MELANOPIC EQUIVALENT DAYLIGHT ILLUMINANCE

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MAY I INTRODUCE MYSELF?

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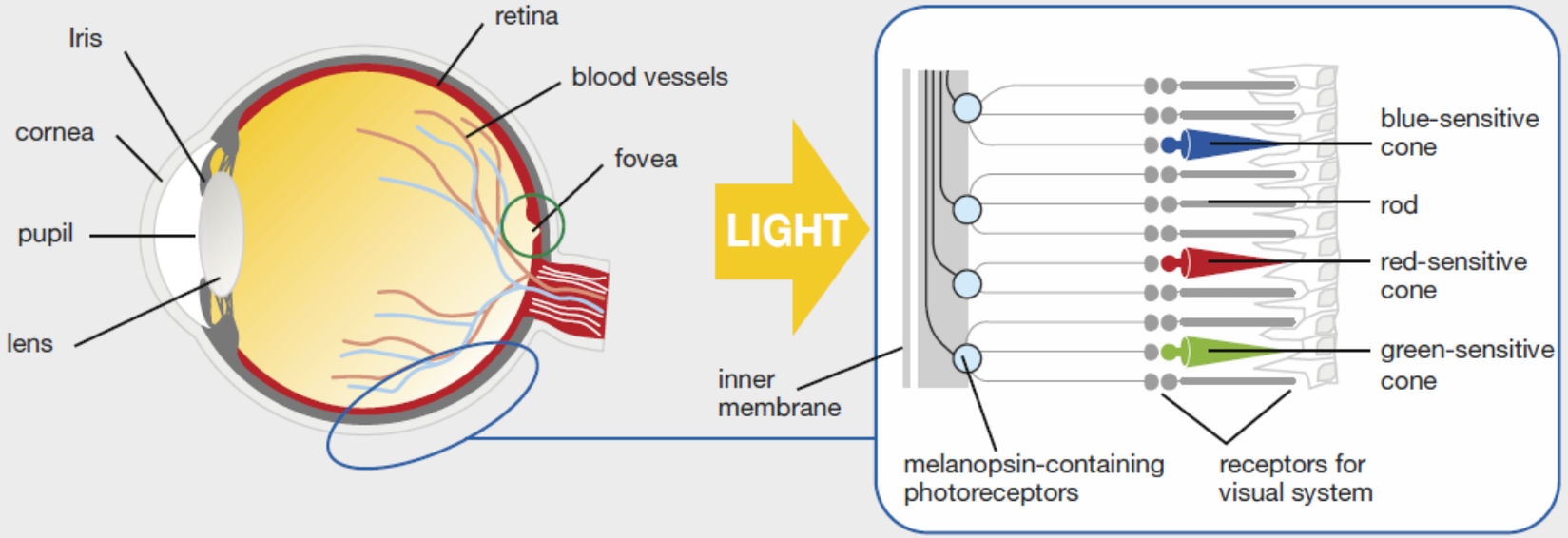
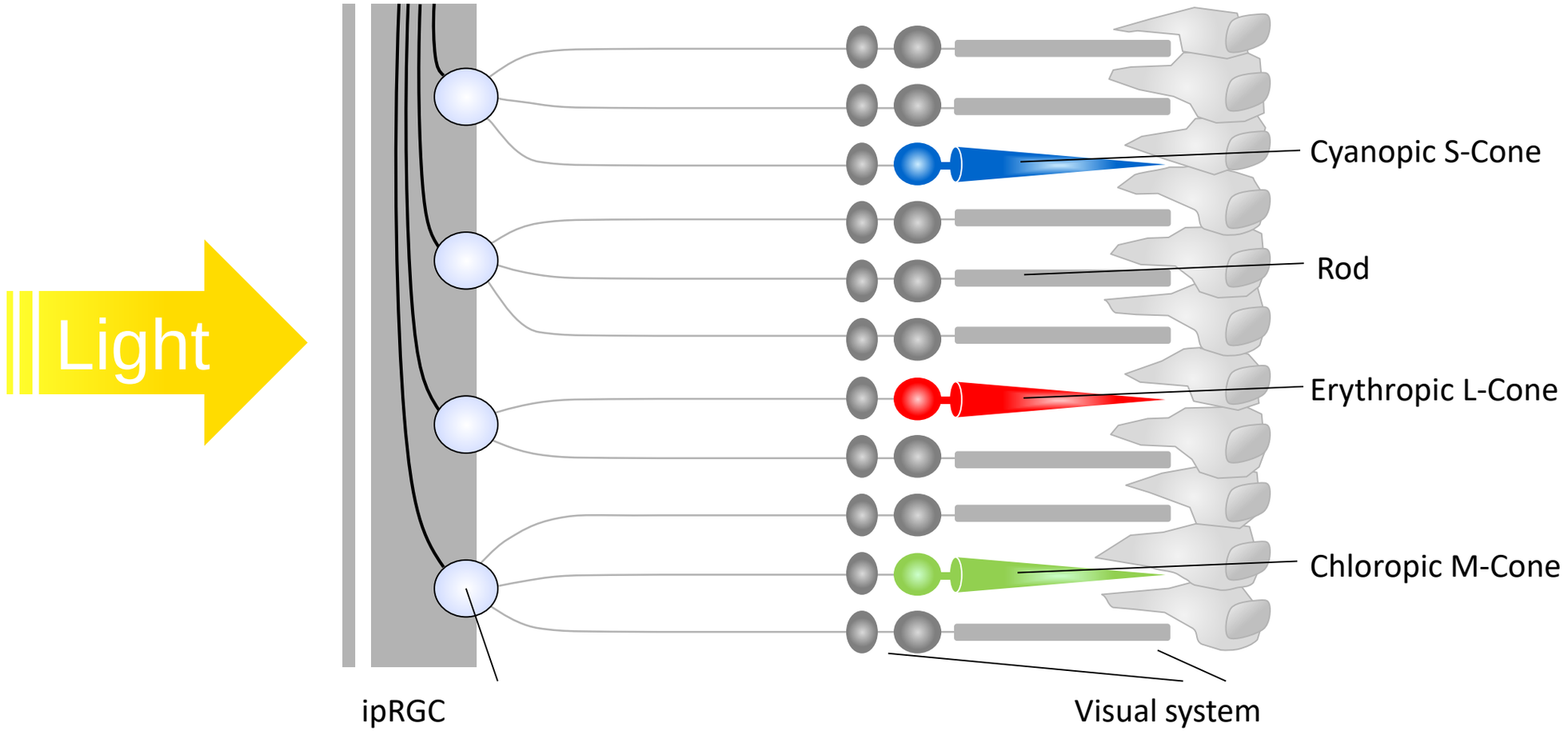
THE EYE

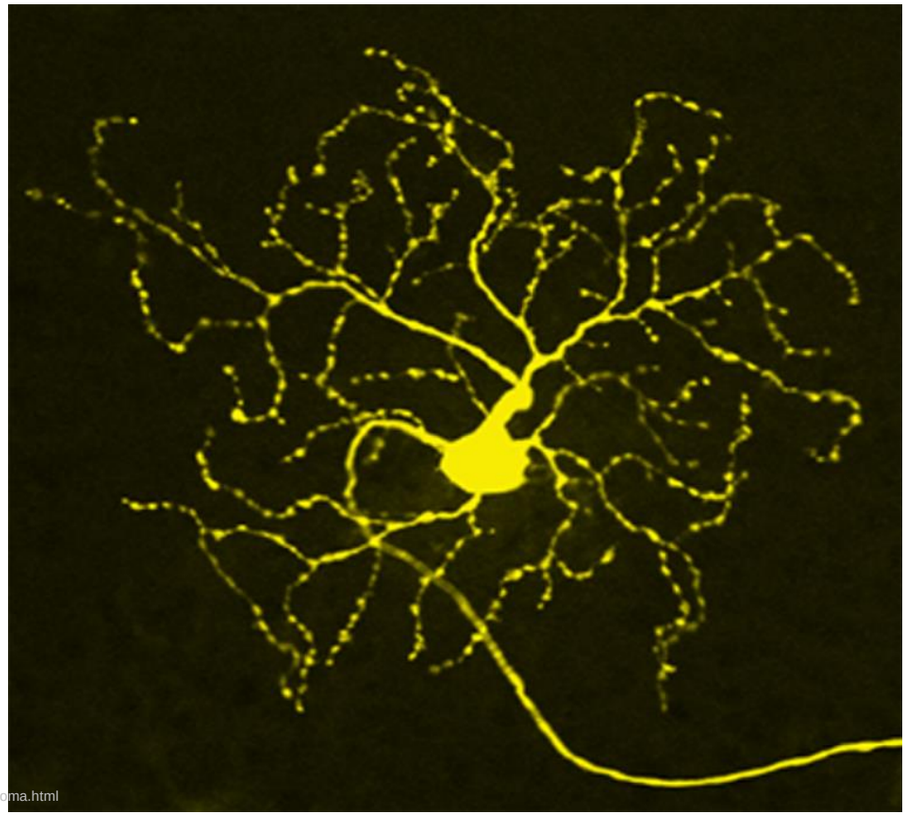


- 120 million rods are highly sensitive for brightness vision
- 7 million cones are receptors more sensitive for colour vision

INTRINSICAL PHOTOSENSITVE RETINAL GANGLION CELL

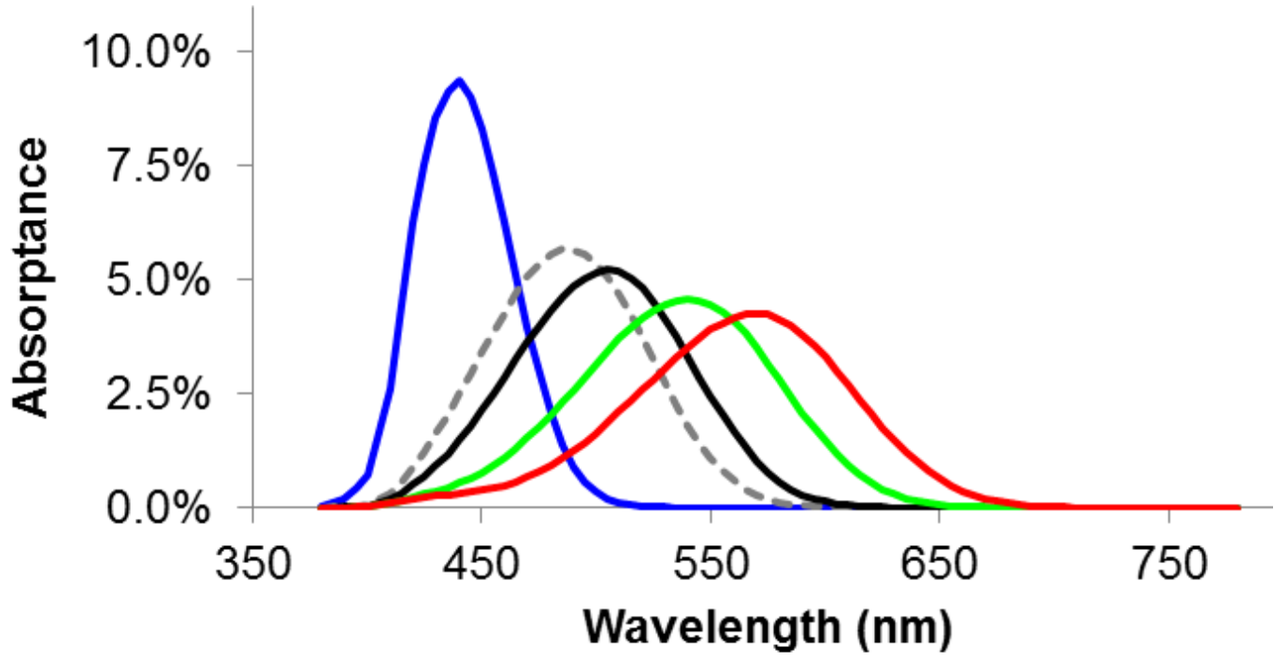


RETINAL GANGLION CELL



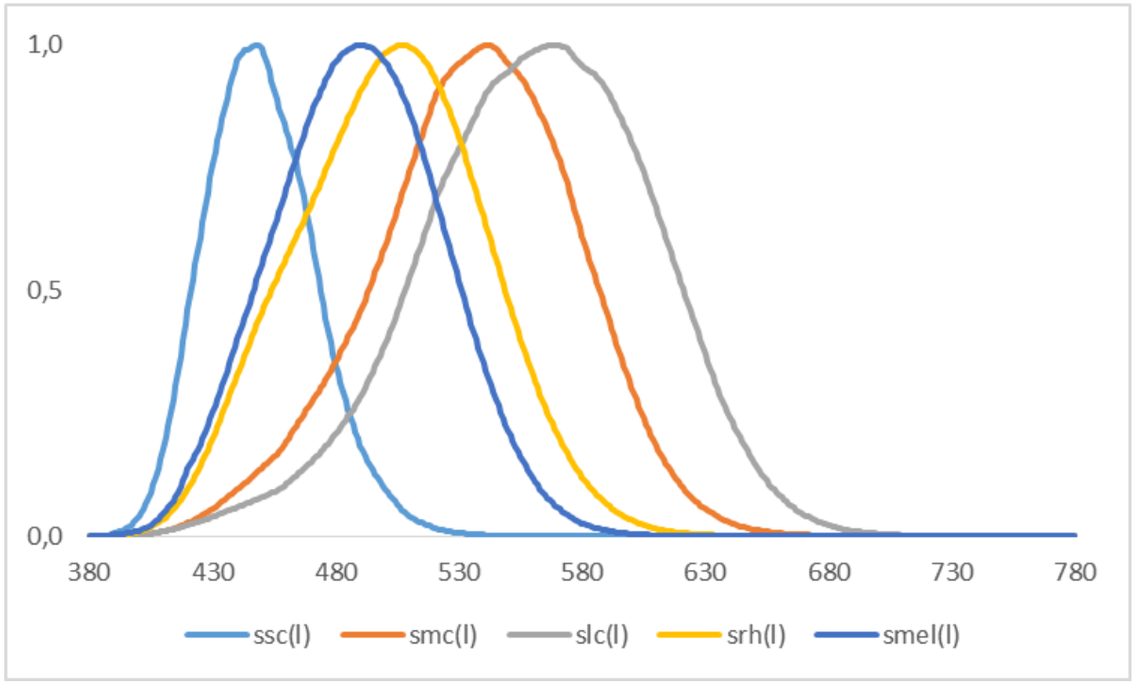
http://www.hopkinsmedicine.org/wilmer/glaucoma_center_excellence/book/chapter_what_is_glaucoma.html

THE MELANOPIC APPROACH BY ROB LUCAS
MELANOPIC IRRADIANCE OR MELANOPIC LUX OR α-OPIC



Symbol	Prefix	Sensitivity	λ_{max}	α in $N_\alpha(\lambda)$	Curve
E_{sc}	Cyanopic	S cone	419.0	sc	$N_{sc}(\lambda)$
E_z	Melanopic	Melanopsin	480.0	z	$N_z(\lambda)$
E_r	Rhodopic	Rod	496.3	r	$N_r(\lambda)$
E_{mc}	Chloropic	M cone	530.8	mc	$N_{mc}(\lambda)$
E_{lc}	Erythropic	L cone	558.4	lc	$N_{lc}(\lambda)$

CIE S 026/E:2018



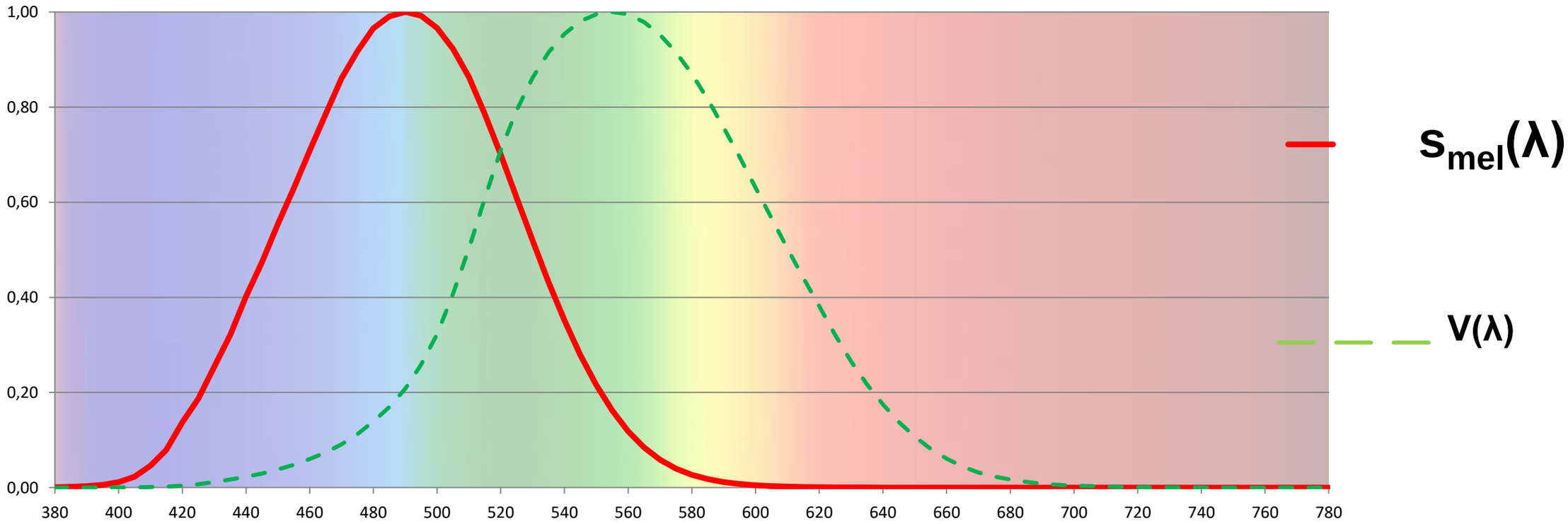
Five α-opic spectra

(based on Lucas et al. 2014)

$s_{sc}(l)$	S-Cone
$s_{mc}(l)$	M-Cone
$s_{lc}(l)$	L-Cone
$s_{rh}(l)$	Rhodopic
$s_{mel}(l)$	Melanopic

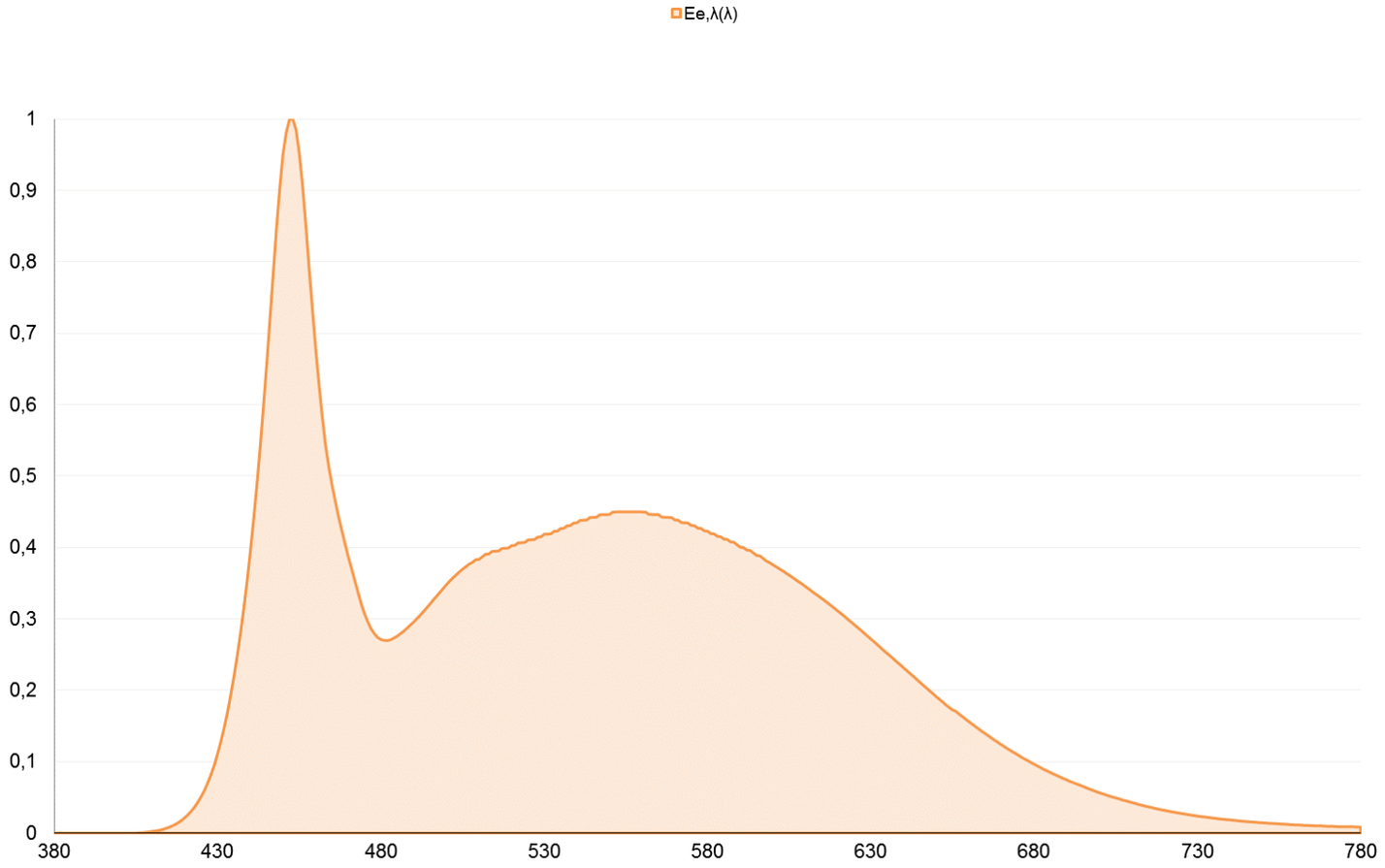
CIE S 026/E:2018

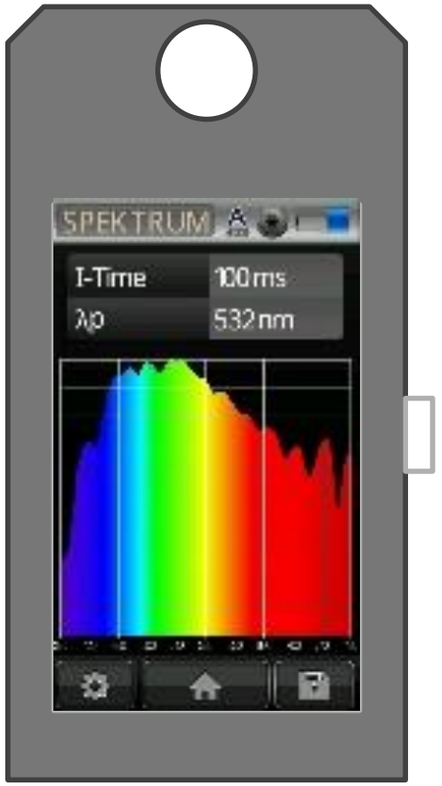
Definition of the **melanopic *activity spectrum* $S_{mel}(\lambda)$**



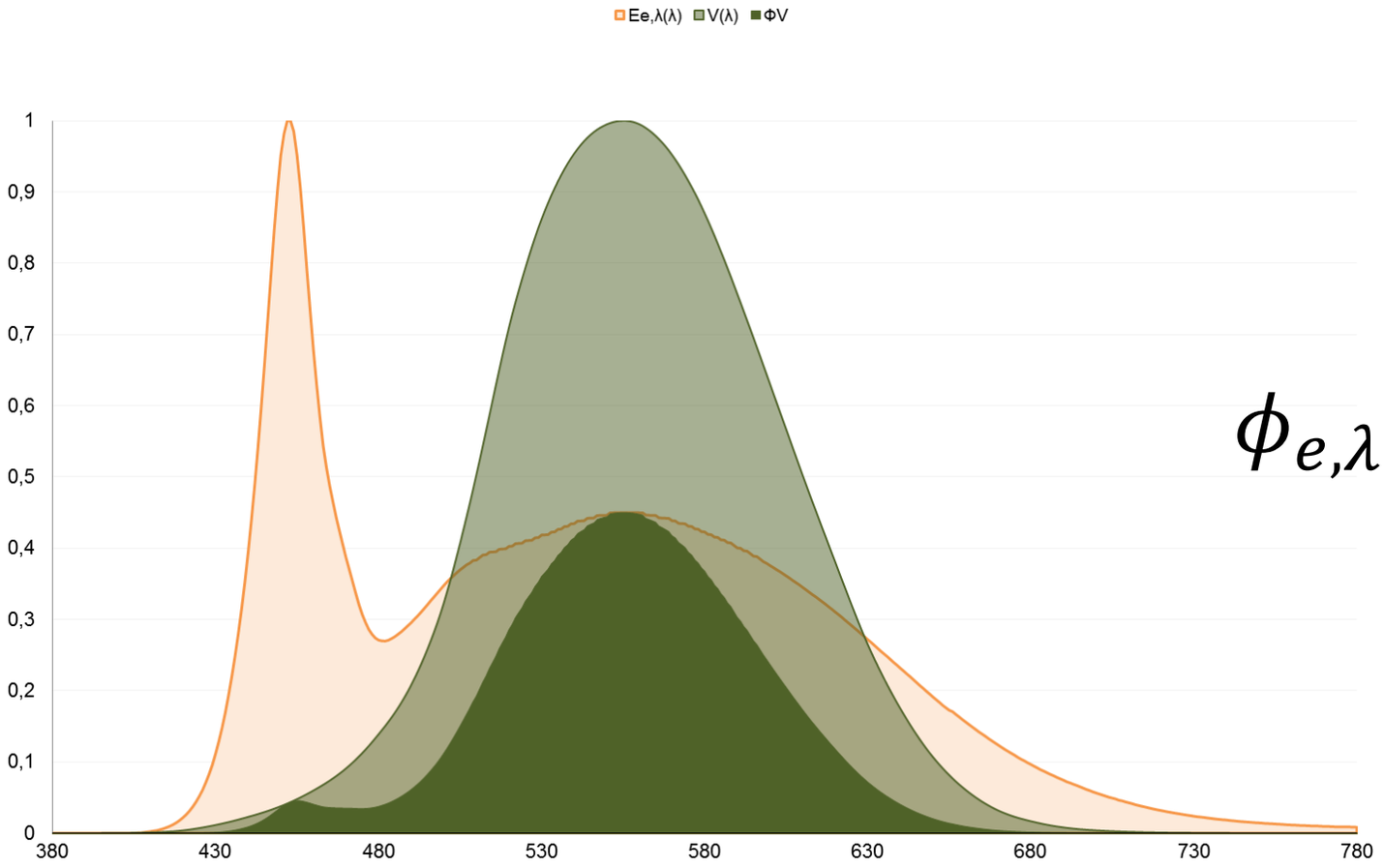
How to calculate the melanopic equivalent daylight illuminance?

1. KNOW THE SPECTRA OF YOUR LIGHT SOURCE



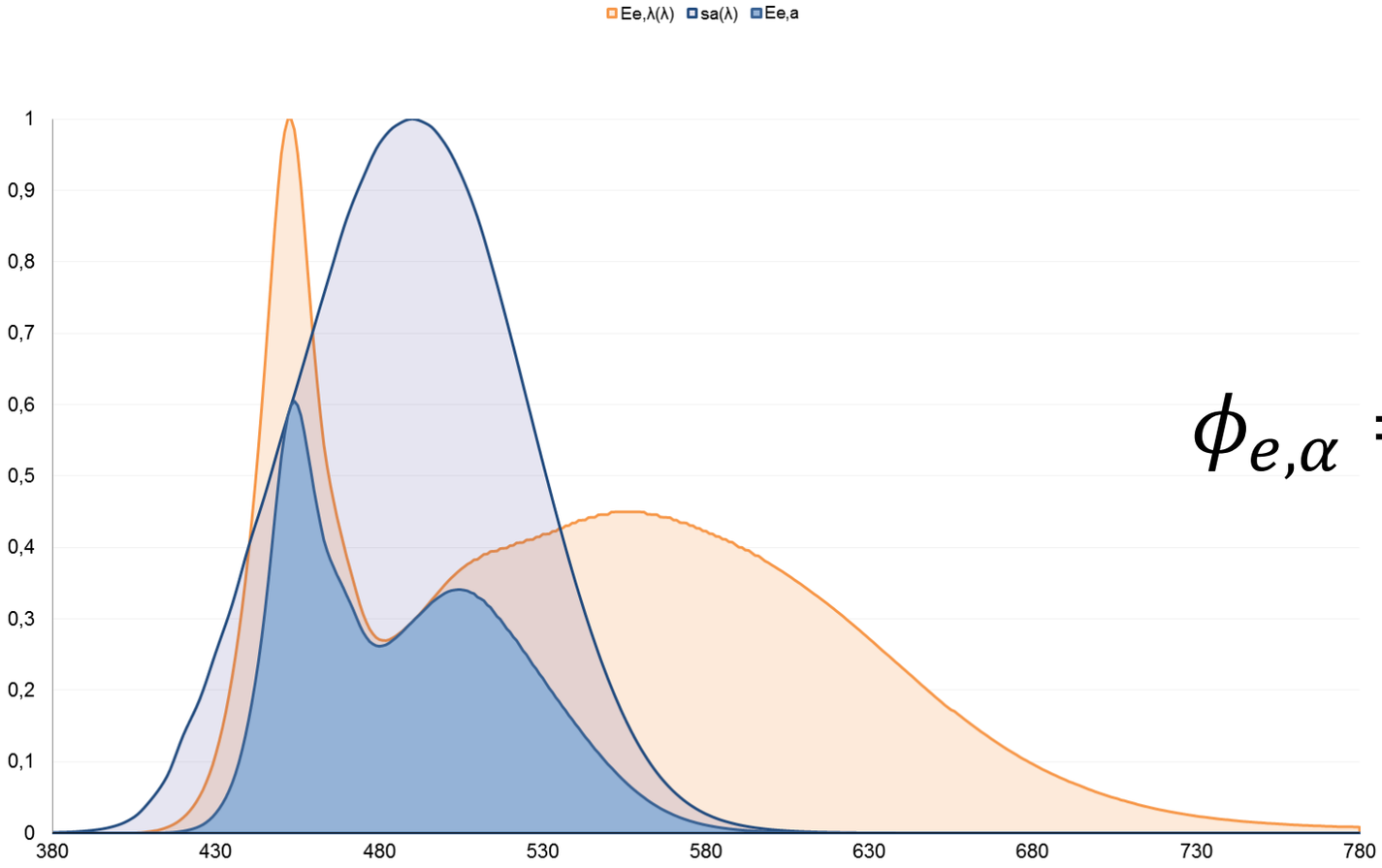


2. CALCULATE THE LUMINOUS FLUX



$$\phi_{e,\lambda} = K_m \int \phi_{e,\lambda}(\lambda)\, V(\lambda) d\lambda$$

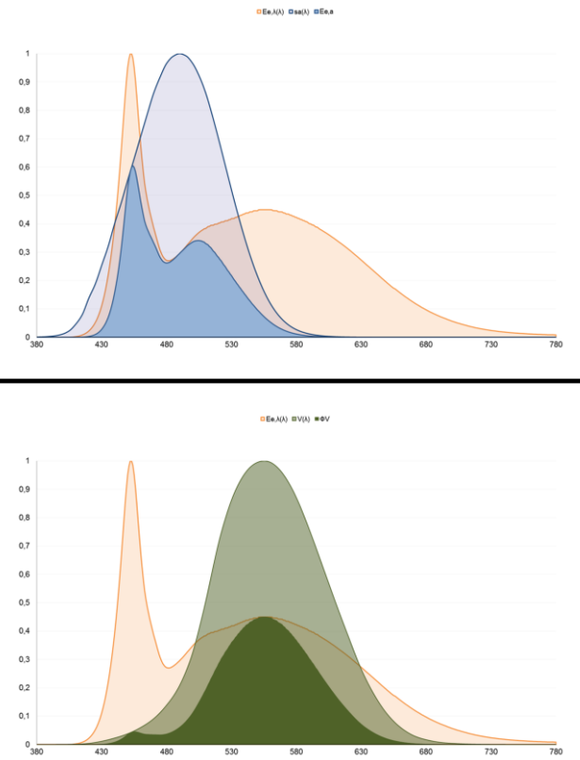
3. CALCULATE THE α–OPIC RADIANT FLUX



$$\phi_{e,\alpha} = \int \phi_{e,\lambda}(\lambda)\, s_{\alpha}(\lambda) d\lambda$$

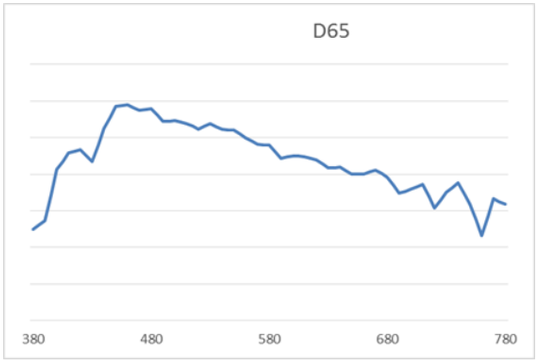
4. CALCULATE THE α–OPIC EFFICACY OF LUMINOUS RADIATION

$$K_{\alpha,V} = \frac{\phi_\alpha}{\phi_V} = \frac{\int \phi_{e,\lambda}(\lambda)\, s_\alpha(\lambda) d\lambda}{K_m \int \phi_{e,\lambda}(\lambda)\, V(\lambda) d\lambda} =$$



5. MELANOPIC DAYLIGHT (D65) EFFICACY RATIO

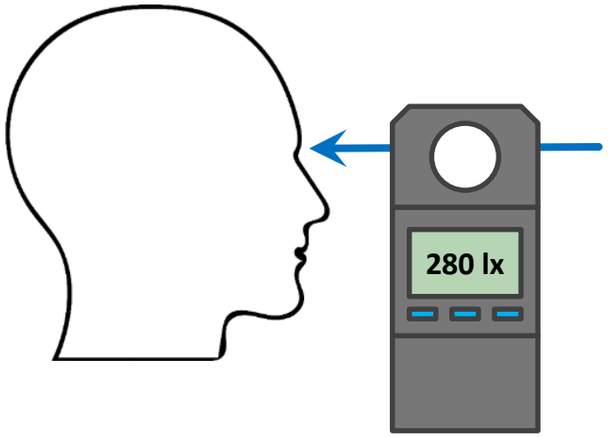
$$\gamma_{mel,V}^{D65} = \frac{K_{\alpha,V}}{K_{mel,V}^{D65}}$$

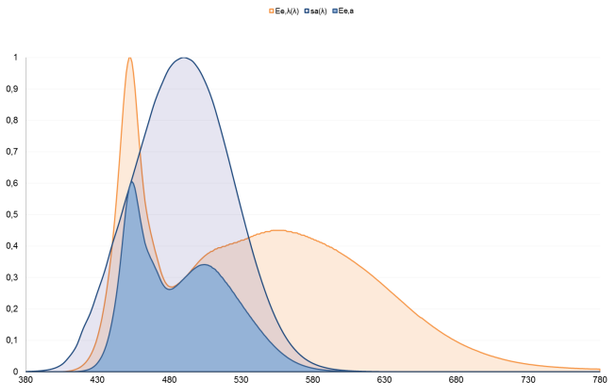


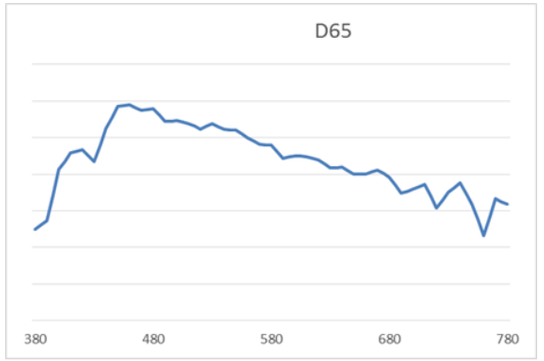
$$K_{mel,V}^{D65} = 1{,}3262\ \frac{mW}{lm}$$

Note: α–opic efficacy of luminous radiation has the inverse units of K_m and is expressed in watts per lumen

Example Melanopic Equivalent Daylight Illuminance







Ev = 280 lx

X

$\gamma_{mel,V}^{D65} = 0.85$

=

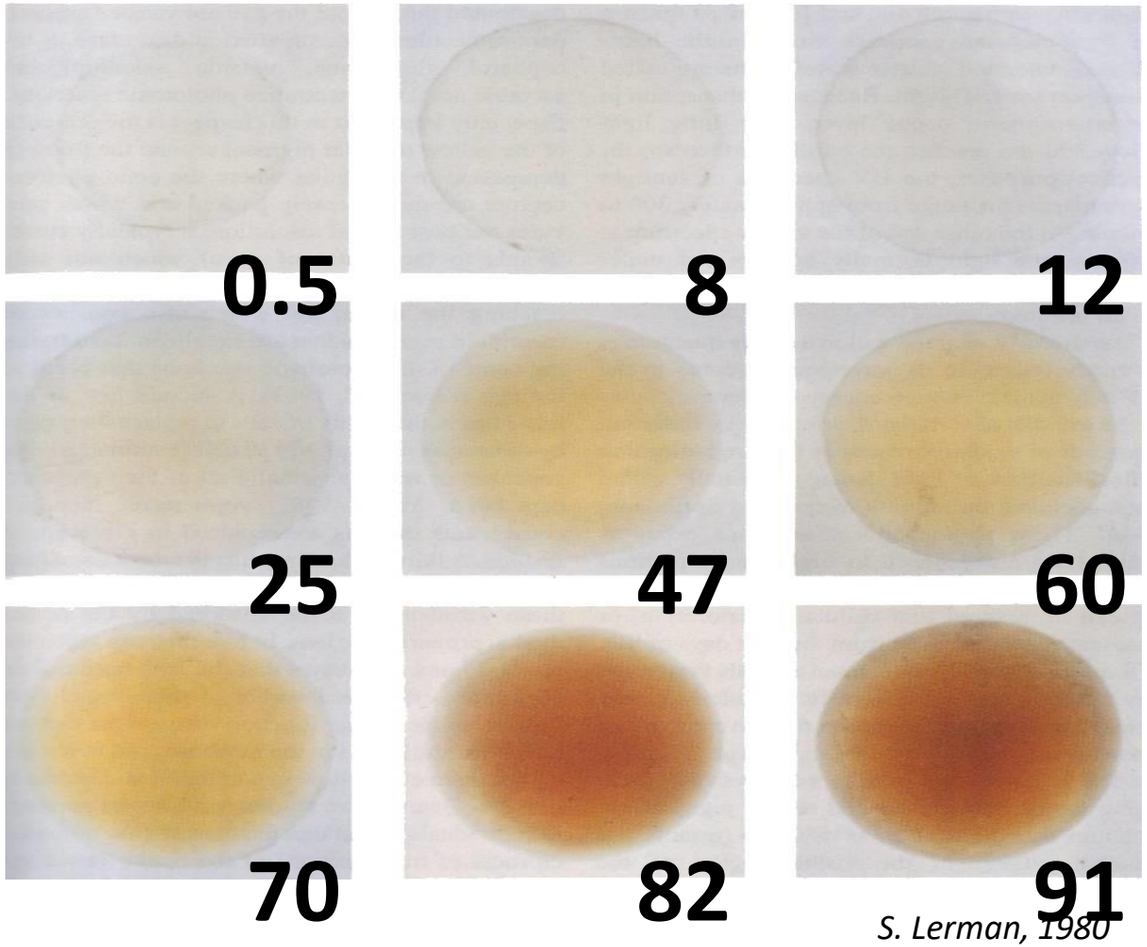
$E_{e,\alpha}$ = 238 lx

THE EYE – AGEING PROCESS

Ageing effects on the eye:

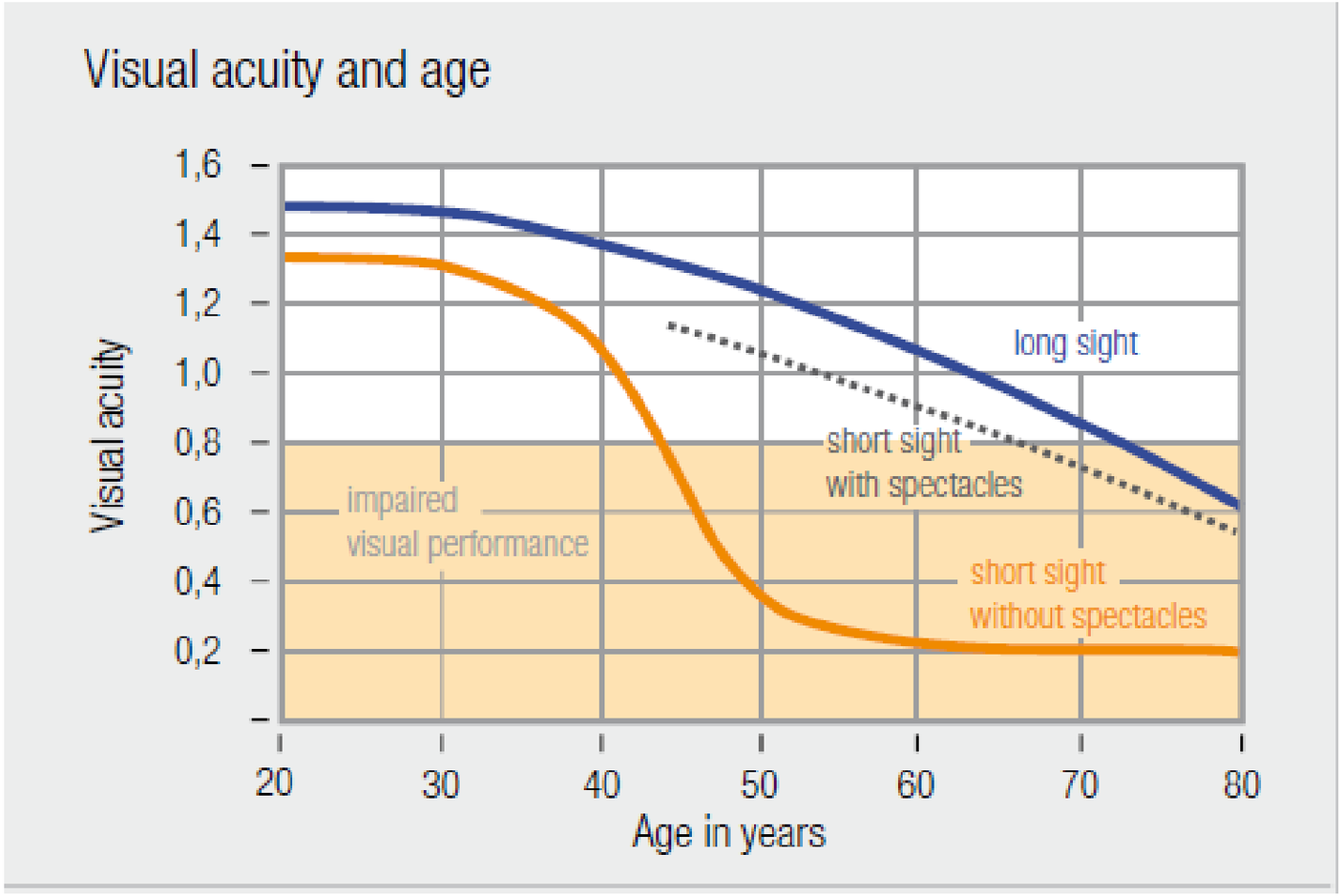
- Dulling of dioptric apparatus (lens, vitreous body, cornea)
- Yellowing of the lens
- Limited work range of iris

→ Effects make everything similar
→ lowers the circadian effect of light



S. Lerman, 1980

VISION ACCORDING TO AGE



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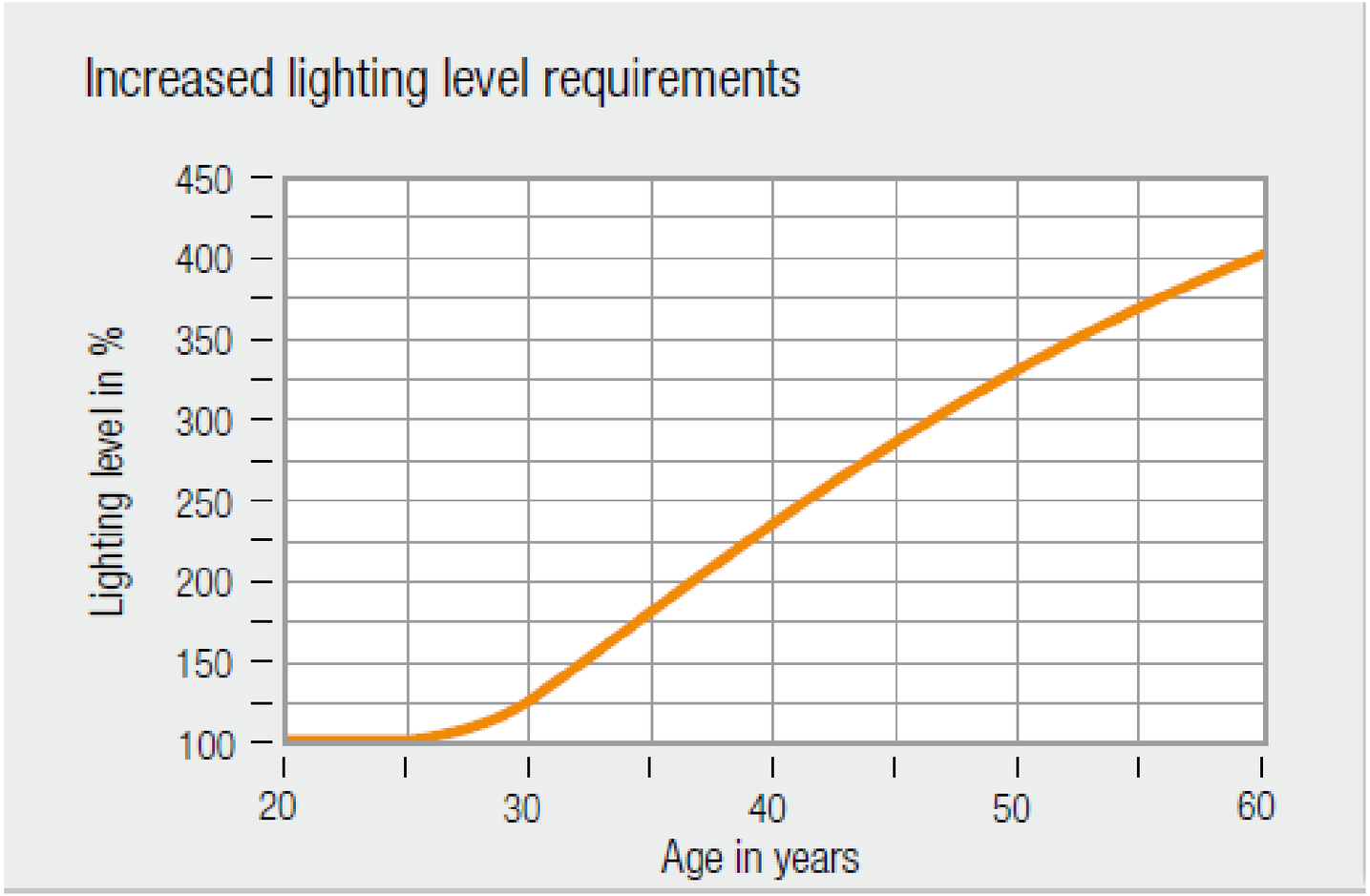

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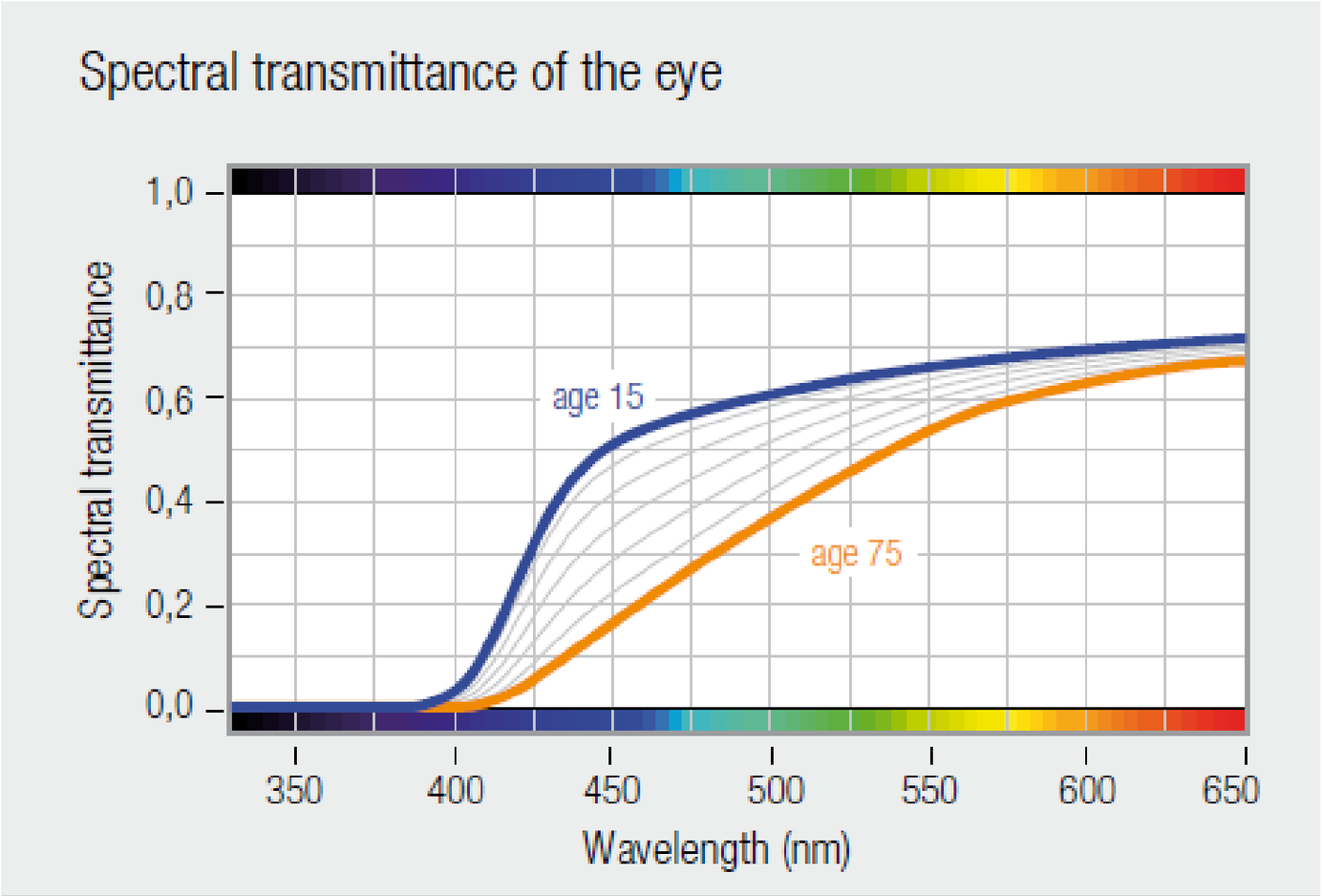
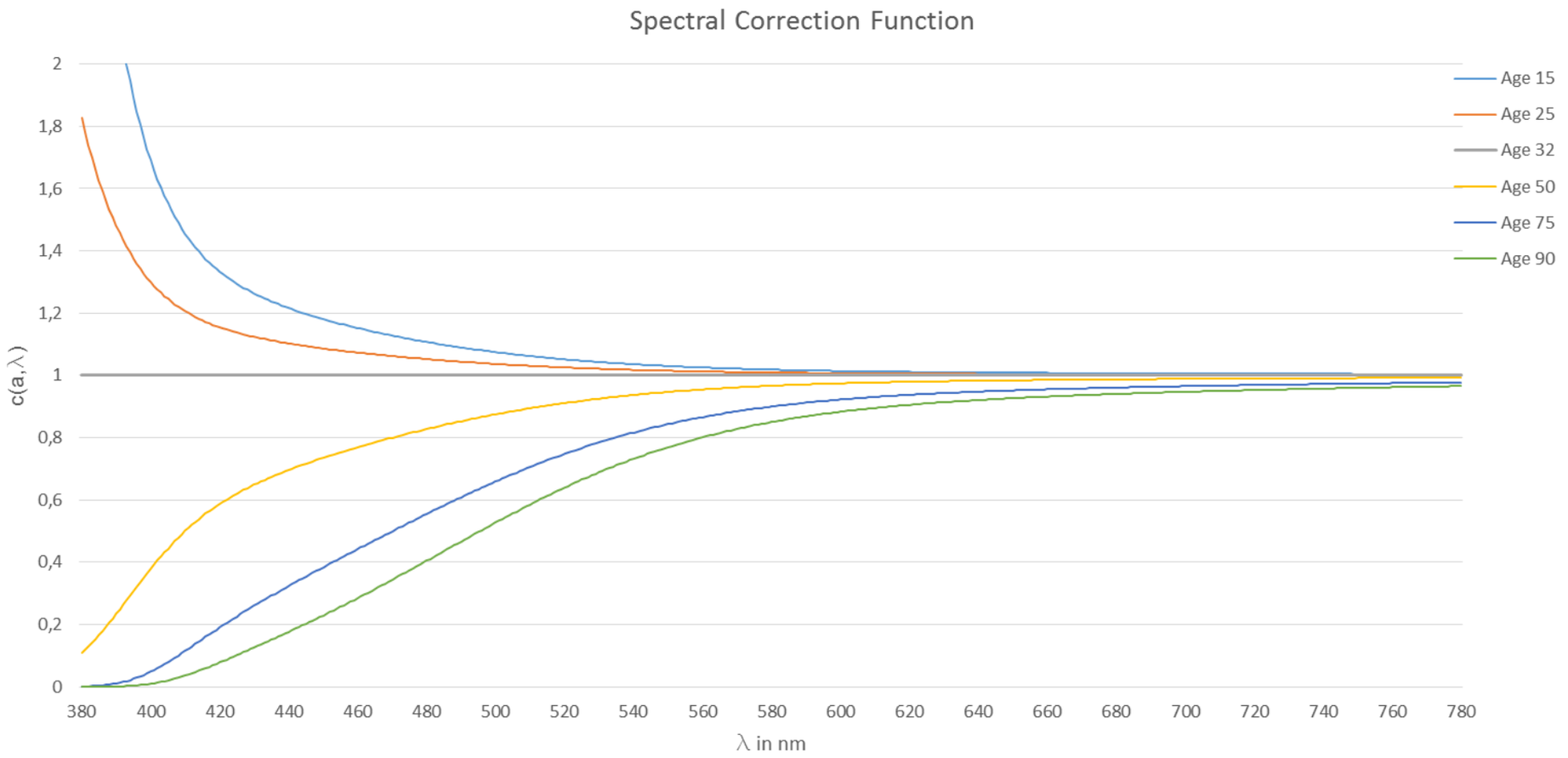
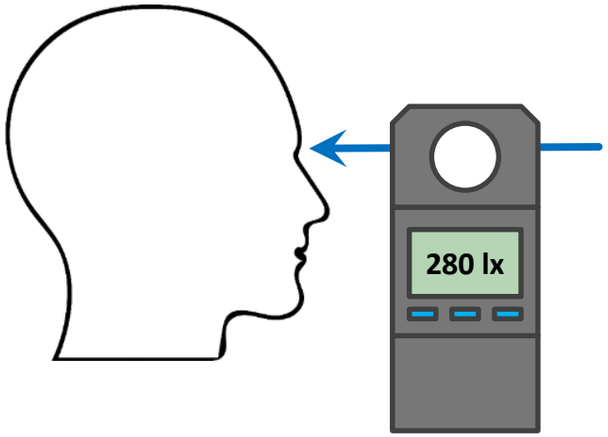


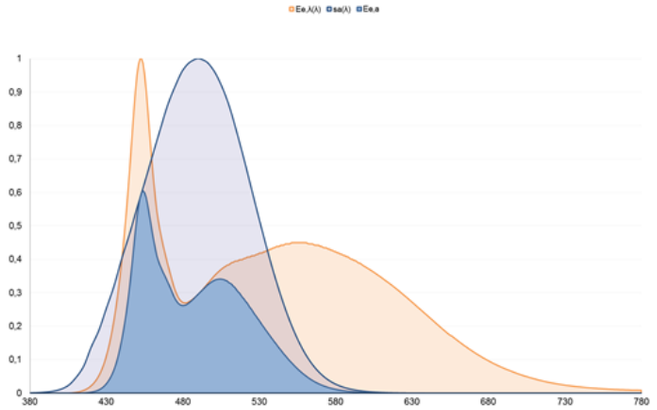
AGE-RELATED CORRECTION FACTORS

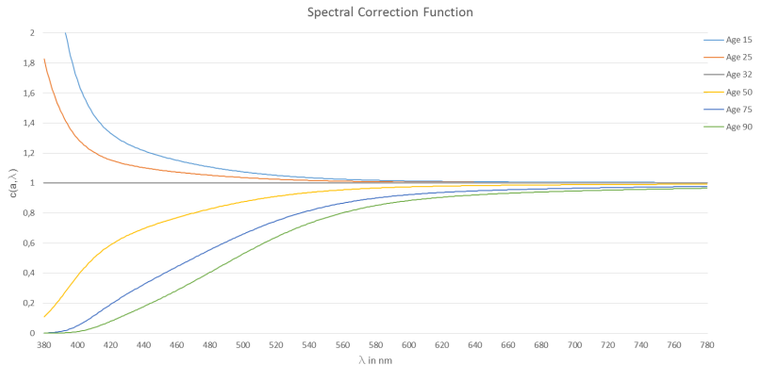
SPECTRAL CORRECTION FUNCTION



EXAMPLE OF
AGE RELATED MELANOPIC EQUIVALENT DAYLIGHT ILLUMINANCE





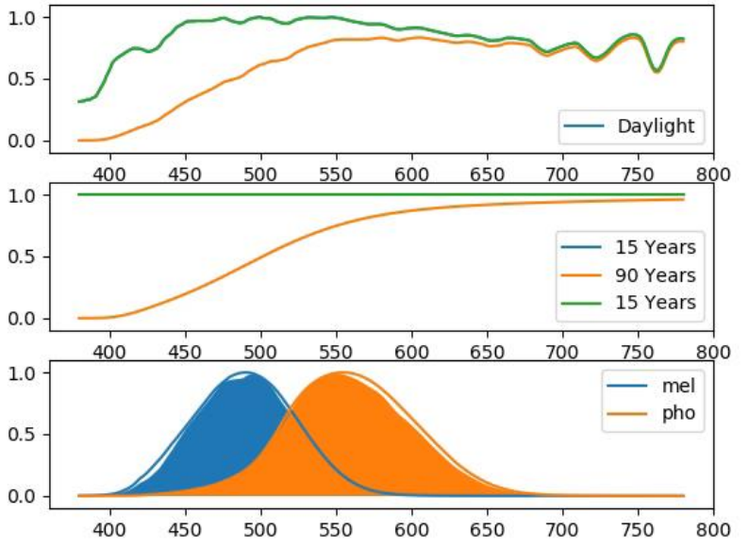


Age	25	32	50	75	90
$E_{e,\alpha}(\mathrm{A})$ in lx	271	238	157	75	45

Original

diminished optical transmission

incl. White Balance



OPTICAL TRANSMISSION SIMULATION
by D. Stabenau