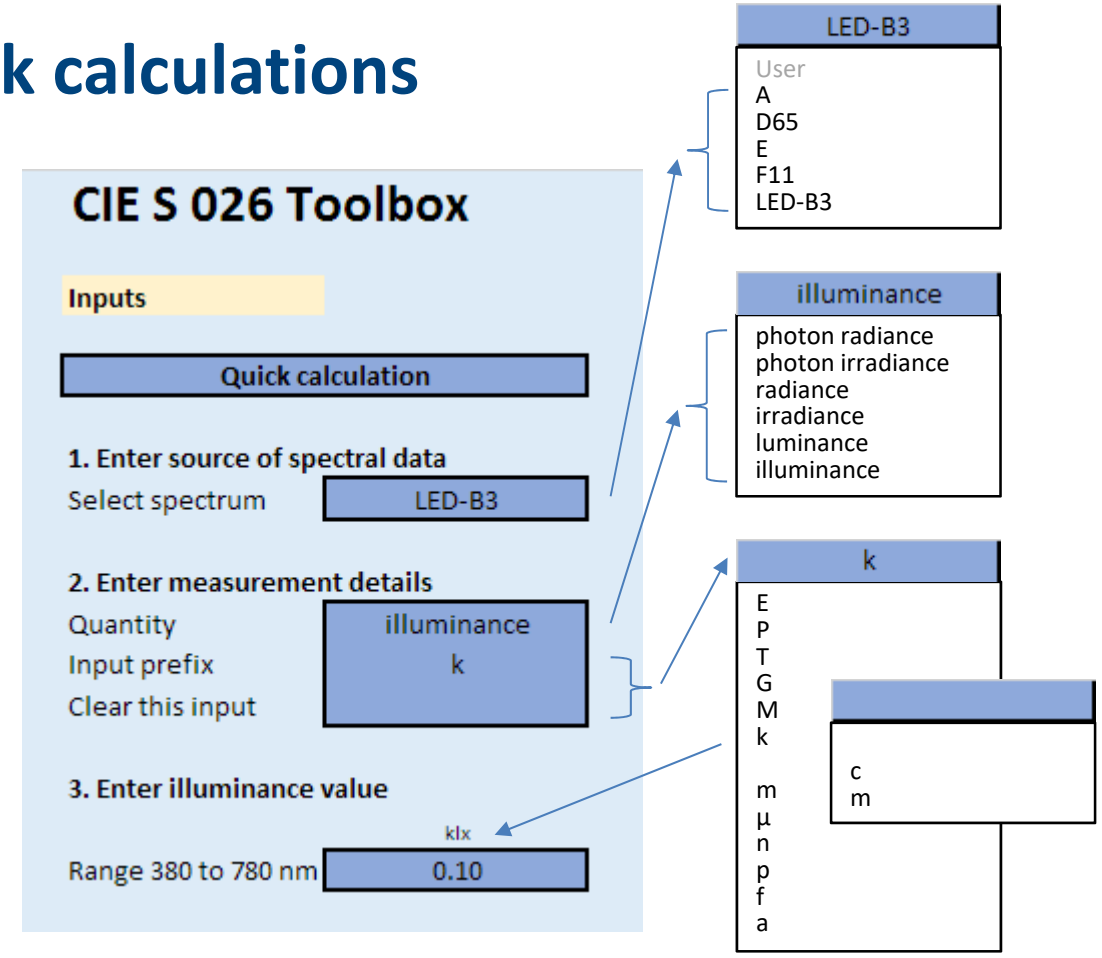
Inputs: Quick calculations

For built-in spectra

1. Select from list
   (5 CIE illuminants) **< LED-B3 >**

2. Select quantity
   (6 options) **< illuminance >**
   & units
   (SI prefixes) **< k > < blank >**

3. Enter value
   (The end) **< 0.1 klx = 100 lx >**



Outputs: Results

Three basic quantities

irradiance, illuminance and log photon irradiance

α-opic irradiance

(in $W.m^{-2}$)

α-opic ELR

efficacy of luminous radiation, (in $mW.lm^{-1}$)

α-opic DER

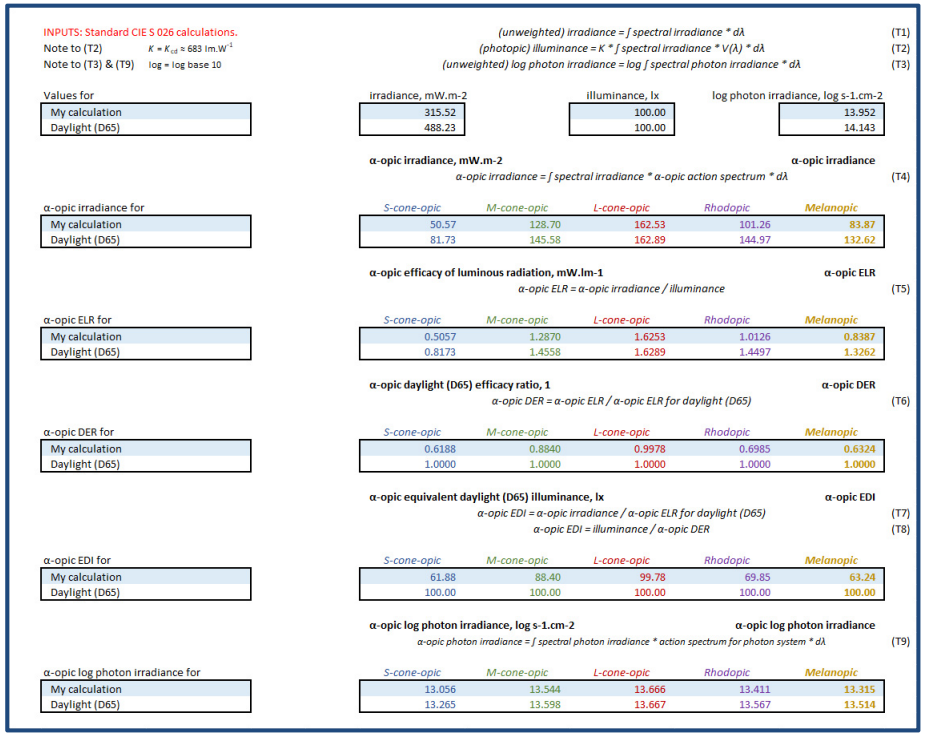
daylight (D65) efficacy ratio, (dimensionless)

α-opic EDI

equivalent daylight (D65) illuminance, (in lux)

α-opic photon irradiance

(in $\log_{10} s^{-1}.m^{-2}$)



INPUTS: Standard CIE S 026 calculations.
Note to (T2) $K = K_{cd} \approx 683\ lm.W^{-1}$
Note to (T3) & (T9) log = log base 10

*(unweighted) irradiance = ∫ spectral irradiance * dλ* (T1)
*(photopic) illuminance = K * ∫ spectral irradiance * V(λ) * dλ* (T2)
*(unweighted) log photon irradiance = log ∫ spectral photon irradiance * dλ* (T3)

Values for	irradiance, mW.m-2	illuminance, lx	log photon irradiance, log s-1.cm-2
My calculation	315.52	100.00	13.952
Daylight (D65)	488.23	100.00	14.143

α-opic irradiance, mW.m-2 — **α-opic irradiance**
*α-opic irradiance = ∫ spectral irradiance * α-opic action spectrum * dλ* (T4)

α-opic irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	50.57	128.70	162.53	101.26	83.87
Daylight (D65)	81.73	145.58	162.89	144.97	132.62

α-opic efficacy of luminous radiation, mW.lm-1 — **α-opic ELR**
α-opic ELR = α-opic irradiance / illuminance (T5)

α-opic ELR for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.5057	1.2870	1.6253	1.0126	0.8387
Daylight (D65)	0.8173	1.4558	1.6289	1.4497	1.3262

α-opic daylight (D65) efficacy ratio, 1 — **α-opic DER**
α-opic DER = α-opic ELR / α-opic ELR for daylight (D65) (T6)

α-opic DER for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.6188	0.8840	0.9978	0.6985	0.6324
Daylight (D65)	1.0000	1.0000	1.0000	1.0000	1.0000

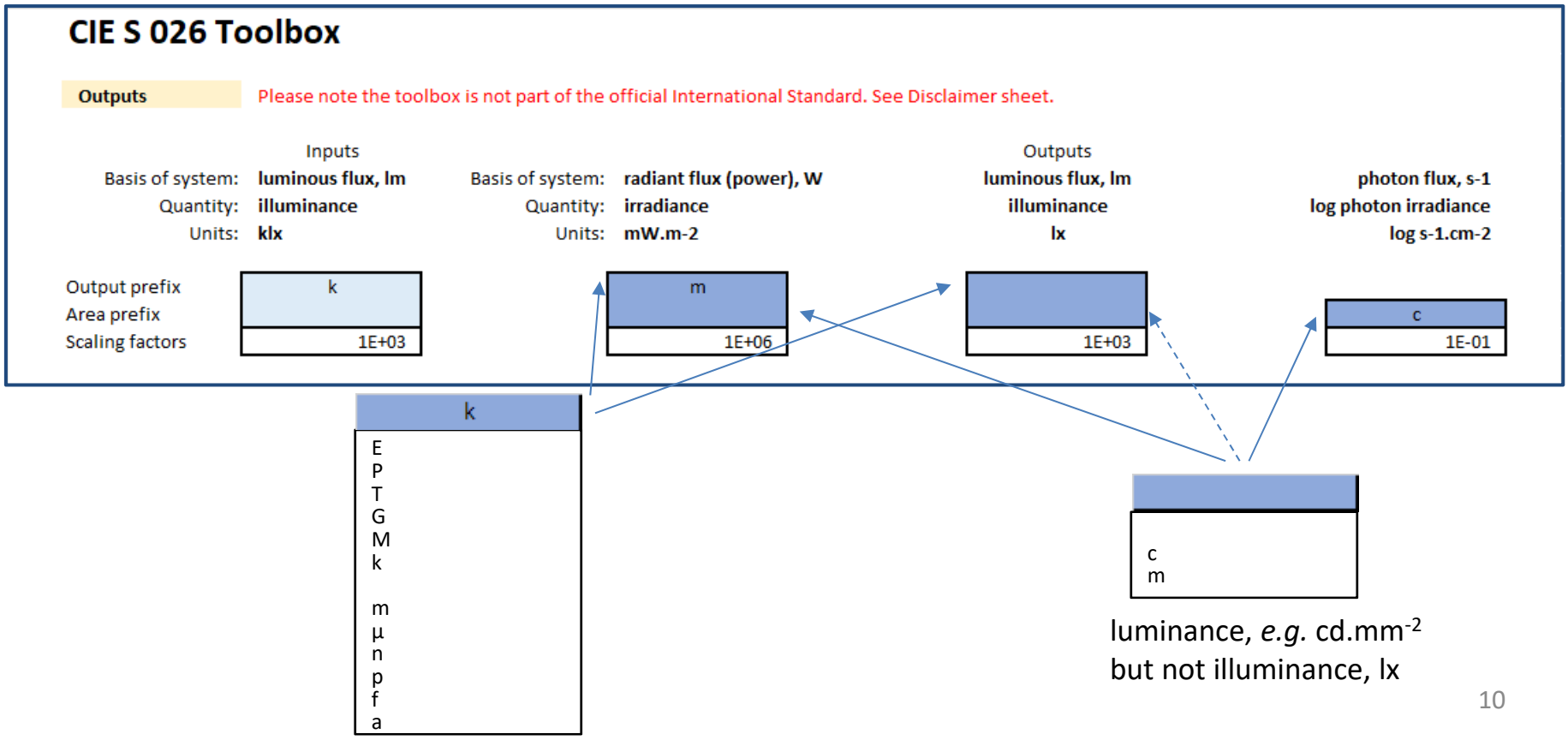
α-opic equivalent daylight (D65) illuminance, lx — **α-opic EDI**
α-opic EDI = α-opic irradiance / α-opic ELR for daylight (D65) (T7)
α-opic EDI = illuminance / α-opic DER (T8)

α-opic EDI for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	61.88	88.40	99.78	69.85	63.24
Daylight (D65)	100.00	100.00	100.00	100.00	100.00

α-opic log photon irradiance, log s-1.cm-2 — **α-opic log photon irradiance**
*α-opic photon irradiance = ∫ spectral photon irradiance * action spectrum for photon system * dλ* (T9)

α-opic log photon irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	13.056	13.544	13.666	13.411	13.315
Daylight (D65)	13.265	13.598	13.667	13.567	13.514

Outputs: SI prefixes



Outputs: Basic quantities

Irradiance

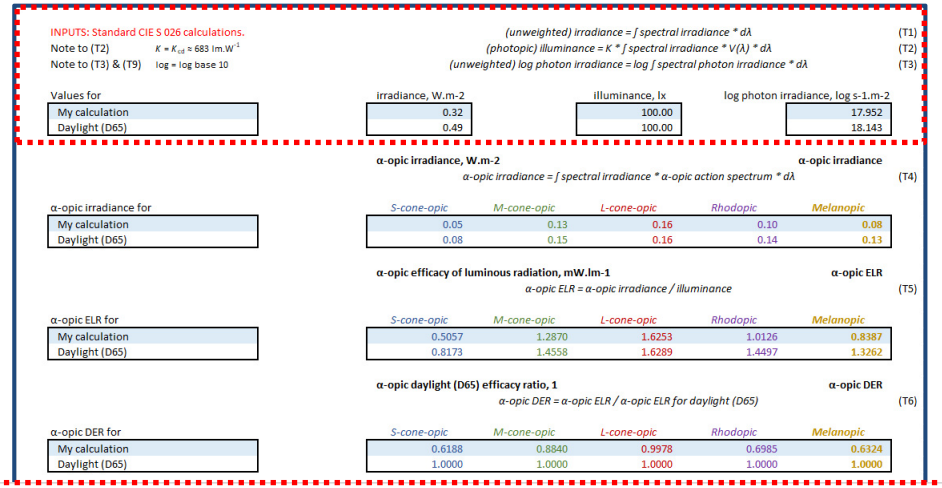
(in $W.m^{-2}$)

Illuminance

(in lux)

Log photon irradiance

(in $\log_{10} s^{-1}.m^{-2}$)



INPUTS: Standard CIE S 026 calculations.
Note to (T2) $K = K_{cd} \approx 683\ lm.W^{-1}$
Note to (T3) & (T9) log = log base 10

*(unweighted) irradiance = ∫ spectral irradiance * dλ* (T1)
*(photopic) illuminance = K * ∫ spectral irradiance * V(λ) * dλ* (T2)
*(unweighted) log photon irradiance = log ∫ spectral photon irradiance * dλ* (T3)

Values for	irradiance, W.m-2	illuminance, lx	log photon irradiance, log s-1.m-2
My calculation	0.32	100.00	17.952
Daylight (D65)	0.49	100.00	18.143

α-opic irradiance, W.m-2 — **α-opic irradiance**
*α-opic irradiance = ∫ spectral irradiance * α-opic action spectrum * dλ* (T4)

α-opic irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.05	0.13	0.16	0.10	0.08
Daylight (D65)	0.08	0.15	0.16	0.14	0.13

α-opic efficacy of luminous radiation, mW.lm-1 — **α-opic ELR**
α-opic ELR = α-opic irradiance / illuminance (T5)

α-opic ELR for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.5057	1.2870	1.6253	1.0126	0.8387
Daylight (D65)	0.8173	1.4558	1.6289	1.4497	1.3262

α-opic daylight (D65) efficacy ratio, 1 — **α-opic DER**
α-opic DER = α-opic ELR / α-opic ELR for daylight (D65) (T6)

α-opic DER for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.6188	0.8840	0.9978	0.6985	0.6324
Daylight (D65)	1.0000	1.0000	1.0000	1.0000	1.0000

INPUTS: Standard CIE S 026 calculations.
Note to (T2) $K = K_{cd} \approx 683\ lm.W^{-1}$
Note to (T3) & (T9) log = log base 10

*(unweighted) irradiance = ∫ spectral irradiance * dλ* (T1)
*(photopic) illuminance = K * ∫ spectral irradiance * V(λ) * dλ* (T2)
*(unweighted) log photon irradiance = log ∫ spectral photon irradiance * dλ* (T3)

Values for	irradiance, W.m-2	illuminance, lx	log photon irradiance, log s-1.m-2
My calculation	0.32	100.00	17.952
Daylight (D65)	0.49	100.00	18.143

Outputs: Rescaling using SI prefixes

CIE S 026 Toolbox

Outputs Please note the toolbox is not part of the official International Standard. See Disclaimer sheet.

	Inputs		Outputs		
Basis of system:	**luminous flux, lm**	Basis of system:	**radiant flux (power), W**	**luminous flux, lm**	**photon flux, s-1**
Quantity:	**illuminance**	Quantity:	**irradiance**	**illuminance**	**log photon irradiance**
Units:	**klx**	Units:	**mW.m-2**	**lx**	**log s-1.cm-2**
Output prefix	k		m		c
Area prefix					
Scaling factors	1E+03		1E+06	1E+03	1E-01

INPUTS: Standard CIE S 026 calculations.

Note to (T2) $K = K_{cd} \approx 683\ lm.W^{-1}$

Note to (T3) & (T9) log = log base 10

*(unweighted) irradiance = ∫ spectral irradiance * dλ* (T1)

*(photopic) illuminance = K * ∫ spectral irradiance * V(λ) * dλ* (T2)

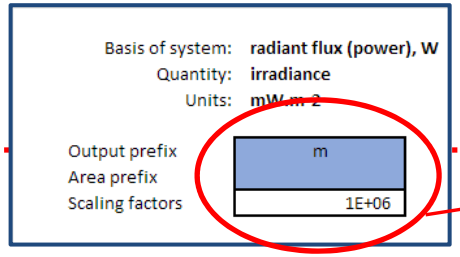
*(unweighted) log photon irradiance = log ∫ spectral photon irradiance * dλ* (T3)

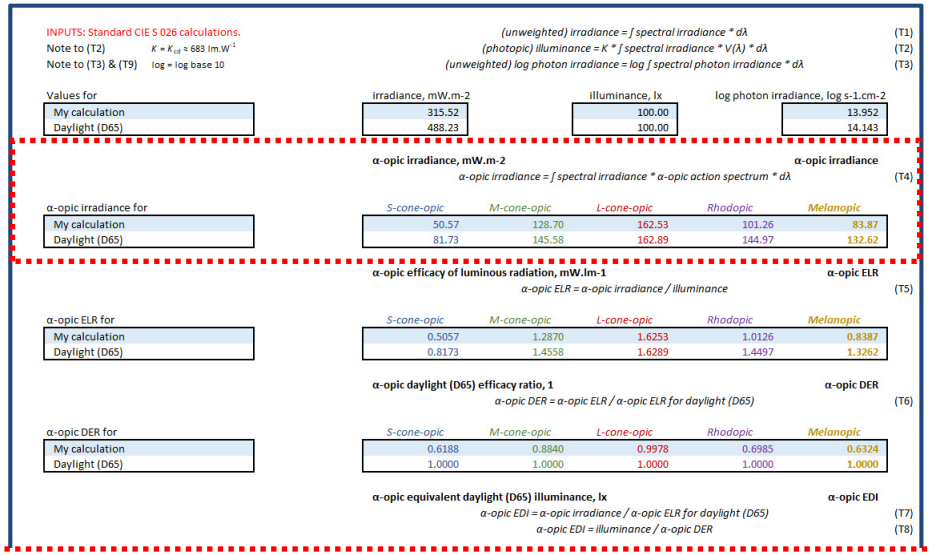
Values for	irradiance, mW.m-2	illuminance, lx	log photon irradiance, log s-1.cm-2
My calculation	315.52	100.00	13.952
Daylight (D65)	488.23	100.00	14.143

Outputs: α-opic irradiance

E_{α} [in W.m^{-2}]

"effective photobiological irradiance with the spectral irradiance, $E_{e,\lambda}(\lambda)$, spectrally weighted with the α-opic action spectrum $s_{\alpha}(\lambda)$"



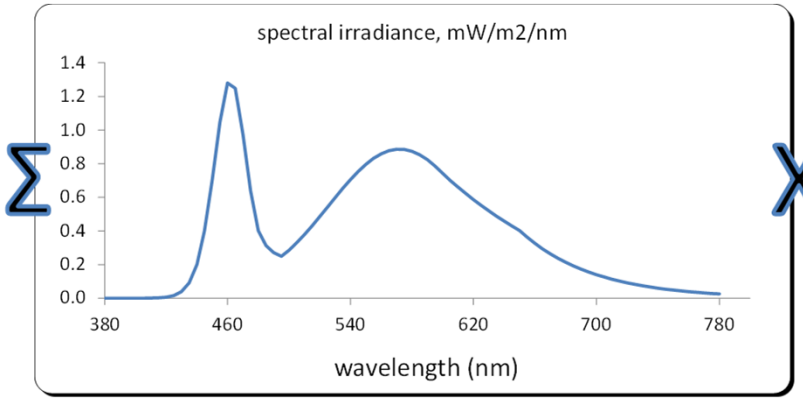


α-opic irradiance, mW.m-2 **α-opic irradiance**

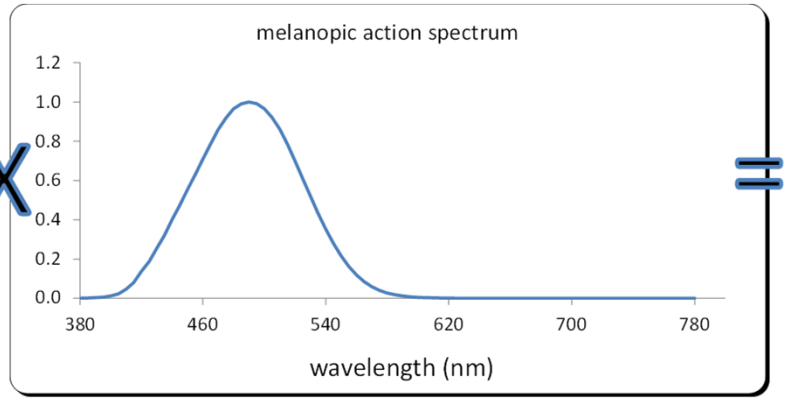
*α-opic irradiance = ∫ spectral irradiance * α-opic action spectrum * dλ* (T4)

α-opic irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	50.57	128.70	162.53	101.26	83.87
Daylight (D65)	81.73	145.58	162.89	144.97	132.62

Calculating melanopic irradiance



$\sum$ X



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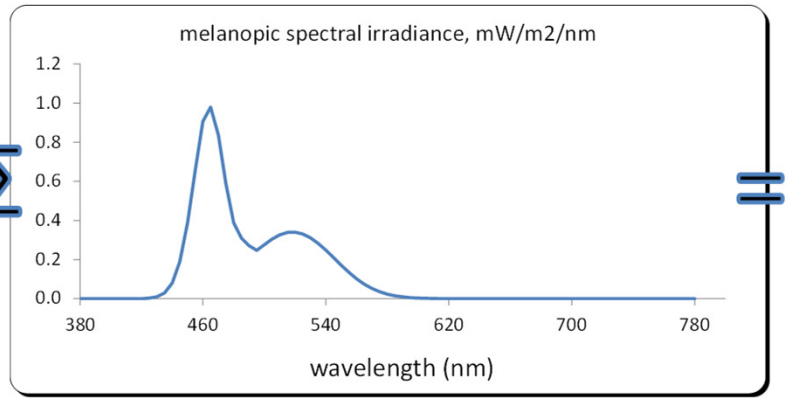
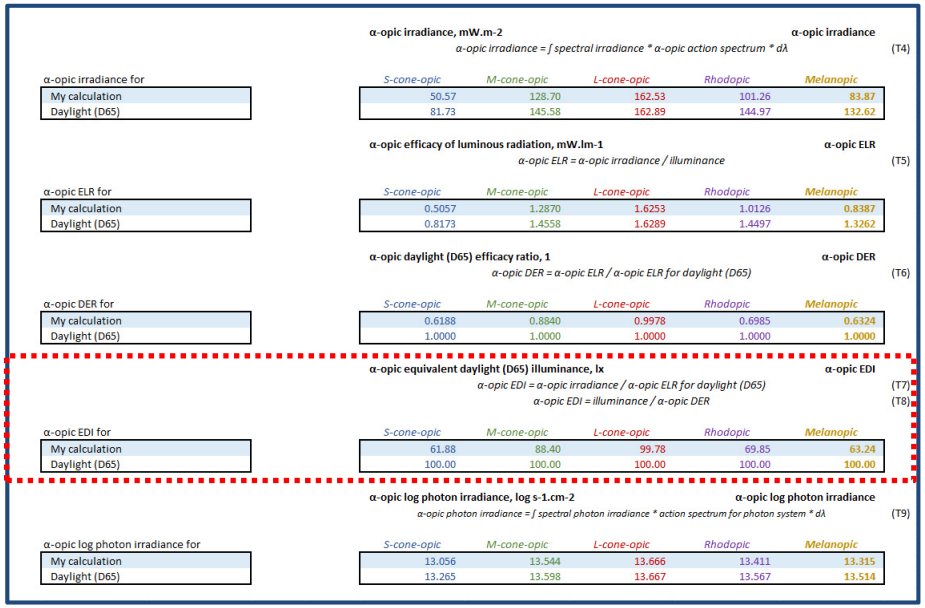


$\sum$ = 83.9 mW.m^{-2}

Outputs: α-opic EDI

EDI = Equivalent Daylight (D65) Illuminance

"illuminance produced by radiation conforming to standard daylight (D65) that provides an equal α-opic irradiance, as the test source"



α-opic irradiance, mW.m-2 — **α-opic irradiance**

*α-opic irradiance = ∫ spectral irradiance * α-opic action spectrum * dλ* (T4)

α-opic irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	50.57	128.70	162.53	101.26	83.87
Daylight (D65)	81.73	145.58	162.89	144.97	132.62

α-opic efficacy of luminous radiation, mW.lm-1 — **α-opic ELR**

α-opic ELR = α-opic irradiance / illuminance (T5)

α-opic ELR for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.5057	1.2870	1.6253	1.0126	0.8387
Daylight (D65)	0.8173	1.4558	1.6289	1.4497	1.3262

α-opic daylight (D65) efficacy ratio, 1 — **α-opic DER**

α-opic DER = α-opic ELR / α-opic ELR for daylight (D65) (T6)

α-opic DER for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.6188	0.8840	0.9978	0.6985	0.6324
Daylight (D65)	1.0000	1.0000	1.0000	1.0000	1.0000

α-opic equivalent daylight (D65) illuminance, lx — **α-opic EDI**

α-opic EDI = α-opic irradiance / α-opic ELR for daylight (D65) (T7)

α-opic EDI = illuminance / α-opic DER (T8)

α-opic EDI for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	61.88	88.40	99.78	69.85	63.24
Daylight (D65)	100.00	100.00	100.00	100.00	100.00

α-opic log photon irradiance, log s-1.cm-2 — **α-opic log photon irradiance**

*α-opic photon irradiance = ∫ spectral photon irradiance * action spectrum for photon system * dλ* (T9)

α-opic log photon irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	13.056	13.544	13.666	13.411	13.315
Daylight (D65)	13.265	13.598	13.667	13.567	13.514

α-opic equivalent daylight (D65) illuminance, lx — **α-opic EDI**

α-opic EDI = α-opic irradiance / α-opic ELR for daylight (D65) (T7)

α-opic EDI = illuminance / α-opic DER (T8)

α-opic EDI for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	61.88	88.40	99.78	69.85	63.24
Daylight (D65)	100.00	100.00	100.00	100.00	100.00

Outputs: Calculation of α-opic EDI

EDI = Equivalent Daylight (D65) Illuminance

"illuminance produced by radiation conforming to standard daylight (D65) that provides an equal α-opic irradiance, as the test source"

$$E_{v,\alpha}^{D65} = E_{\alpha} \cdot E_{v}^{D65} / E_{\alpha}^{D65}$$

$$K_{\alpha,v}^{D65} = E_{\alpha}^{D65} / E_{v}^{D65}$$

$$E_{v,\alpha}^{D65} = E_{\alpha} / K_{\alpha,v}^{D65}$$

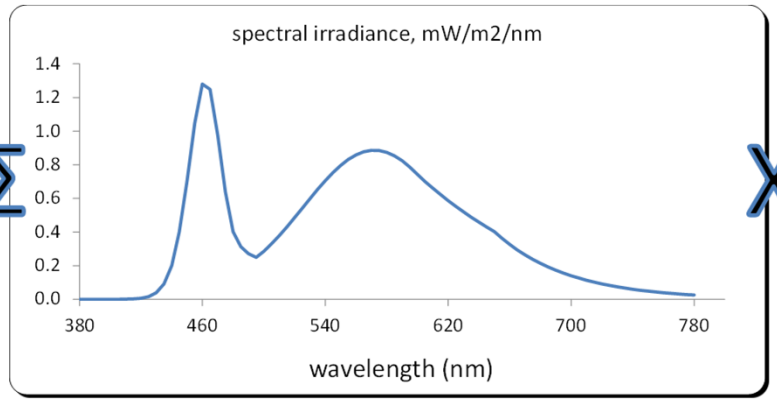
α-opic equivalent daylight (D65) illuminance, lx — **α-opic EDI**

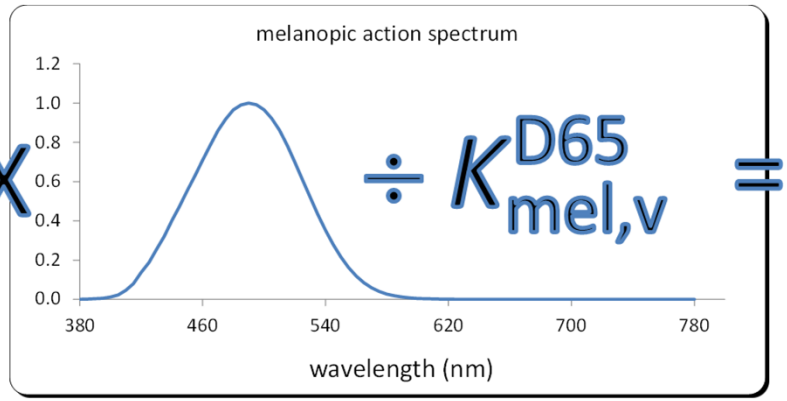
α-opic EDI = α-opic irradiance / α-opic ELR for daylight (D65) (T7)

α-opic EDI = illuminance / α-opic DER (T8)

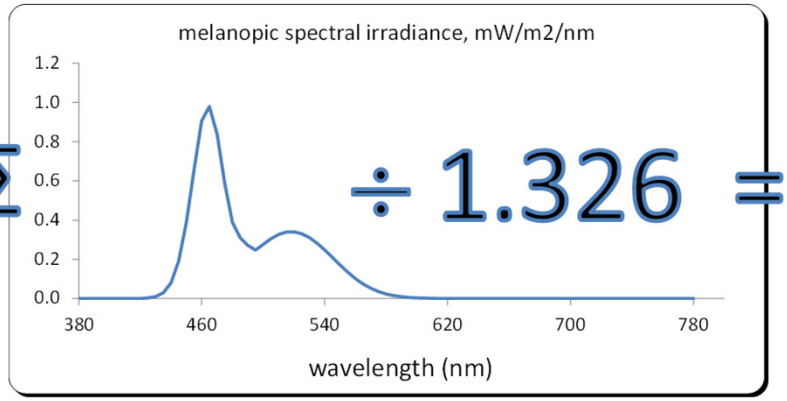
α-opic EDI for	*S-cone-opic*	*M-cone-opic*	*L-cone-opic*	*Rhodopic*	*Melanopic*
My calculation	61.88	88.40	99.78	69.85	63.24
Daylight (D65)	100.00	100.00	100.00	100.00	100.00

Calculating melanopic equivalent daylight (D65) illuminance

$\sum$ 

$\times$ 

$\div K_{mel,v}^{D65} =$

$\sum$ 

$\div 1.326 = 63.2$ lux

Calculation summary

melanopic irradiance	$83.9\ mW.m^{-2}$	$1\ mW.m^{-2}$
÷	÷	÷
melanopic ELR	$1.326\ mW.lm^{-1}$	$1\ mW.lm^{-1}$
=	=	=
melanopic EDI	$63.2\ lux$	$1\ lm.m^{-2}$ = $1\ lux$

Outputs: α-opic photon irradiance

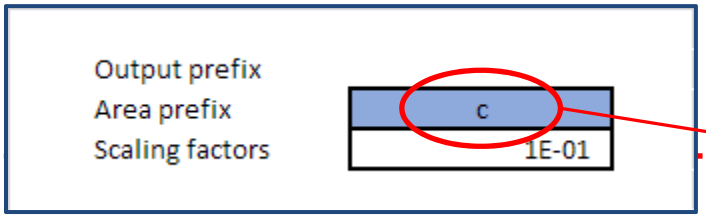
$E_{\mathrm{p},\alpha}$ [in $s^{-1}.m^{-2}$]

"effective photobiological photon irradiance with the spectral photon irradiance, $E_{\mathrm{p},\lambda}(\lambda)$ (or number of photons per second per square metre), spectrally weighted with the α-opic action spectrum $s_{\mathrm{p},\alpha}(\lambda)$"

Measurement value (input sheet)

The value should match the quantity name and units selected, and shown above. Leave blank if using a spectral input.

Displayed to 2 d.p., but enter to required accuracy. Take extra care with accuracy for log quantities.



α-opic log photon irradiance, log s-1.cm-2 **α-opic log photon irradiance**

*α-opic photon irradiance = ∫ spectral photon irradiance * action spectrum for photon system * dλ* (T9)

α-opic log photon irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	13.056	13.544	13.666	13.411	13.315
Daylight (D65)	13.265	13.598	13.667	13.567	13.514

Inputs: User-defined spectrum

For user spectra

1. Select TEST

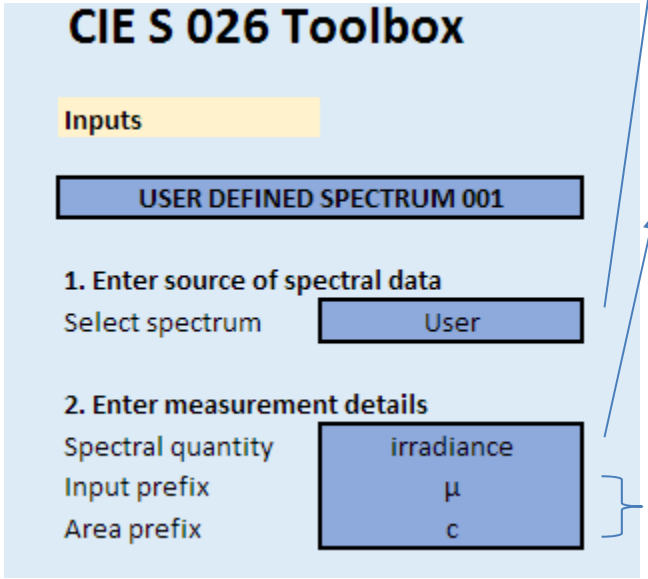
   < User >

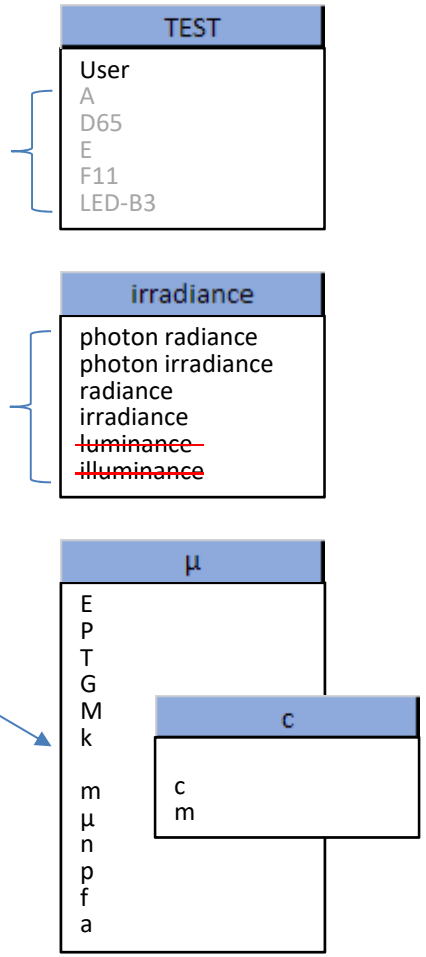
2. Select quantity

   (4 options) **< irradiance >**

   & units

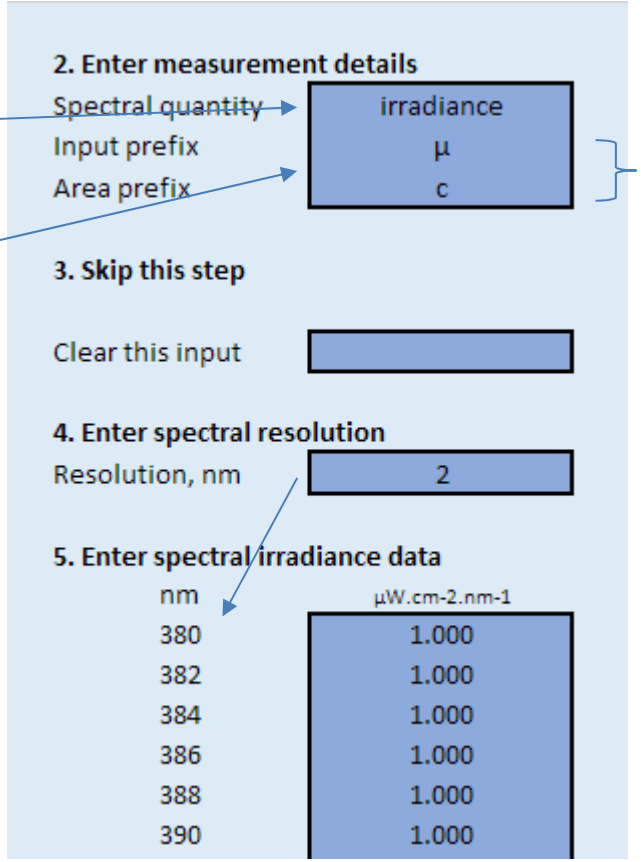
   (SI prefixes) **< µ > < c >**





Inputs: User-defined spectrum (2)

2. Select quantity
   (4 options) **< irradiance >**
   & units
   (SI prefixes) **< µ > < c >**
3. Clear step 3
4. Enter resolution
   (1,2,4 or 5 nm) **< 2 >**
5. and spectrum
   (380 nm to 780 nm)



Outputs: what else (1)

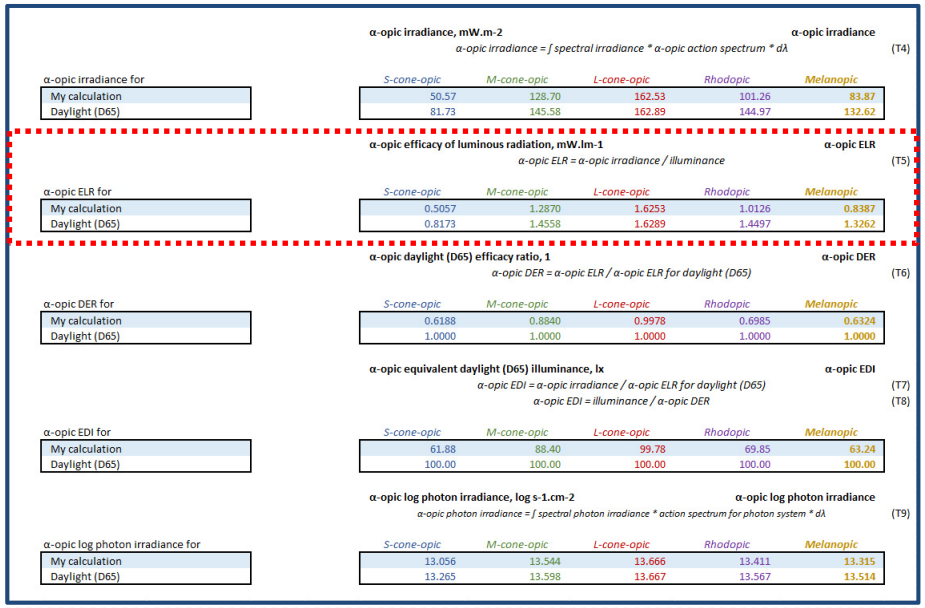
α-opic ELR [in mW.lm^{-1}]

(efficacy of luminous radiation)

$$K_{\alpha,\mathrm{v}}^{\mathrm{D65}} = E_{\alpha}^{\mathrm{D65}} / E_{\mathrm{v}}^{\mathrm{D65}}$$

Why? Because…

$$E_{\mathrm{v},\alpha}^{\mathrm{D65}} = E_{\alpha} / K_{\alpha,\mathrm{v}}^{\mathrm{D65}}$$



α-opic irradiance, mW.m-2 — **α-opic irradiance**

*α-opic irradiance = ∫ spectral irradiance * α-opic action spectrum * dλ* (T4)

α-opic irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	50.57	128.70	162.53	101.26	83.87
Daylight (D65)	81.73	145.58	162.89	144.97	132.62

α-opic efficacy of luminous radiation, mW.lm-1 — **α-opic ELR**

α-opic ELR = α-opic irradiance / illuminance (T5)

α-opic ELR for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.5057	1.2870	1.6253	1.0126	0.8387
Daylight (D65)	0.8173	1.4558	1.6289	1.4497	1.3262

α-opic daylight (D65) efficacy ratio, 1 — **α-opic DER**

α-opic DER = α-opic ELR / α-opic ELR for daylight (D65) (T6)

α-opic DER for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.6188	0.8840	0.9978	0.6985	0.6324
Daylight (D65)	1.0000	1.0000	1.0000	1.0000	1.0000

α-opic equivalent daylight (D65) illuminance, lx — **α-opic EDI**

α-opic EDI = α-opic irradiance / α-opic ELR for daylight (D65) (T7)

α-opic EDI = illuminance / α-opic DER (T8)

α-opic EDI for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	61.88	88.40	99.78	69.85	63.24
Daylight (D65)	100.00	100.00	100.00	100.00	100.00

α-opic log photon irradiance, log s-1.cm-2 — **α-opic log photon irradiance**

*α-opic photon irradiance = ∫ spectral photon irradiance * action spectrum for photon system * dλ* (T9)

α-opic log photon irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	13.056	13.544	13.666	13.411	13.315
Daylight (D65)	13.265	13.598	13.667	13.567	13.514

α-opic efficacy of luminous radiation, mW.lm-1 — **α-opic ELR**

α-opic ELR = α-opic irradiance / illuminance (T5)

α-opic ELR for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.5057	1.2870	1.6253	1.0126	0.8387
Daylight (D65)	0.8173	1.4558	1.6289	1.4497	1.3262

Outputs: what else (2)

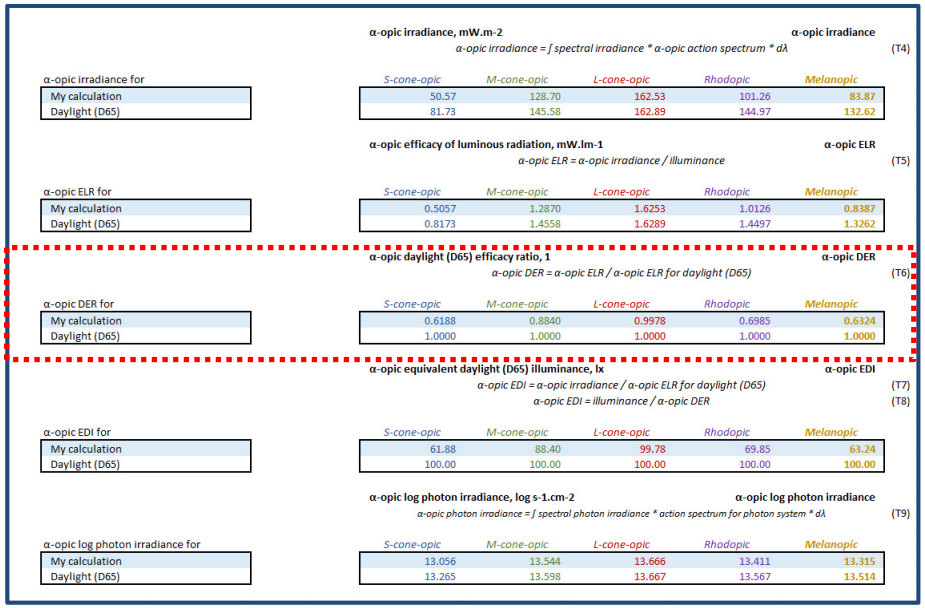
α-opic DER [no units]

(daylight (D65) efficacy ratio)

$$\gamma_{\alpha,\mathrm{v}}^{\mathrm{D65}} = K_{\alpha,\mathrm{v}} / K_{\alpha,\mathrm{v}}^{\mathrm{D65}}$$

Why? Because…

$$E_{\mathrm{v},\alpha}^{\mathrm{D65}} = E_{\mathrm{v}} \cdot \gamma_{\alpha,\mathrm{v}}^{\mathrm{D65}}$$



α-opic irradiance, mW.m-2 — **α-opic irradiance**

*α-opic irradiance = ∫ spectral irradiance * α-opic action spectrum * dλ* (T4)

α-opic irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	50.57	128.70	162.53	101.26	83.87
Daylight (D65)	81.73	145.58	162.89	144.97	132.62

α-opic efficacy of luminous radiation, mW.lm-1 — **α-opic ELR**

α-opic ELR = α-opic irradiance / illuminance (T5)

α-opic ELR for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.5057	1.2870	1.6253	1.0126	0.8387
Daylight (D65)	0.8173	1.4558	1.6289	1.4497	1.3262

α-opic daylight (D65) efficacy ratio, 1 — **α-opic DER**

α-opic DER = α-opic ELR / α-opic ELR for daylight (D65) (T6)

α-opic DER for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	0.6188	0.8840	0.9978	0.6985	0.6324
Daylight (D65)	1.0000	1.0000	1.0000	1.0000	1.0000

α-opic equivalent daylight (D65) illuminance, lx — **α-opic EDI**

α-opic EDI = α-opic irradiance / α-opic ELR for daylight (D65) (T7)

α-opic EDI = illuminance / α-opic DER (T8)

α-opic EDI for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	61.88	88.40	99.78	69.85	63.24
Daylight (D65)	100.00	100.00	100.00	100.00	100.00

α-opic log photon irradiance, log s-1.cm-2 — **α-opic log photon irradiance**

*α-opic photon irradiance = ∫ spectral photon irradiance * action spectrum for photon system * dλ* (T9)

α-opic log photon irradiance for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
My calculation	13.056	13.544	13.666	13.411	13.315
Daylight (D65)	13.265	13.598	13.667	13.567	13.514

α-opic daylight (D65) efficacy ratio, 1 — **α-opic DER**

α-opic DER = α-opic ELR / α-opic ELR for daylight (D65) (T6)

α-opic DER for	S-cone-opic	M-cone-opic	L-cone-opic	Rhodopic	Melanopic
USER DEFINED SPECTRUM 001	0.6188	0.8840	0.9978	0.6985	0.6324
Daylight (D65)	1.0000	1.0000	1.0000	1.0000	1.0000

Glossary

List of symbols and abbreviations that can be used in scientific publications (units and formulae not shown)

Previously published

E_v = (photopic) illuminance & L_v = (photopic) luminance
$E = E_e$ = irradiance (*i.e.* unweighted) & $L = L_e$ = radiance (*i.e.* unweighted)
E_p = photon irradiance (*i.e.* unweighted) & L_p = photon radiance (*i.e.* unweighted)

From CIE S 026:2018

$s_\alpha(\lambda) = s_{e,\alpha}(\lambda)$ = α-opic spectral weighting function (action spectrum)

$K_{\alpha,v}$ = α-opic efficacy of luminous radiation, **α-opic ELR**
$K^{D65}{}_{\alpha,v}$ = α-opic ELR for daylight (D65)

$\gamma_{\alpha,v}$ = α-opic daylight (D65) efficacy ratio, **α-opic DER**

$E_\alpha = E_{e,\alpha}$ = α-opic irradiance (*i.e.* weighted by $s_\alpha(\lambda)$)
$E^{D65}{}_{v,\alpha}$ = α-opic equivalent daylight (D65) illuminance, **α-opic EDI**

$L_\alpha = L_{e,\alpha}$ = α-opic radiance (*i.e.* weighted by $s_\alpha(\lambda)$)
$L^{D65}{}_{v,\alpha}$ = α-opic equivalent daylight (D65) luminance, **α-opic EDL**

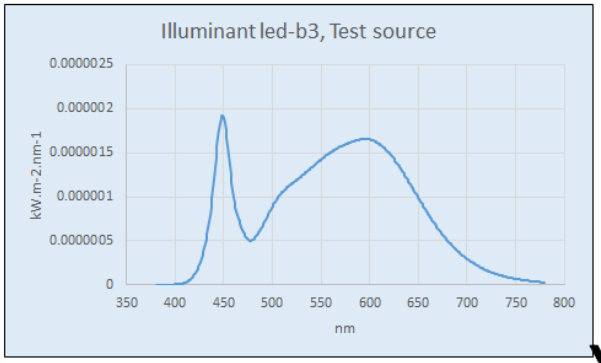
From CIE S 026:2018 and 9th edition of SI Brochure (published draft)

$s_{p,\alpha}(\lambda)$ = α-opic spectral weighting function (action spectrum) in the photon system (renormalised to maximum of 1)
$E_{p,\alpha}$ = α-opic photon irradiance (*i.e.* weighted by $s_{p,\alpha}(\lambda)$)
$L_{p,\alpha}$ = α-opic photon radiance (*i.e.* weighted by $s_{p,\alpha}(\lambda)$)

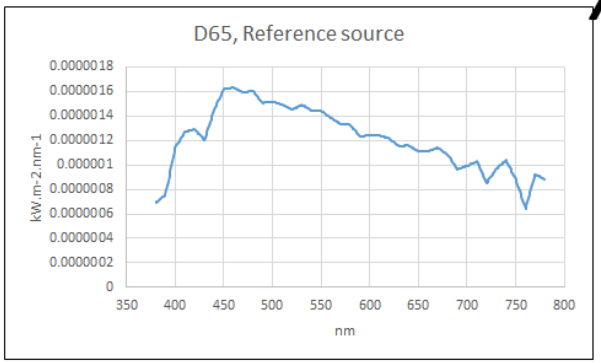
Further α-opic quantities and their symbols can be derived, *e.g.* α-opic equivalent daylight (D65) luminous flux, $\Phi^{D65}{}_{v,\alpha}$. However, any other abbreviations, e.g. "α-opic EDLF" may be ambiguous, and should be avoided.

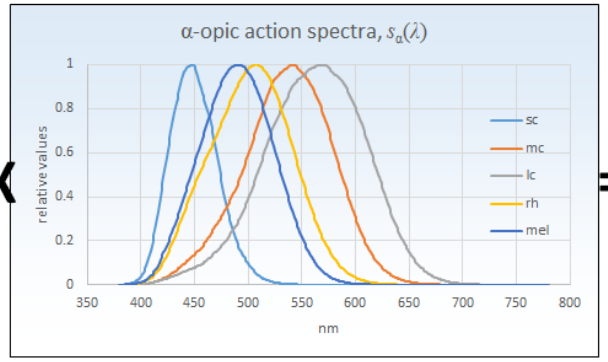
Due to prior publications, the subscript order for ELR and DER differs from α-opic equivalent daylight (D65) quantities.

Charts

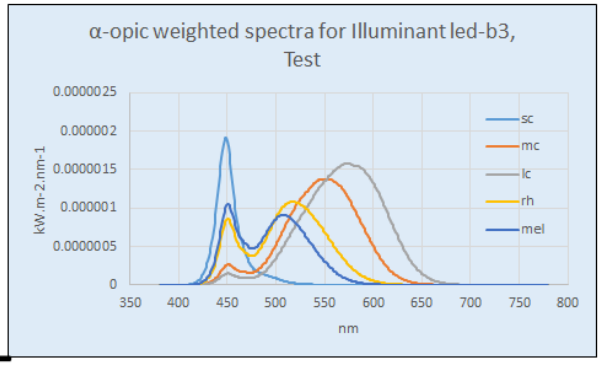

Illuminant led-b3, Test source
kW.m-2.nm-1
0.0000025
0.000002
0.0000015
0.000001
0.0000005
0
350 400 450 500 550 600 650 700 750 800
nm

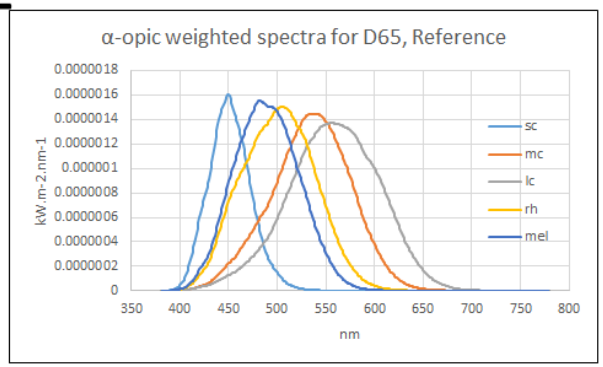
X


D65, Reference source
kW.m-2.nm-1
0.0000018
0.0000016
0.0000014
0.0000012
0.000001
0.0000008
0.0000006
0.0000004
0.0000002
0
350 400 450 500 550 600 650 700 750 800
nm


α-opic action spectra, $s_\alpha(\lambda)$
relative values
1
0.8
0.6
0.4
0.2
0
350 400 450 500 550 600 650 700 750 800
nm
sc
mc
lc
rh
mel

=


α-opic weighted spectra for Illuminant led-b3, Test
kW.m-2.nm-1
0.0000025
0.000002
0.0000015
0.000001
0.0000005
0
350 400 450 500 550 600 650 700 750 800
nm
sc
mc
lc
rh
mel


α-opic weighted spectra for D65, Reference
kW.m-2.nm-1
0.0000018
0.0000016
0.0000014
0.0000012
0.000001
0.0000008
0.0000006
0.0000004
0.0000002
0
350 400 450 500 550 600 650 700 750 800
nm
sc
mc
lc
rh
mel