

Medical light sources for diagnostic and therapeutic applications

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Introduction



https://upload.wikimedia.org/wikipedia/commons/8/8b/Rtwnef_Ambulance_Rettungsdienst_Germany.jpg

http://www.thiex.de/bilder/galerie/Bloc-op2-1347630580-4088-_gross.jpg

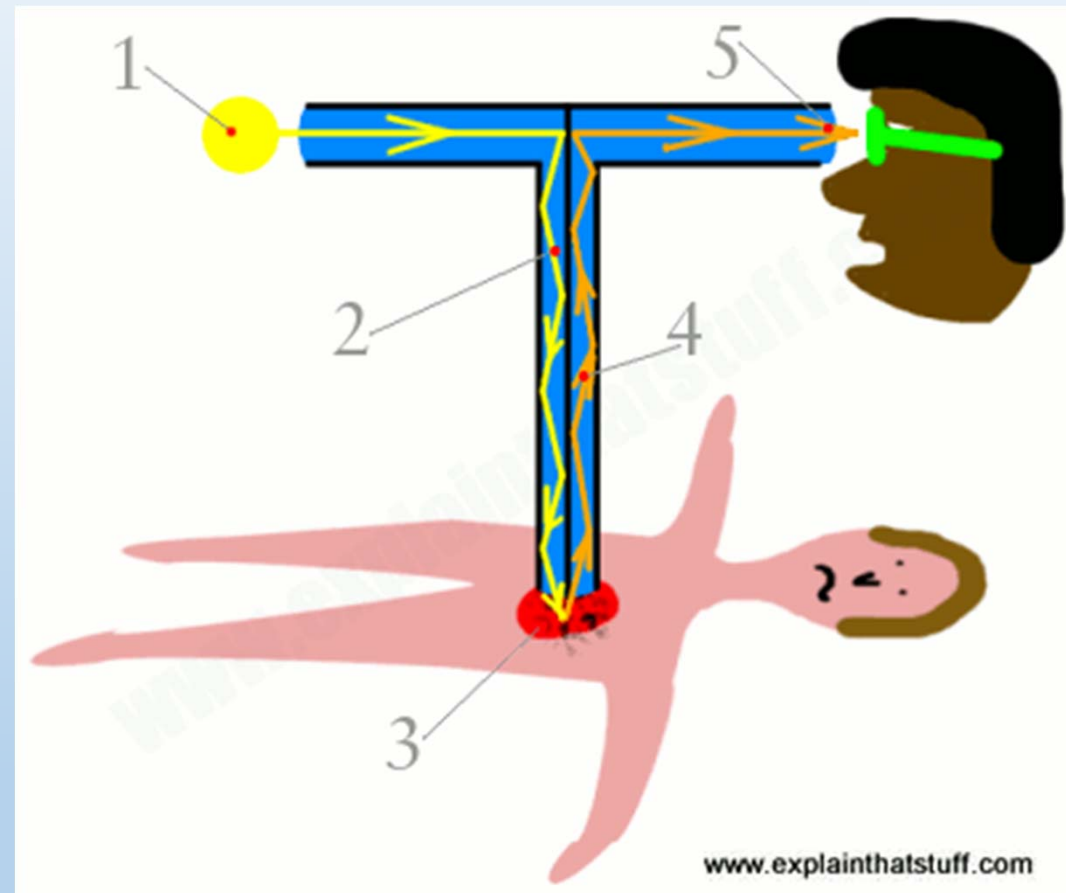
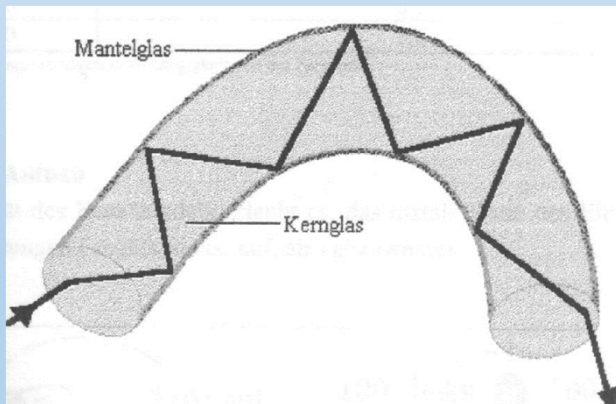
<https://www.thieme.de/viostatics/bilder/vio-2/final/de/bilder/arzt-im-beruf/aerztliches-handeln-rachenuntersuchung-A.jpg>



Endoscopy - introduction

ed to have a look into the body of humans
animals

Basic principle:
transfer of light through a fibre optic via total
reflection between core and outer layers



Medizintechnik, R. Kramme, 4. Auflage, Springer Verlag
http://www.tec.tdietz.de/images_/Abb3_1.JPG



Endoscopy - introduction

- History:

- Ancient Greece: First mention
- Albucais of Cordoba: First use of sun light
- 1806 P. Bozzini: First fibre optics

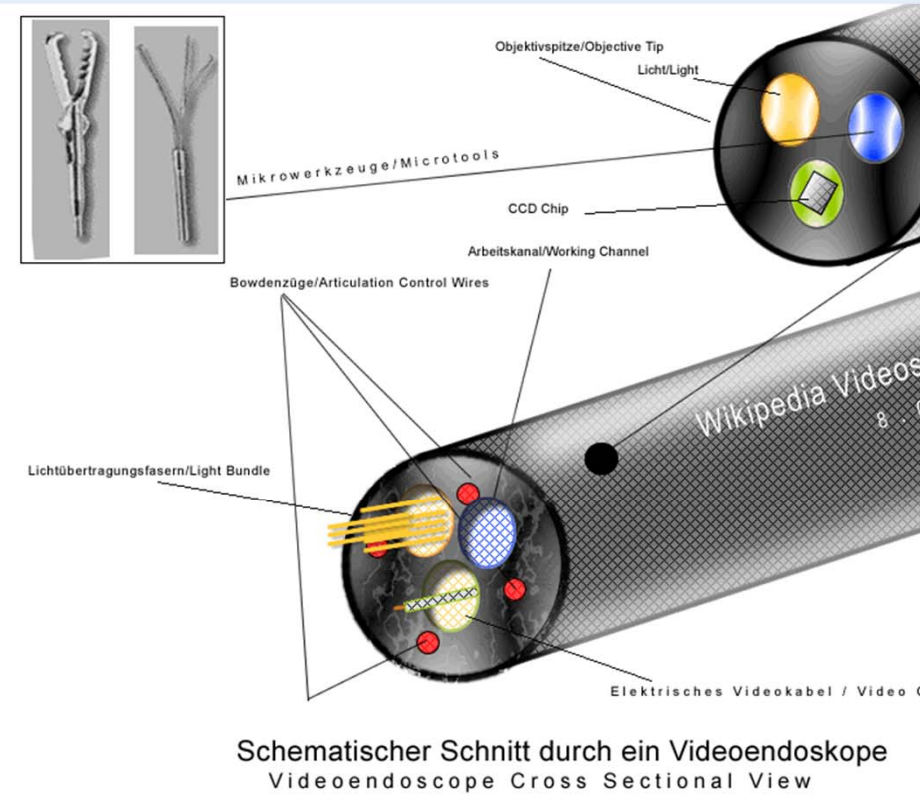
- Fields of application:

- Medical specializations: ENT, urology, gynecology, sport medicine, etc.)
- Body parts and organs: Throat, stomach, bowel, nose, etc.)

<http://www.ag-endoskopie.de/geschichte-der-endoskopie-i>
Medizintechnik, R. Kramme, 4. Auflage, Springer Verlag



Endoscopy - build



https://upload.wikimedia.org/wikipedia/commons/5/52/Videoendoscope_cross_section.gif
https://de.wikipedia.org/wiki/Endoskop#/media/File:Flexibles_Endoskop.jpg



Endoscopy - light sources

- Prerequisites:
 - CRI and colour temperature as close as possible to sunlight
 - High intensities
 - Stable and constant emission
- Techniques:
 - Halogen
 - Xe-discharge
 - LED
 - (metal iodide)
 - (Plasma)

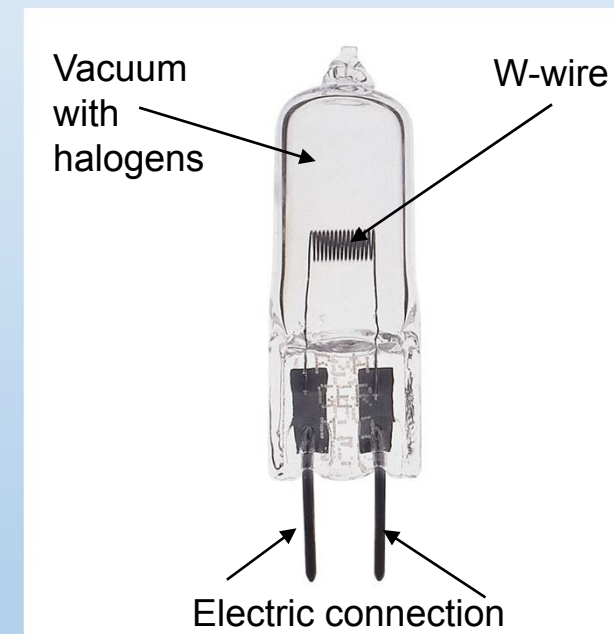




Endoscopy - light sources - halogen

- Lifetime \approx 2000 - 5000 h
- High intensities
- Spectrum \rightarrow continuous in VIS
- Colour temperature 3000-4500 K
- Luminous efficacy approx. 25 lm/W
- CRI approx. 95-100
- Lamp Power 100W, 150 W, 250 W

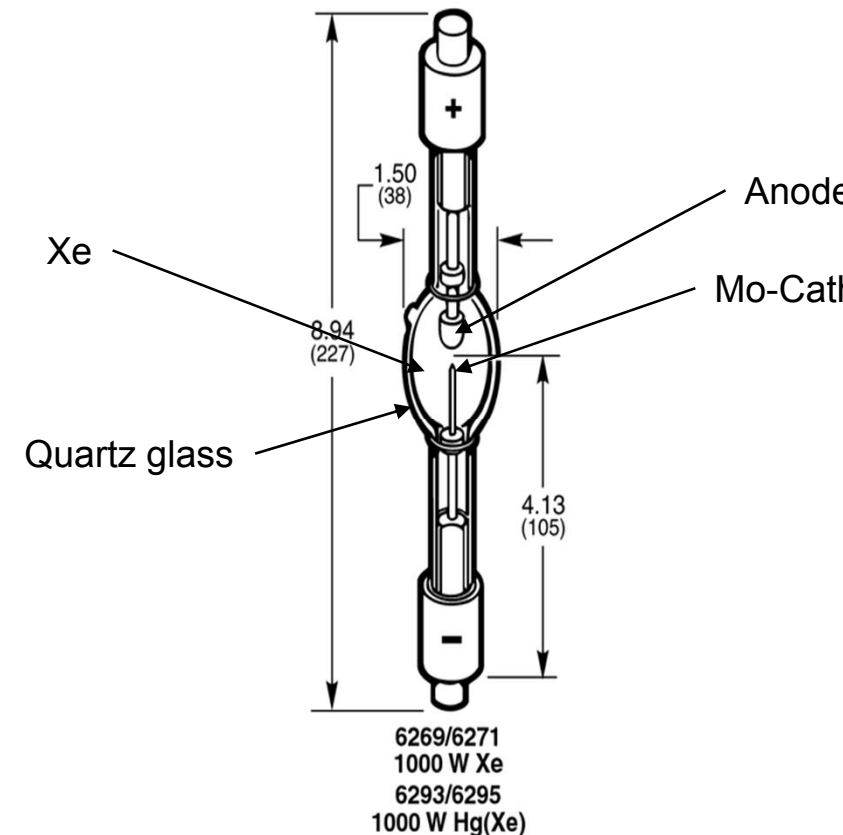
- www.optomic.com
- <http://www.medicalexpo.de>
- <http://www.osram.de>
- <http://www.hellamarine.com/slir/w1024-h1024/2557.dat>





Endoscopy - light sources - Xe-discharge

- Lifetime \approx 500-1200 h
- High intensities
- Spectrum \rightarrow continuous in VIS and very close to sunlight
- Colour temperature 5500-6000 K
- Luminous efficacy approx. 50 lm/W
- CRI approx. 90-95
- Lamp Power 180 W, 300 W

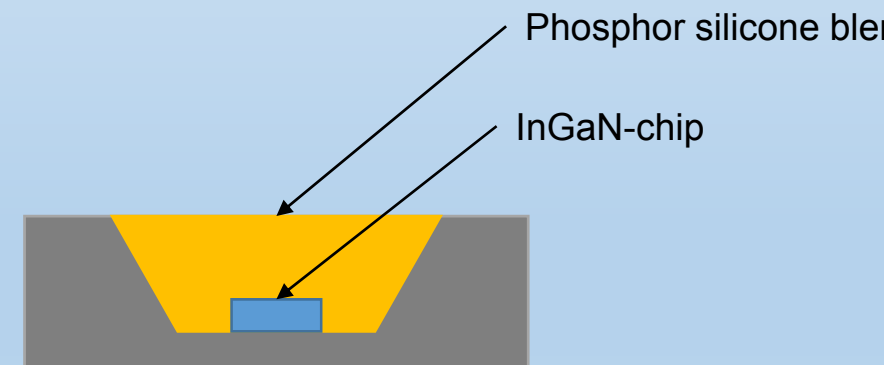


- www.newport.com
- <http://www.medicaexpo.de/prod/aesculap-a-b-braun-company/product-70641-6>
- <http://www.wisap.de/Video-Optics.html>



Endoscopy - light sources - LED

- Lifetime up to 60.000 h
- High intensities
- Spectrum → continuous in VIS
- Colour temperature up to 7000 K
- Luminous efficacy approx. up to 200 lm/W
- CRI 70-90
- Lamp Power 100 W



- <http://www.photonic.at/produkte/medizintechnik/>



Heat lamps - introduction

- Basic principle:
 - “Heat transfer” into the human body via IR-radiation
- History:
 - 400 BC Permenides
 - 1891 mobile lightboxes

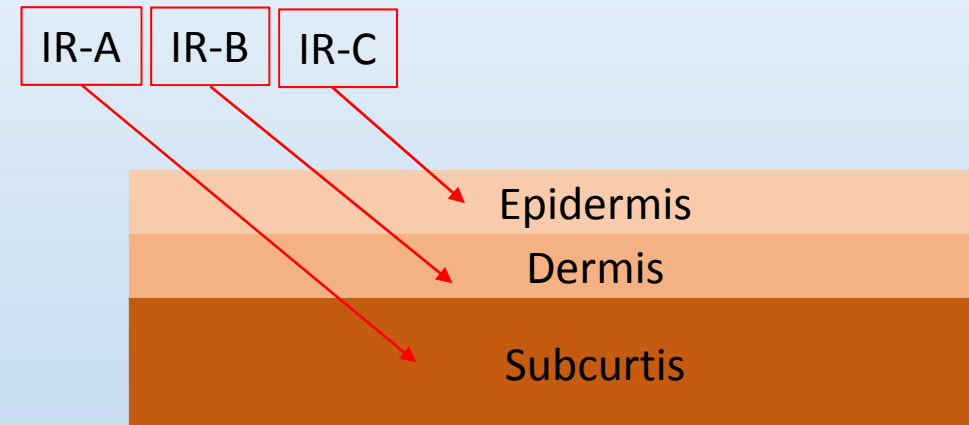


- http://www.philips.de/c-p/HP3616_01/infraphil-infrarotlampe/ubersicht
- <http://www.pharmazeutische-zeitung.de/index.php?id=1406>
- <http://holzner.cc/kopflicht-therapie.jpg>



Heat lamps - effect

- Muscle and link relaxation
- Increase of the blood circulation:
 - Increase of the oxygen supply
 - Increase of substances for the regeneration- and healing processes
 - Improved removal of CO₂ and metabolic products
- Reduced pain signal transmission
- Pain reduction
- Activates the cell metabolism



	Wavelengths [µm]	Penetration depth
IR-A	0,780 – 1,400	4 - 5
IR-B	1,400 – 3,000	Around 2
IR-C	3,000 - 1.000	0.1

- http://www.philips.de/c-p/HP3616_01/infraphil-infrarotlampe/ubersicht
- <http://www.pharmazeutische-zeitung.de/index.php?id=1406>
- B. Meffer, H. Meffert, Optische Strahlung und ihre Wirkung auf die Haut, Biomedizinische Technik Band 45 Heft 4/20



Heat lamps – fields of application

- Acute and chronic muscle pain
- Muscle and link stiffness
- Deeper Lumbar spine problems
- Sprains
- Chronic inflammations:
 - Rheumatism
 - Sinusitis
 - Bronchitis
- Circulatory disturbances
- Morbus Sudeck
- ...

- <http://www.pharmazeutische-zeitung.de/index.php?id=1406>



Heat lamps – light sources

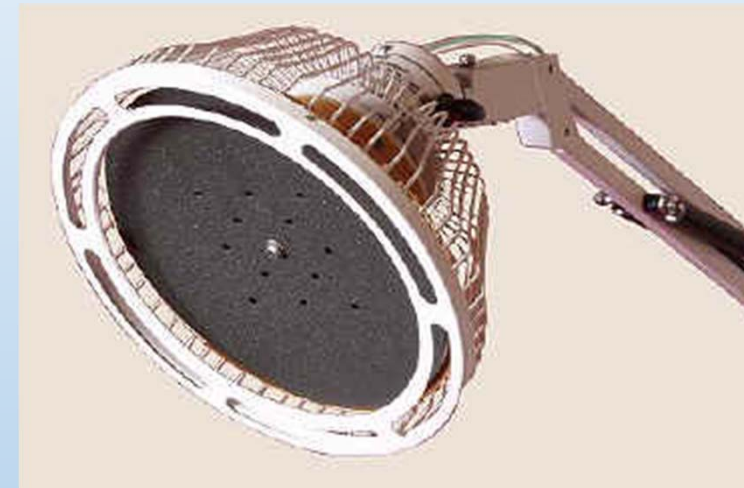


- <http://www.philips.de/c-m-pe/schmerztherap>
- <https://schwa-medico.de>



Heat lamps - light sources

- Lamp Power: 150 W, 200 W, 250 W, 300 W, 650 W
- Life time: 125 h, 500h, 1000h
- Halogen lamp, quartz lamp, TDP



[p://www.philips.de/c-m-pe/schmerztherapie](http://www.philips.de/c-m-pe/schmerztherapie)
[p://www.raeucherzeit.de/shop/image.php?productid=16291](http://www.raeucherzeit.de/shop/image.php?productid=16291)
[p://www.bessere-wege-gehen.de/broschuere_gougong.pdf](http://www.bessere-wege-gehen.de/broschuere_gougong.pdf)



Blue light pain therapy

- Formation of NO out of nitrite
- NO has vessel expanding effects → increase of blood circulation
- Wavelength: 453 nm
- Light sources: LED



<http://www.gesuendernet.de/specials/archiv/philips-bluetouch/item/521-wirkweise-blaues-led-licht-in-der-schmerztherapie.html>
http://www.philips.de/c-p/PR3743_00/bluetouch-per-app-gesteuertes-bluetouch-geraet
<http://www.pharmazeutische-zeitung.de/index.php?id=39012>



Blue light acne therapy

- Formation of oxygen radicals out of porphyrins:
 - E.T. from triplet of the porphyrin to molecular oxygen
- Killing the propionic bacteria
- Wavelength: 400 - 450 nm
- Light sources: LED



www.lichttherapie-ratgeber.de/einsatzbereiche/hautkrankheiten/lichttherapie-gegen-akne-blaues-und-rotes-licht-ergaenzen-sich
www.hautarzt-meldorf.de/akne-behandlung/
www.akne-blog.de/wp-content/blaulicht-lampe-akne.jpg

en radicals and related species, O. Augusto and S. Miyamoto, principles of free radical biomedicine Vol. 1, Nova Science, 2011

etical and experimental analysis of luminescence signal of singlet oxygen for different photosensitizers, J. Baier et al., Journal of photochemistry and photobiology, 87 (2007)



Jaundice care

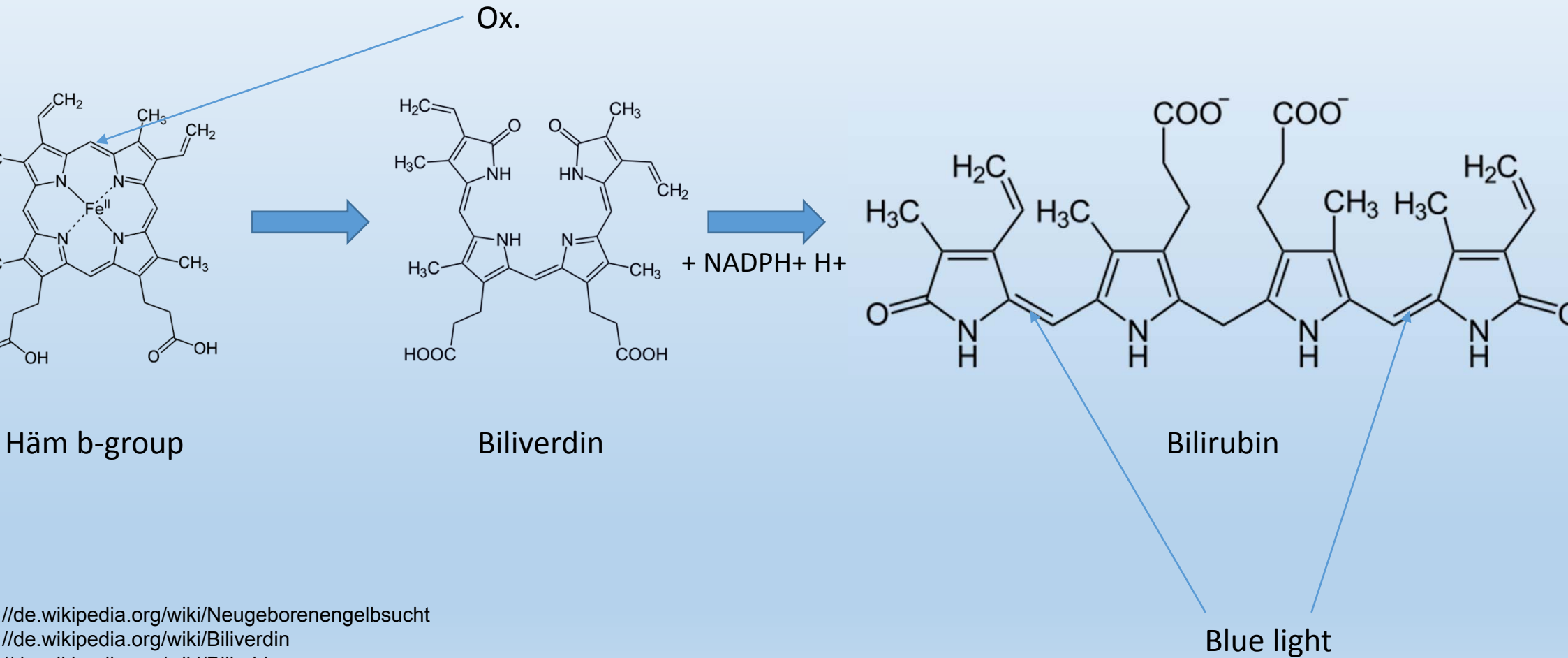
- Light sources: LED
- Wave length: 450 – 475 nm



<http://www.baby-und-familie.de/Neugeborenenengelbsucht>
<http://www.still-lexikon.de/wp-content/uploads/2015/05/Ikterus-Fototherapie1.jpg>



Jaundice care



[//de.wikipedia.org/wiki/Neugeborenengelbsucht](https://de.wikipedia.org/wiki/Neugeborenengelbsucht)

[//de.wikipedia.org/wiki/Biliverdin](https://de.wikipedia.org/wiki/Biliverdin)

[//de.wikipedia.org/wiki/Bilirubin](https://de.wikipedia.org/wiki/Bilirubin)

www.baby-und-familie.de/Neugeborenengelbsucht

et al., Lehrbuch der Biochemie, Wiley-VCH, 2. Auflage

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Light therapy

- Light controls the melatonin and serotonin level
- Against “winter depression”
- White light with 2500 – 10.000 lux to imitate summer sun light (~10.000 lux)
- Light source: LED



<http://www.apotheken-umschau.de/Lichttherapie-bei-Depressionen>
http://www.philips.de/c-p/HF3419_01/energyup-energylight/technische-daten



Other fields of application

- Sleep disturbances
- Laser treatments
 - Eye
- Cosmetic treatment
 - Tattoo removal laser e.g. YAG:Nd
 - Remove of pigment spots laser e.g. YAG:Nd
 - Hair removal laser
- Microscopy
- Curing of dental fillings blue light
- Disinfection UV-C radiation
- Psoriasis care UV-B radiation



Conclusions

- Wide range
- Harmless/ healthier
- Area
- Environment friendly

Medical light sources for diagnostic and therapeutic applications

Backup – Morbus Sudeck

- Dystrophy and Atrophy of extremity parts after external influences like an operation, trauma, inflammation
- Dystrophy: malformation (Fehlbildungen)
- Atrophy: tissue loss (Gewebeschwund)