

Non-image forming effects of light

Lecture in chronobiological phototherapy for doctors.
Prague 5

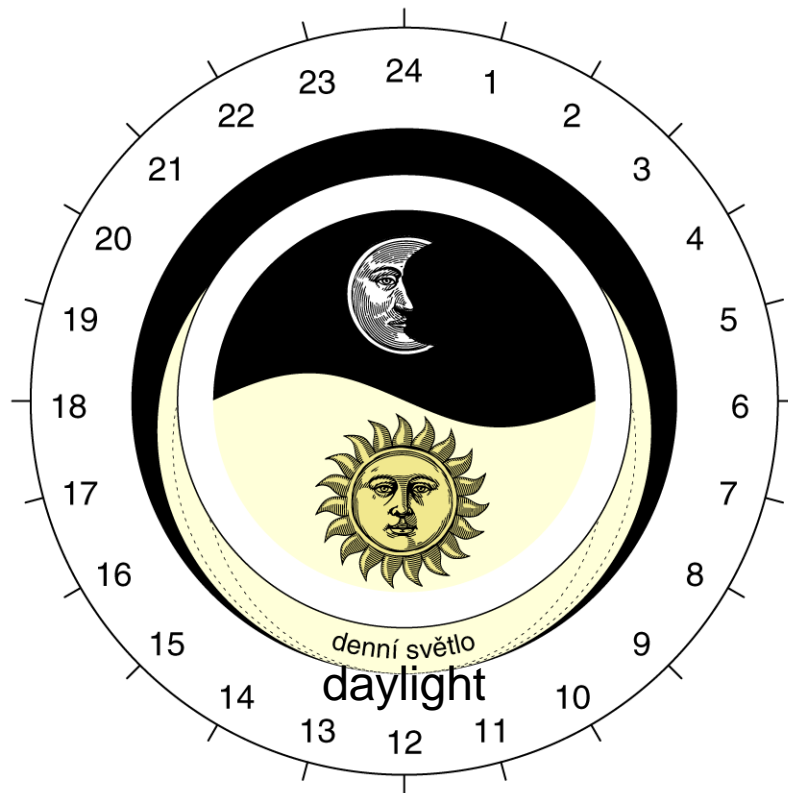
Dipl. Ing. Antonín Fuksa

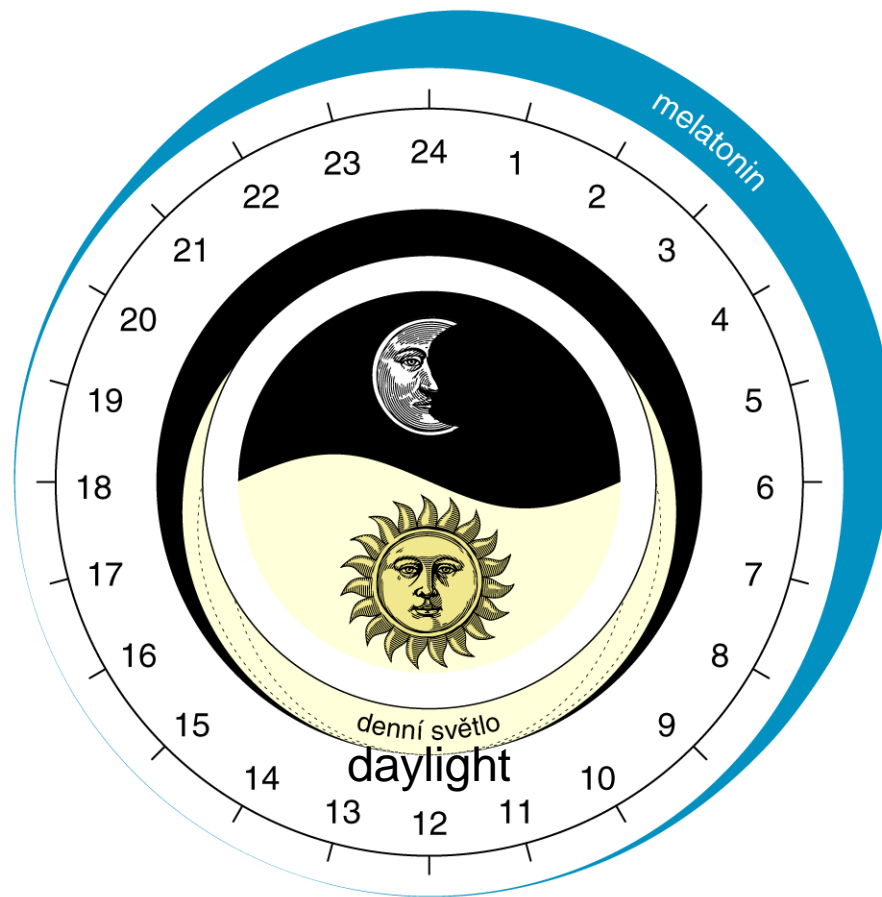
February 10, 2016

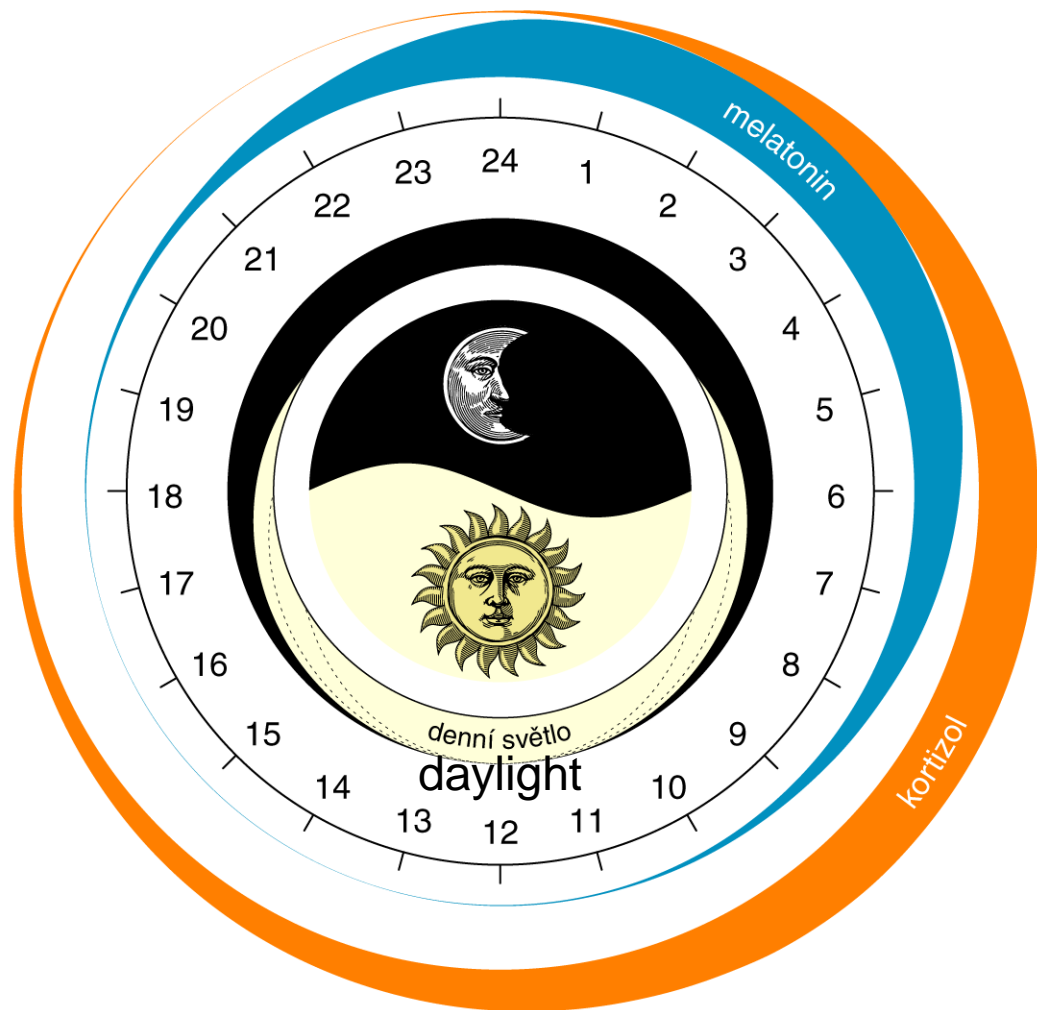


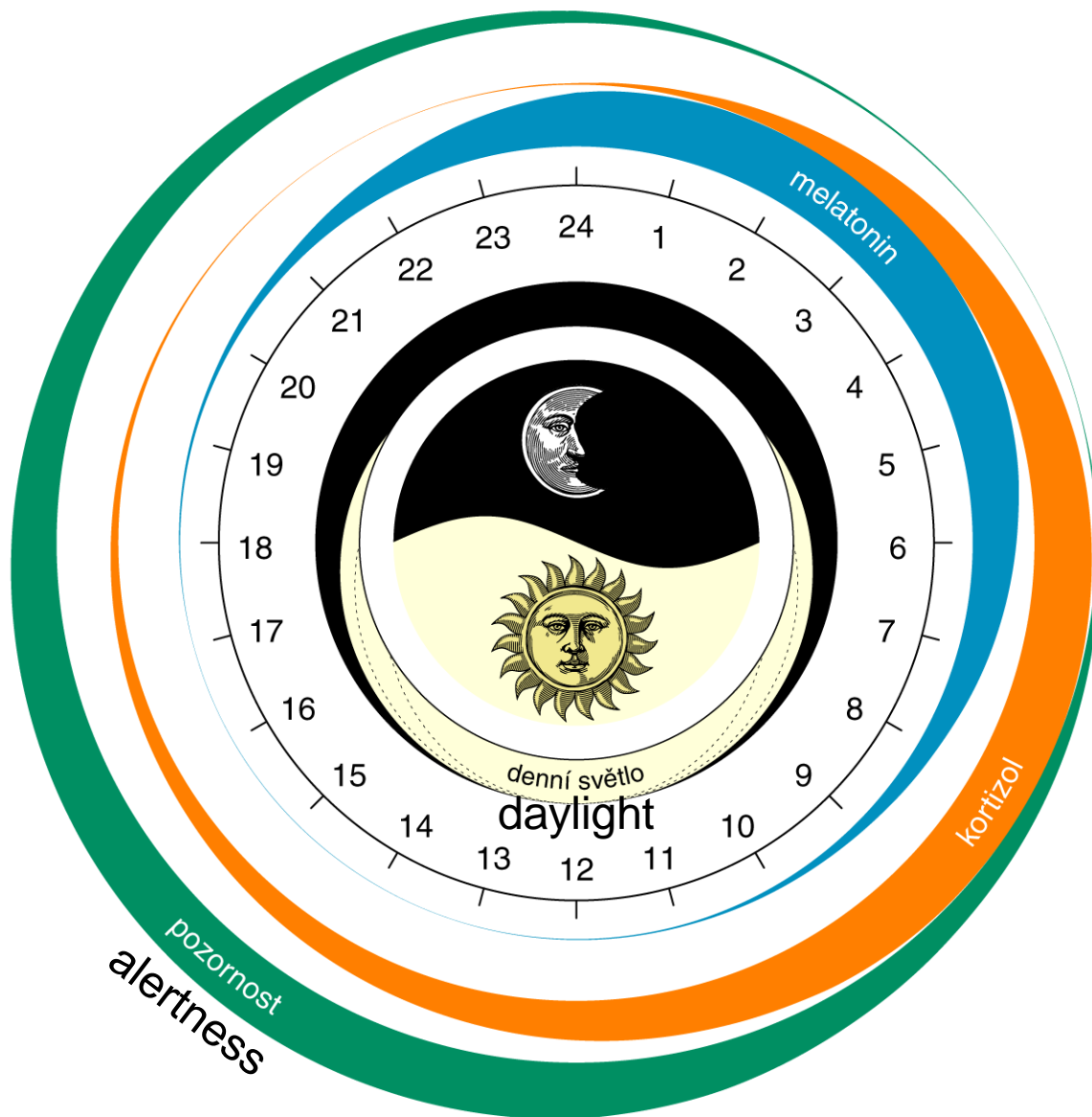


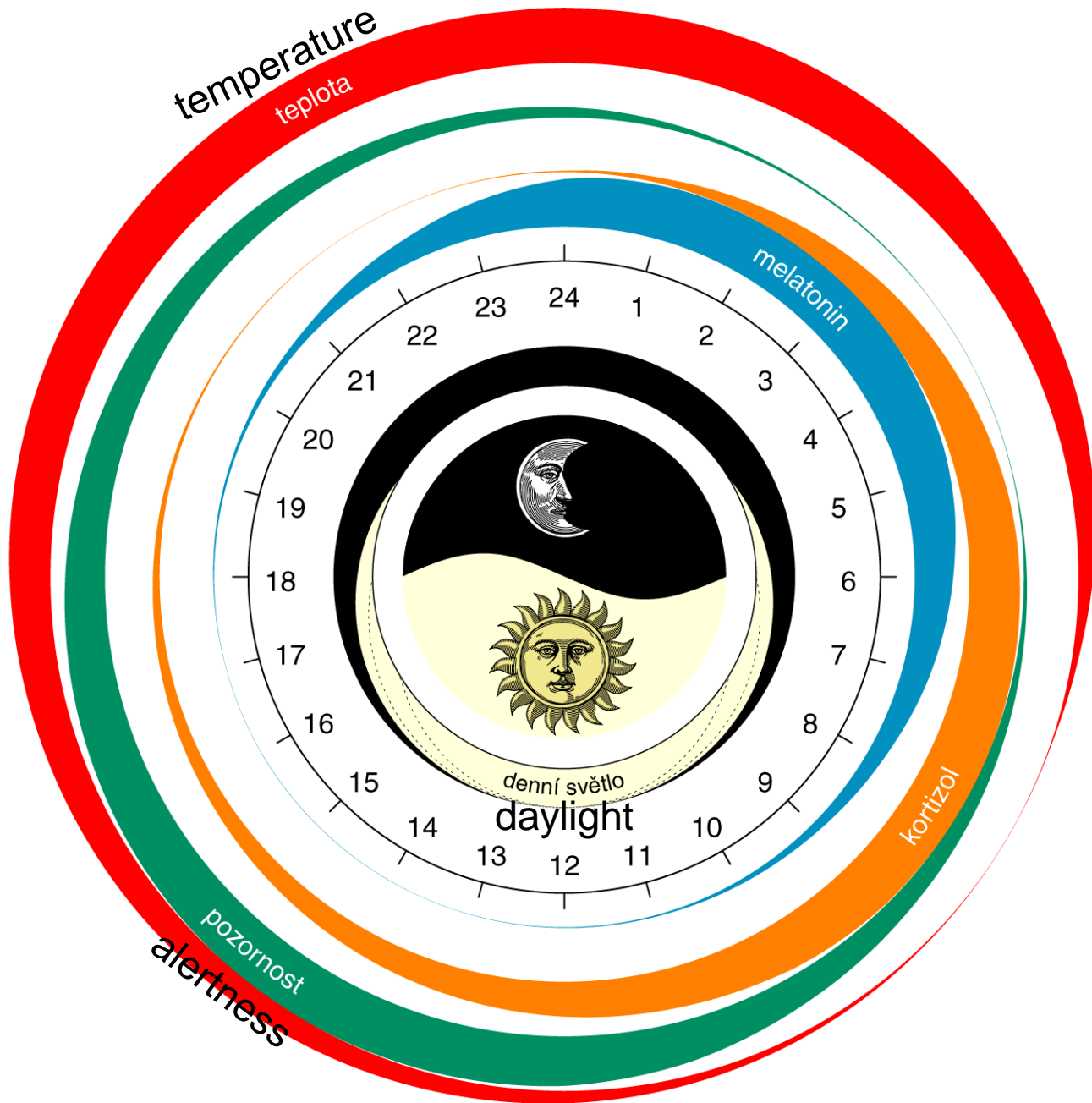
denní světlo
daylight











A novel photoreceptor (i)

- **ipRGCs**

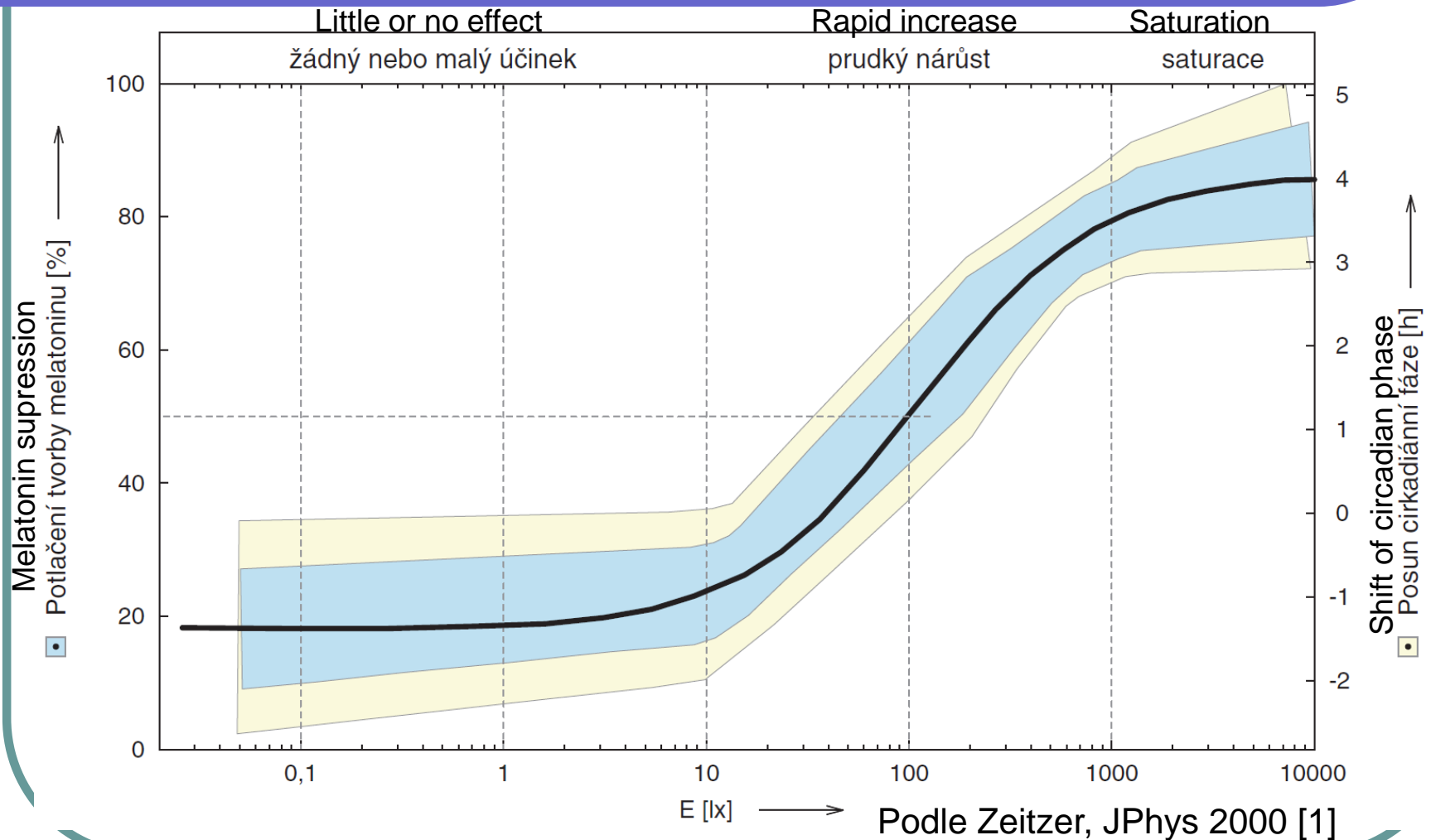
Intrinsically photosensitive Retinal Ganglion Cells

- 1923 (Keeler)
- 1991 (Foster, Provencio)
- 1998 (Provencio)
- 2002 (Hattar, Berson)
- 2007 (Zaidi, Zeisler, Foster)

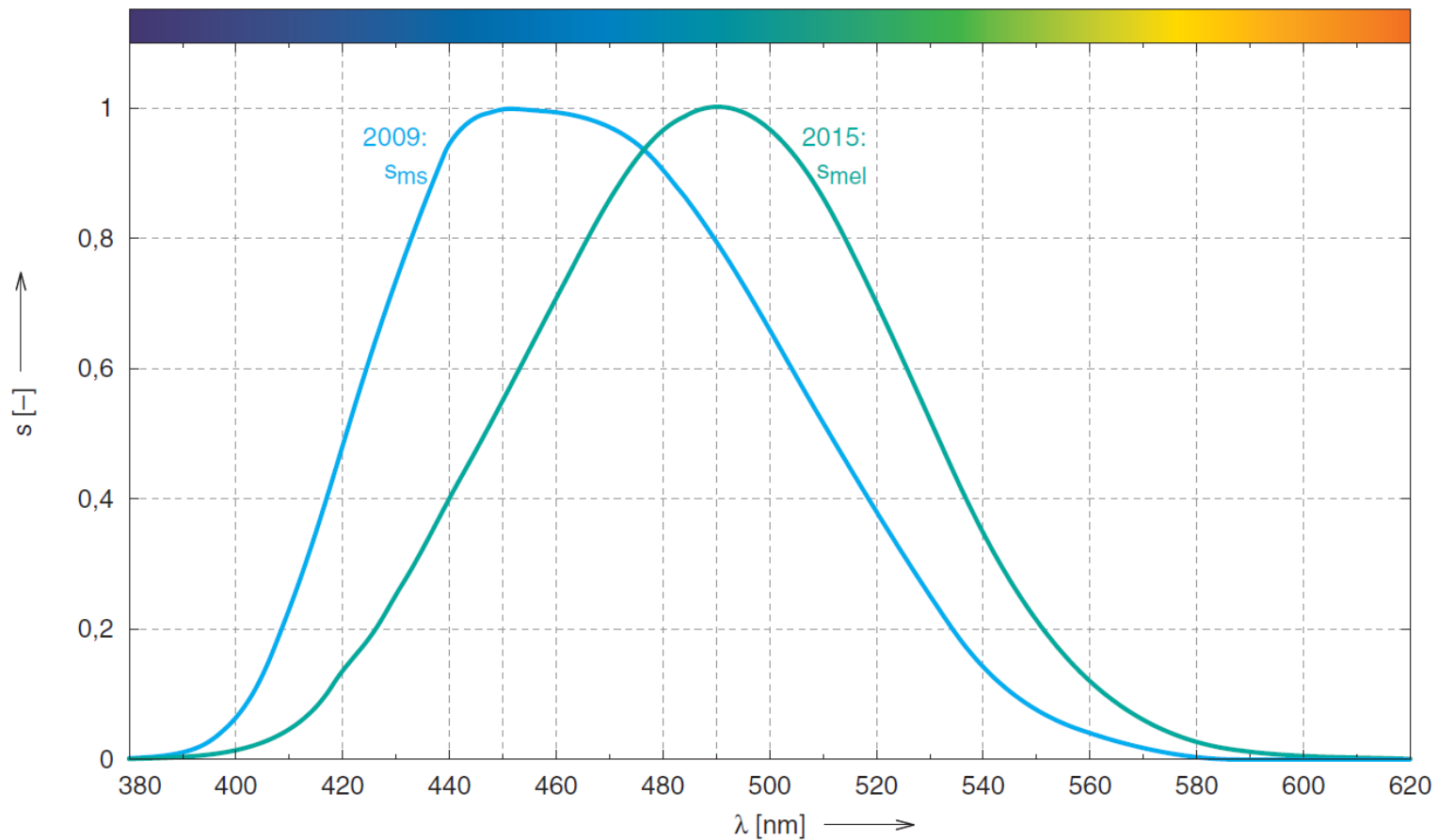
A novel photoreceptor (ii)

- Non-visual (non-image forming) function:
to signalize light level to the brain.
- **Synchronization** of sleep/wake cycle.
*Circadian phase shift. **Long term.***
- **Activation** of the organism by light.
*Melatonin Supression. **Short term.***

Non-image forming effects of light

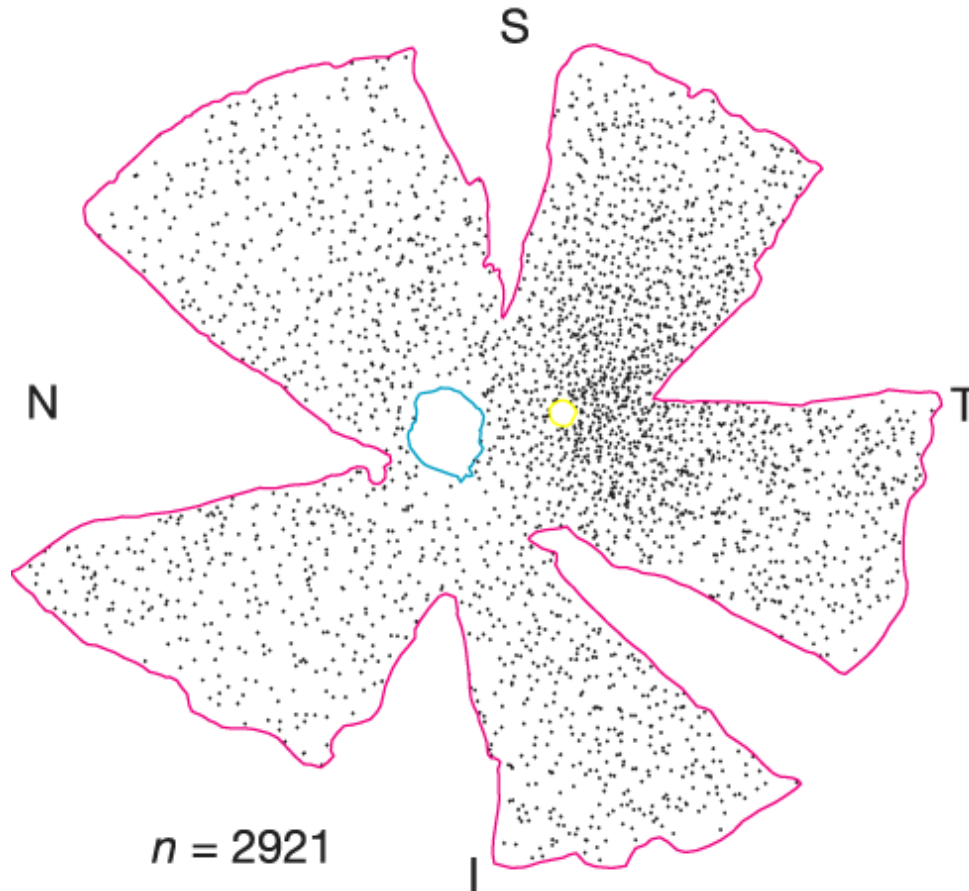


Spectral response of ipRGCs



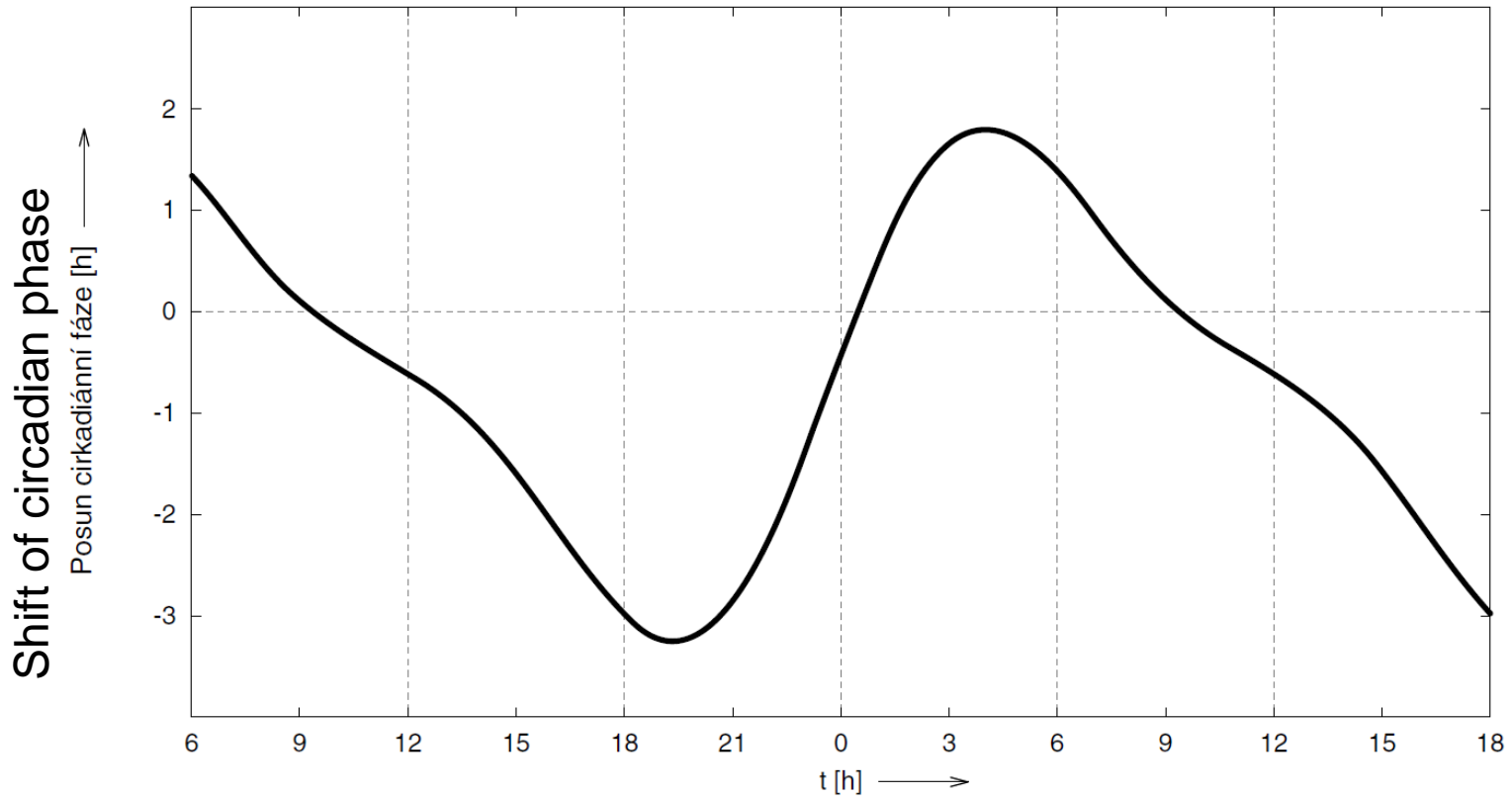
Data: DIN 5031-100

ipRGCs distribution on retina



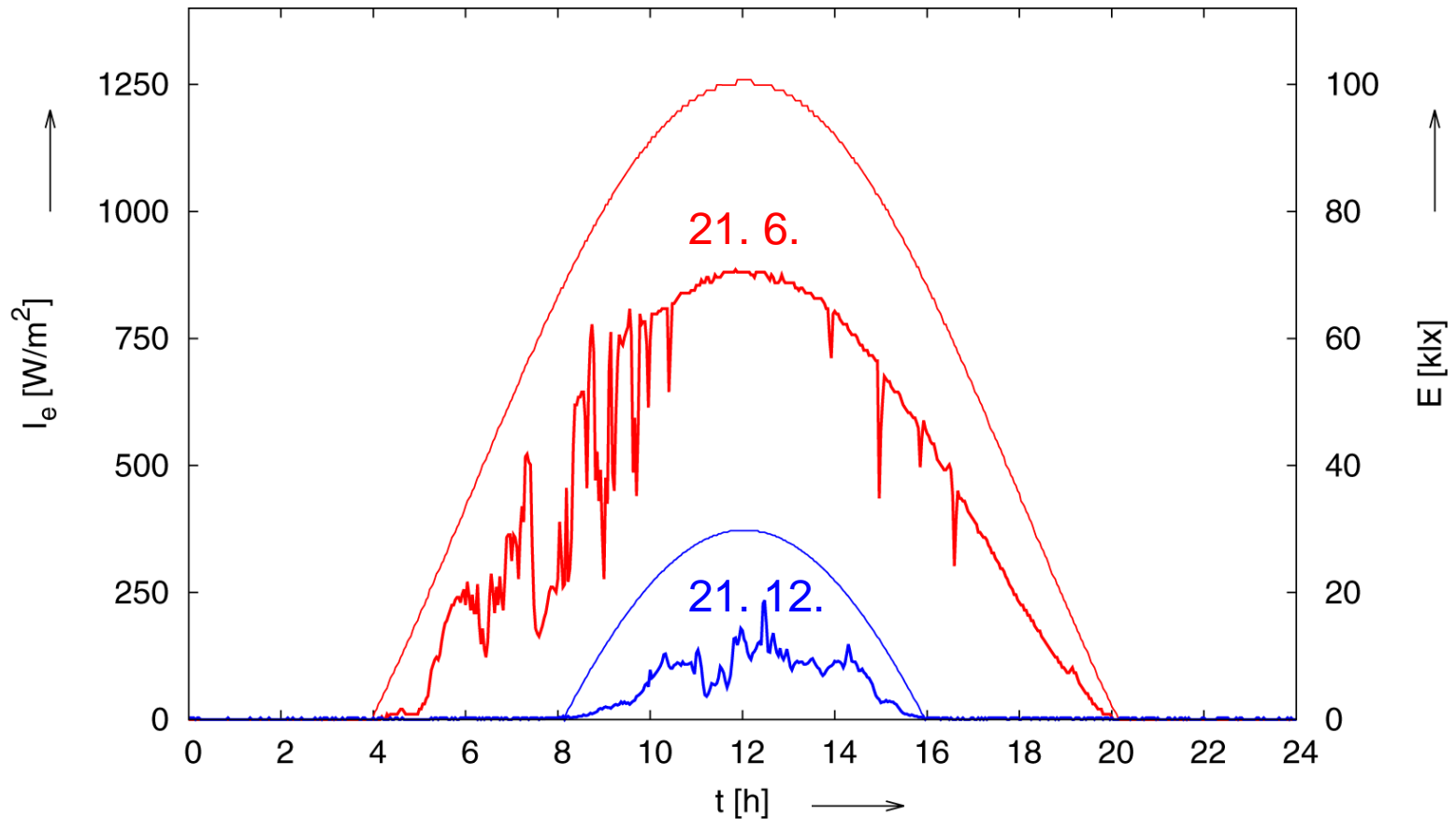
Macaque retina, Dacey, Nature 2005 [3]

Phase response curve



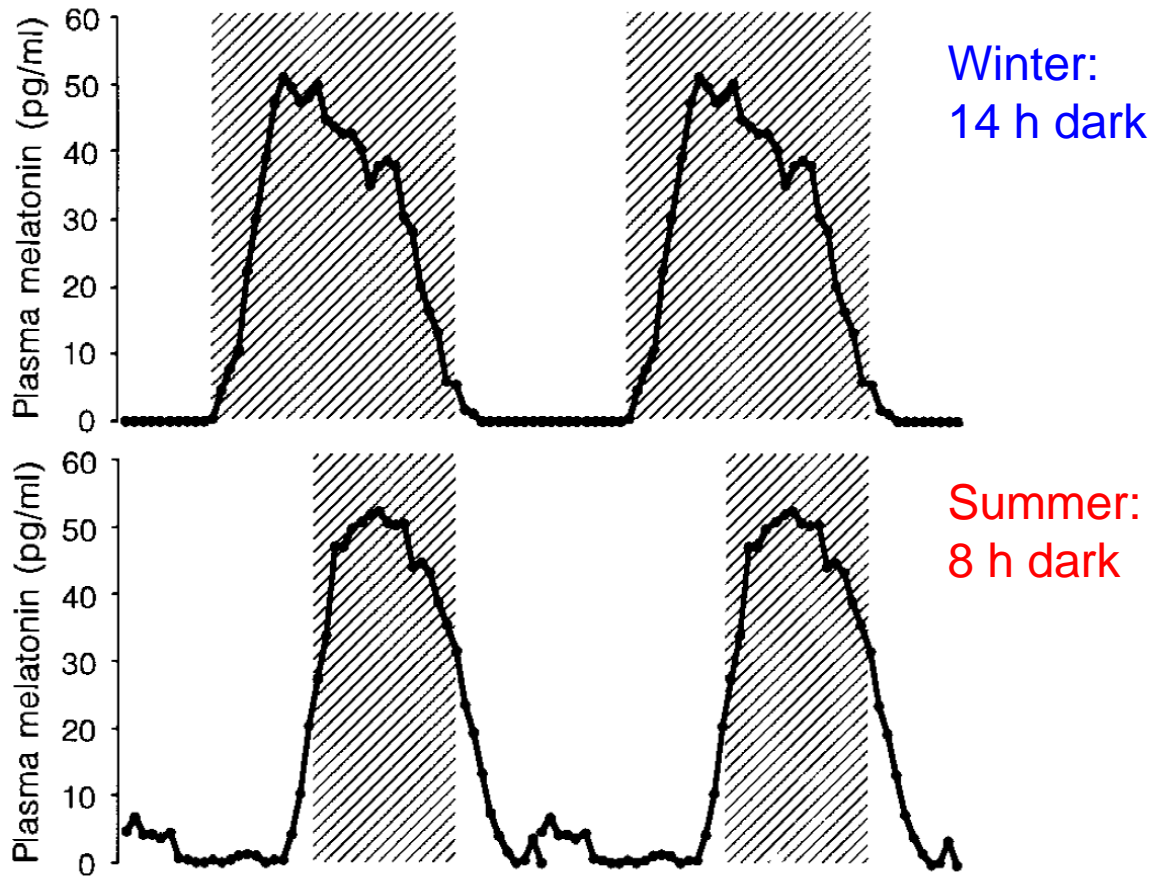
Zeitzer, JPhys 2000 [1]

Annual cycle of light (50th parallel)



Data: ČHMÚ

Night length and melatonin



Wehr, Horm Res 1998 [4]

Research in light therapy

- History (classics -> Rosenthal).
- Elderly care (Zumtobel).
- Patient room lighting (Philips, Xal).
- VFN Prague (NASLI).

- **Chronobiological treatment of depression.**
- **Additional treatment for dementia.**

Chronobiological phototherapy

- Timing of application.
- Intensity at eyes \times length of exposure.
- Contents of the activating blue component.

- Acceptability of light.
- Light dynamics during the day and year.
- Individual factors.

Case study - NASLI SunSun

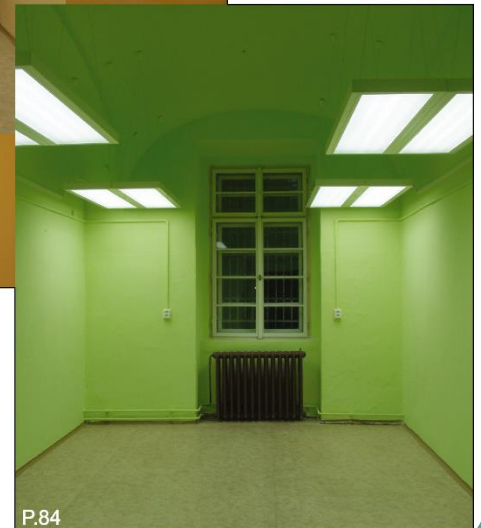
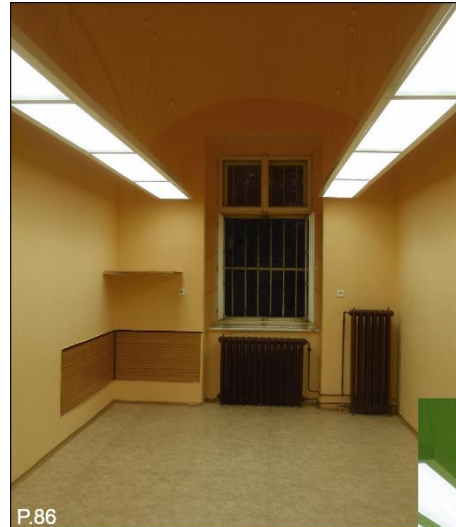
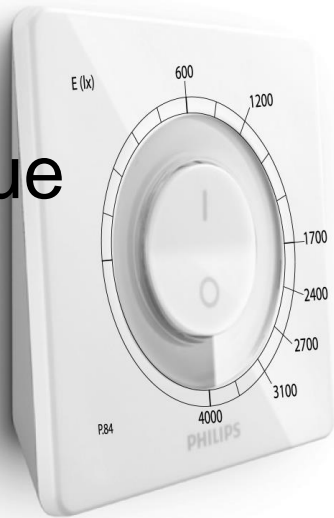
- Desk luminaires
10 000 lx @ 0,2-0,3 m
- For personal use
SAD and general
depression
- $T_c = 6500 \text{ K}$
- $P = 72 \text{ and } 110 \text{ W}$



Case study - NASLI Evidens

- Pendant luminaires
- Patient+lunch room
- $E = 30\text{--}3000\text{ lx}$
- $T_{cp} = 6500\text{ K}$

- VFN Prague
- 2012



Case study - NASLI ADS2max

- Mobile lumin. to patient's bed
- $h = 2,35 \text{ m}$ (1,8 m transp.)
- $E = 0\text{--}2000 \text{ lx}$
- $T_c = 1800\text{--}6500 \text{ K}$
- Autonomous and research modes
- VFN
Prague

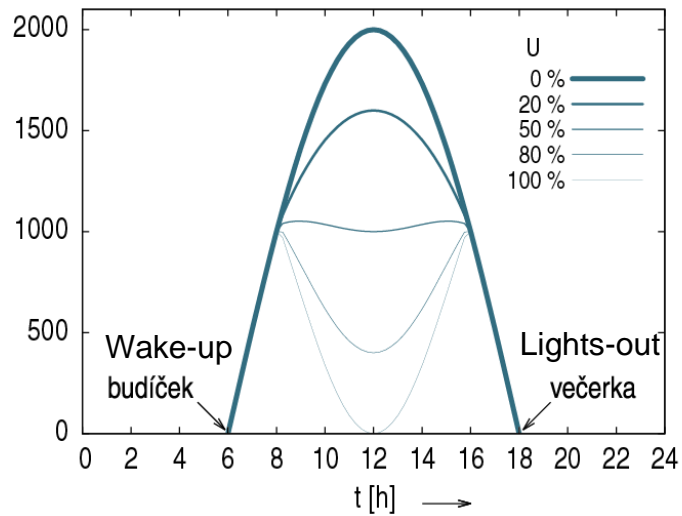


Autonomous mode of ADS2max

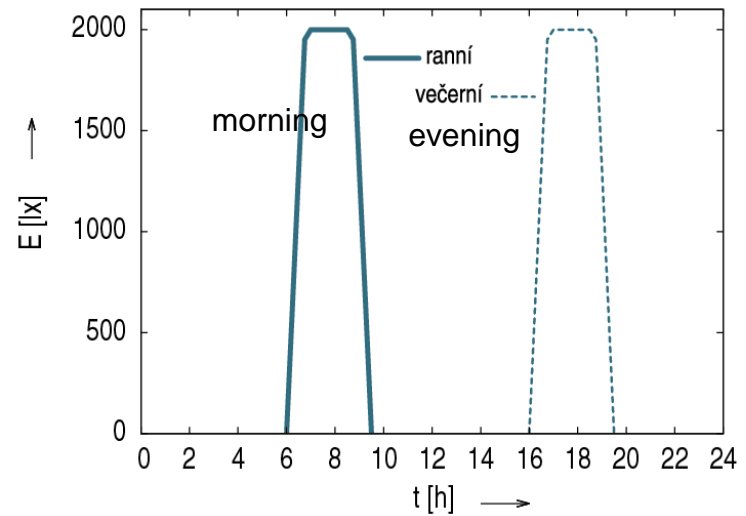
- **Simple control with remote controller.**
- **Programs:**
 - Morning (+evening) bright light therapy.
 - All-day phototherapy („light enhancement“).
 - Down/dusk simulation + combinations.
 - Aid for Wake Therapy.

Autonomous programs

All-day phototherapy



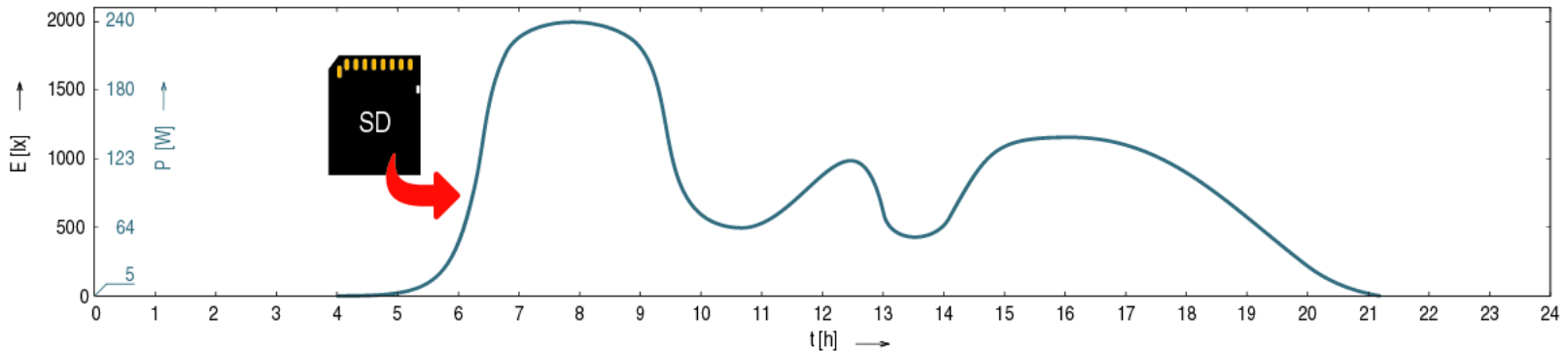
Bright light therapy



Research mode of ADS2max

- **Maximum flexibility**

- Doctor uploads a tailored light schedule on an SD card.
- The luminaire automatically controls the intensity and tone of light depending on the schedule and precision built in clock.



Statutory health insurance

- Chronobiological treatment including phototherapy is a service no. **35115** according to Public notice no. **326 / 2014 Coll of Laws.**
- In a specialized facility only.
- During patient hospitalization only.
- Competent staff.
- Suitable technical equipment.

Our references

- Psychiatric clinic 1. LF UK a VFN, Prague
- Alzheimercentrum Průhonice o.p.s.
- GEMINI eye clinic a.s., Zlín, Průhonice
- D. C. M. clinic, Hradec Králové
- FN Brno – Transfusion & Tissue Department, Třebíč
- ...

Literature and references

- [1] Jamie M. Zeitzer, Derk-Jan Dijk, Richard E. Kronauer, Emery N. Brown and Charles A. Czeisler. Sensitivity of the human circadian pacemaker to nocturnal light: melatonin phase resetting and suppression. *Journal of Physiology*. 2000, 526.3, pp. 695–702.
- [2] Gooley, J. J. et al.: Spectral Responses of the Human Circadian System Depend on the Irradiance and Duration of Exposure to Light. *Science, Translational Medicine*. 2010, issue 31, ISSN 1946-6242, DOI 10.1126/scitranslmed.3000741.
- [3] Dennis M. Dacey et al., Melanopsin-expressing ganglion cells in primate retina signal colour and irradiance and project to the LGN. *Letters to nature*. Nature vol. 433, 17 Feb. 2005. p. 749–754.
- [4] Thomas A. Wehr. Effect of Seasonal Changes in Daylength on Human Neuroendocrine Function. *Horm Res* 1998; 49. p. 118–124.
- [5] Terman MR, Wirz-Justice A. *Chronotherapeutics for Affective Disorders: A Clinician's Manual for Light and Wake Therapy*. 2nd edition, Kager 2013. ISBN 978-3-318-02090-8.

Thank you...

Antonín Fuksa

Further references

- www.ChBFT.CZ
Information in Czech,
free booklet for download
(English version available).
- fuksa@nasli.net