Sources of Infrared radiation

Michael Bentlage

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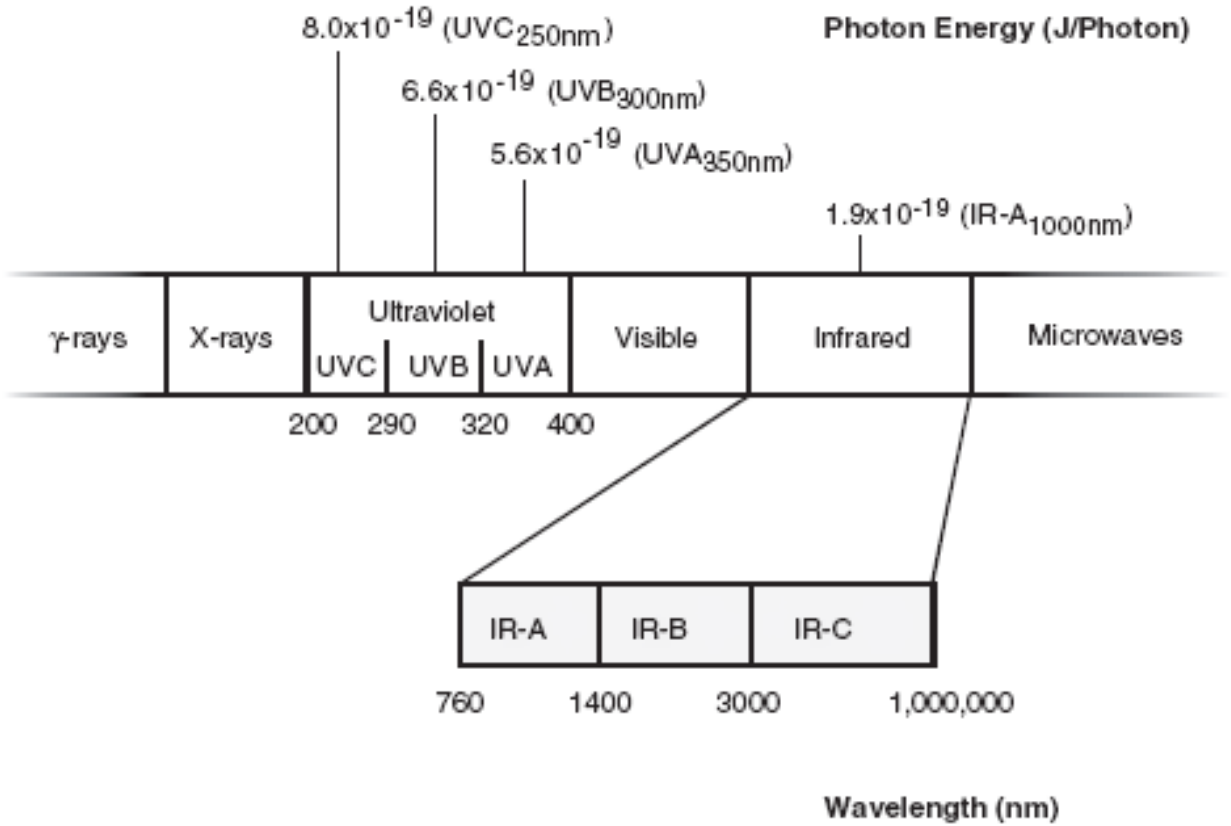
historical background

- 1800 Sir Wilhelm Herschel: Discovers IR-radiation
- 1859 Gustav Kirchhoff: Derives the law of thermal radiation
- 1893 Wilhelm Wien: Derives the displacement law
- 1897 Walther Nernst: Invents the Nernst Glower
- 1901 Max Planck: Derives Plancks Law

classification of the spectral range



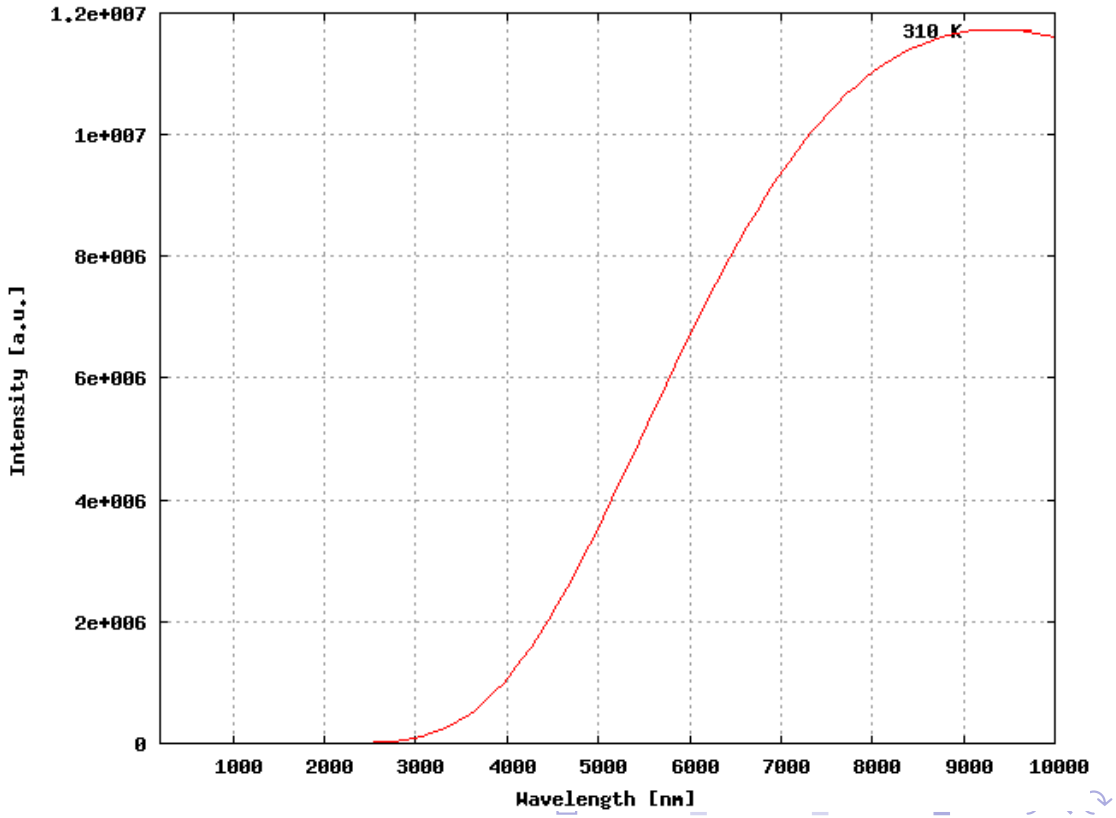
black body radiators

- absorb any incident light
- ideal source for thermal radiation
- Plancks law: $I(\lambda, T) = \frac{2hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda k T}} - 1}$
  - I: Intensity of corresponding wavelength at a given temperature
  - h: Plancks constant
  - c: speed of light
  - λ: wavelength
  - k: Boltzmanns constant
  - T: Temperature
- Wiens displacement law: $\lambda_{\max} = \frac{2897{,}8\,\mu\mathrm{m\,K}}{T}$

examples for black body radiators

- Humans

- peak value = 9.3 µm
- almost no intensity in the visible
- applications:
  - motion detectors
  - temperature measurement
  - Infrared cameras



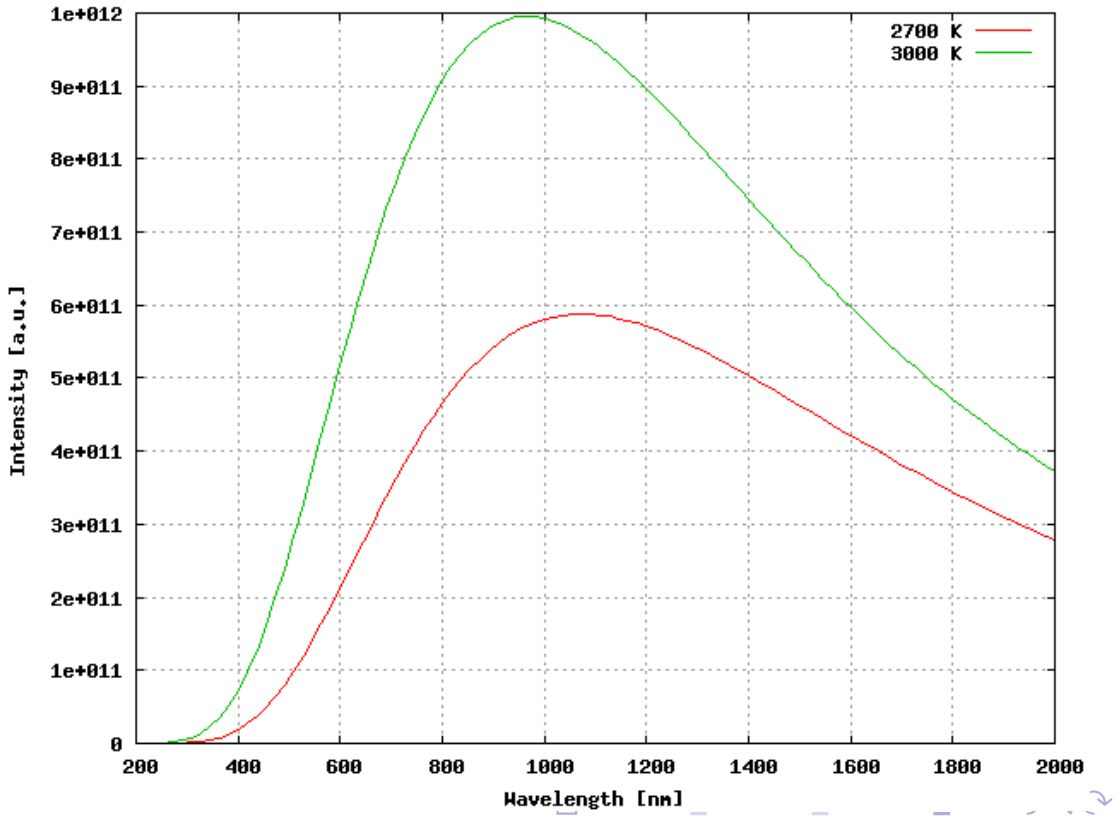
examples for black body radiators

- Humans

examples for black body radiators

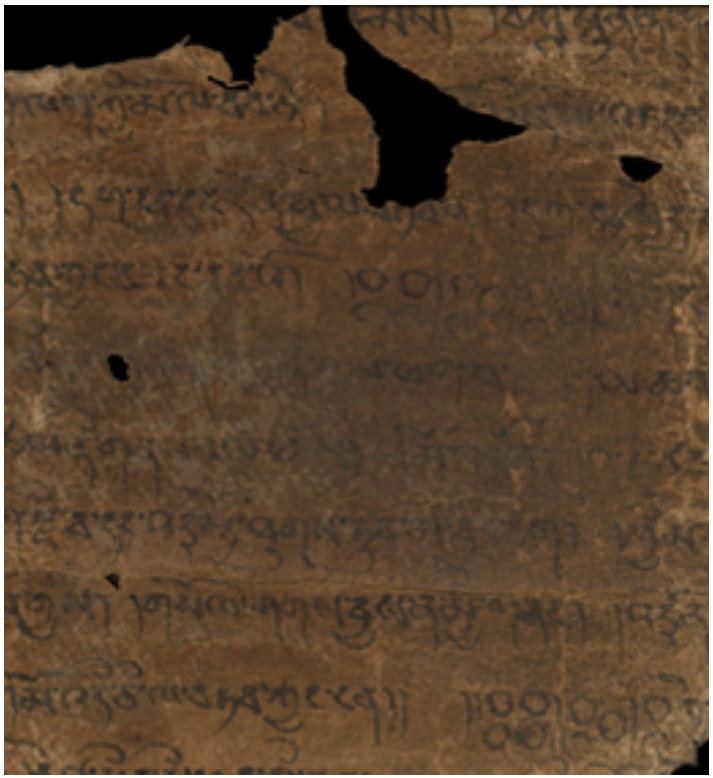
- Incandescent lamps

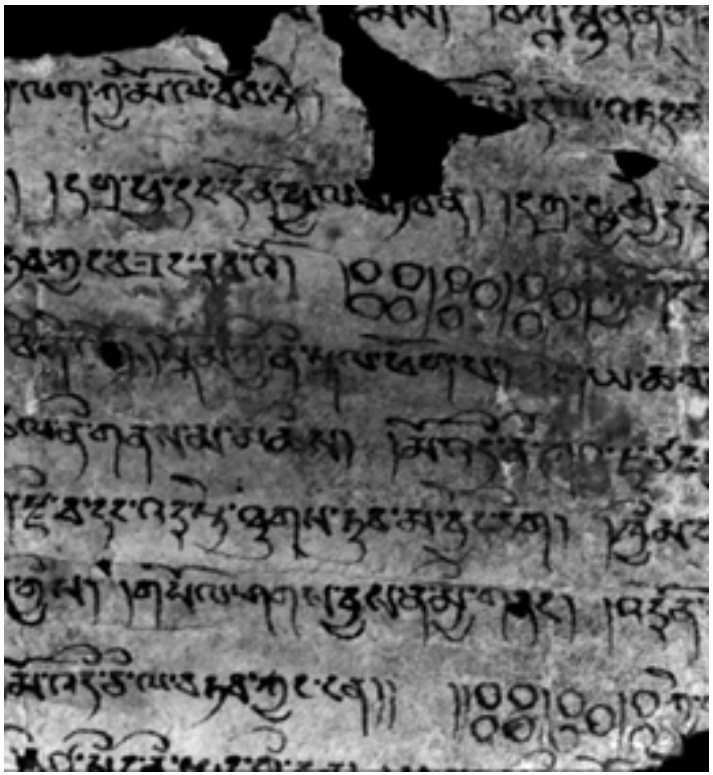
- peak value = 1.1 µm (T = 2700 K)
- peak value = 966 nm (T = 3000 K)
- main part of radiation in the infrared
- applications:
  - medicine & agriculture
  - photography



examples for black body radiators

- Incandescent lamps

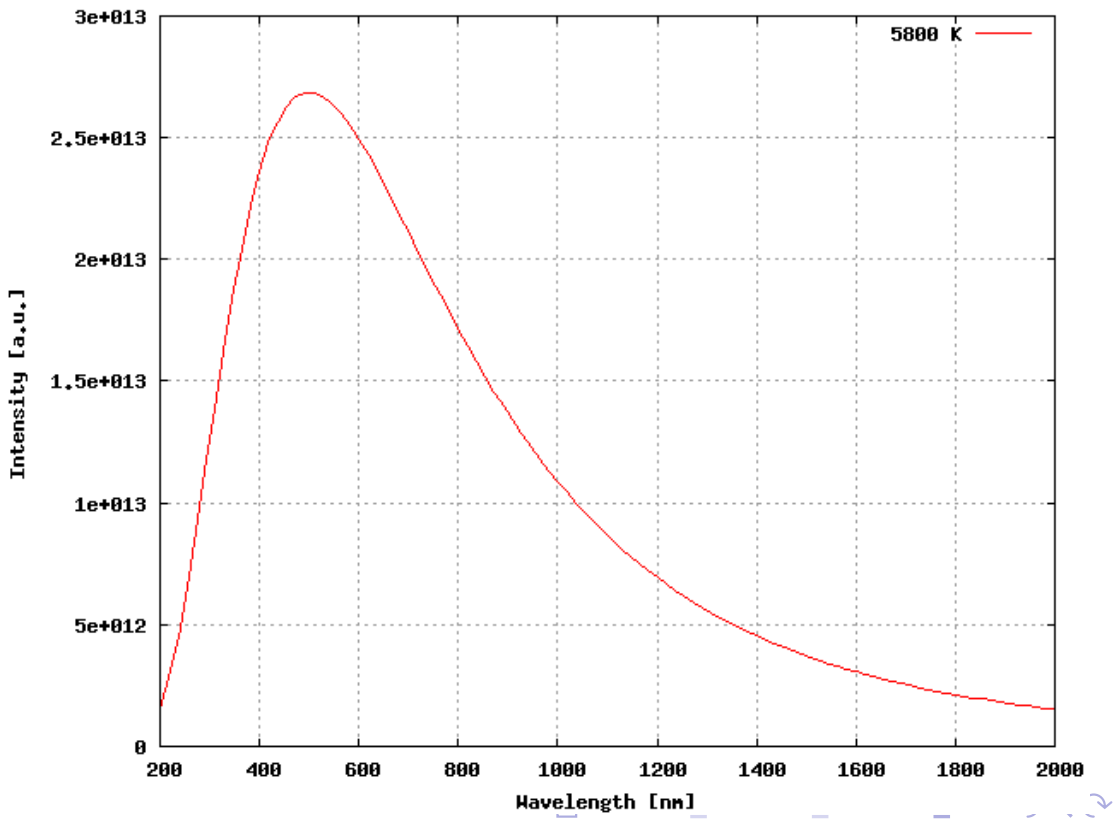




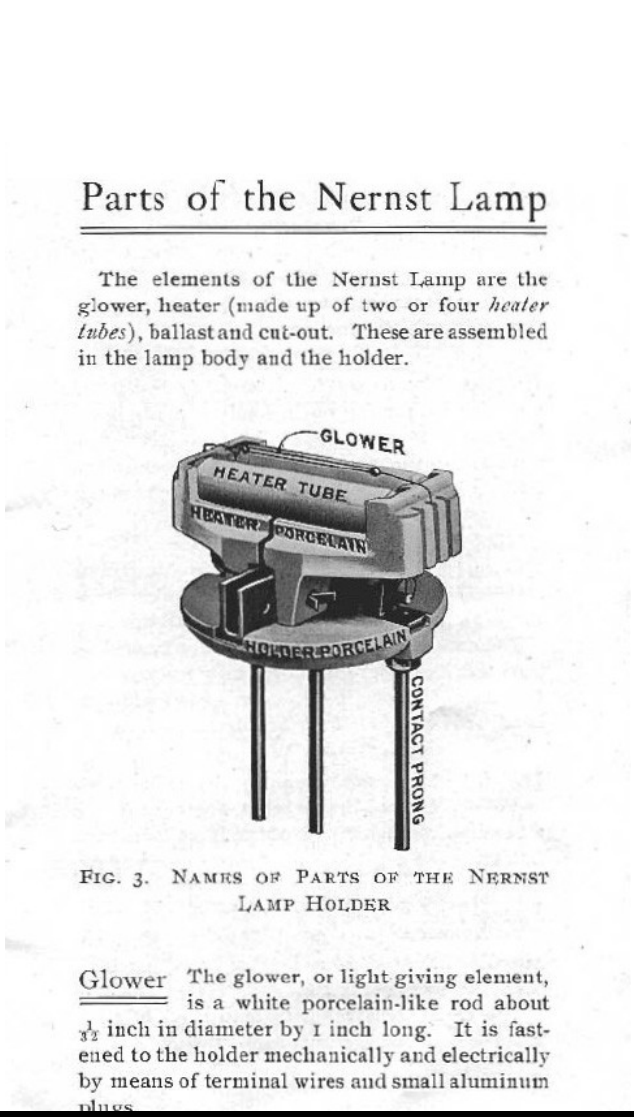
examples for black body radiators

- The sun

- peak value = 500 nm (T = 5800 K)
- real spectrum exhibits Fraunhofer lines
- applications:
  - solar panels



Nernst lamp



Parts of the Nernst Lamp

The elements of the Nernst Lamp are the glower, heater (made up of two or four *heater tubes*), ballast and cut-out. These are assembled in the lamp body and the holder.

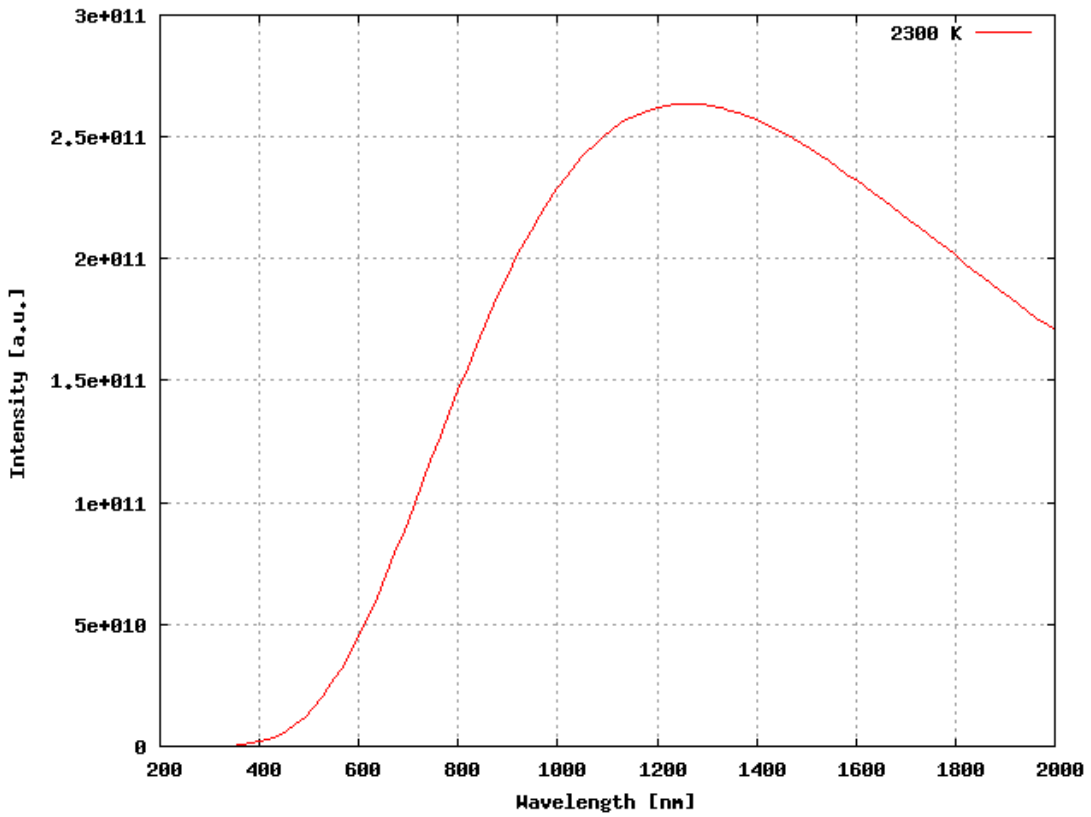
FIG. 3. NAMES OF PARTS OF THE NERNST LAMP HOLDER

Glower The glower, or light-giving element, is a white porcelain-like rod about $\frac{1}{32}$ inch in diameter by 1 inch long. It is fastened to the holder mechanically and electrically by means of terminal wires and small aluminum plugs.

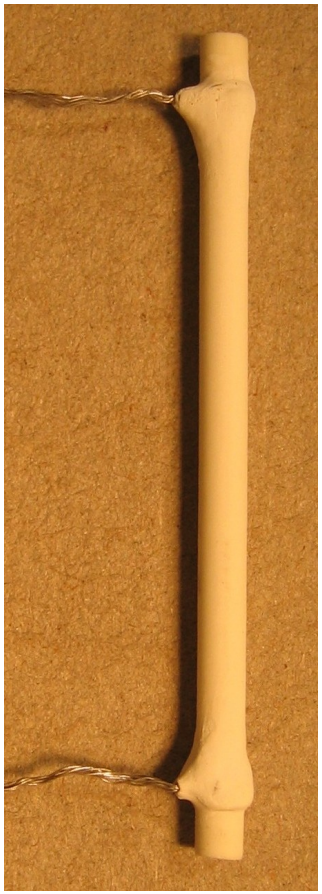
- composition
  - Zirconium oxide ZrO_2 90% wt/wt
  - Yttrium oxide Y_2O_3 7% wt/wt
  - Erbium oxide Er_2O_3 3% wt/wt
- operating temperature: 2300 K
- preheating necessary
- applications
  - general lighting purposes
  - first functional long distance fax
  - ophthalmology
  - projection
  - microscopy

Nernst lamp

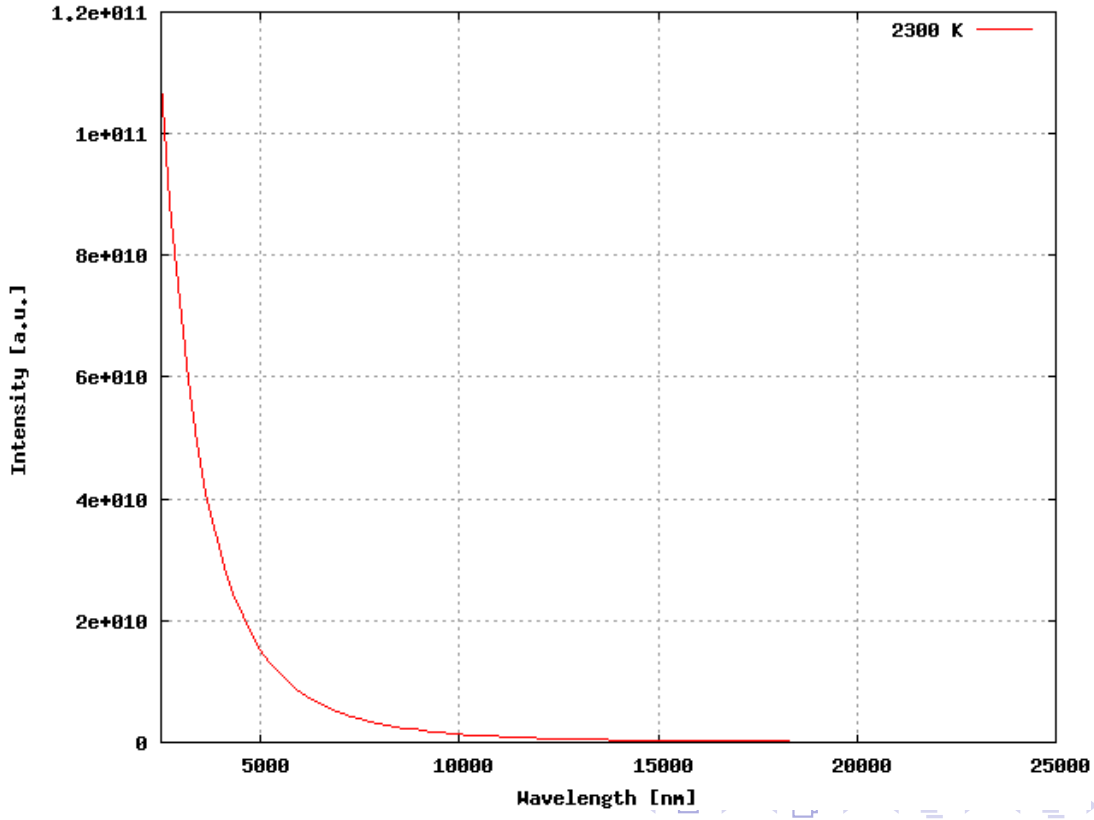
- peak value = 1.3 µm (T = 2300 K)



Nernst glower



- application in Infrared spectroscopy

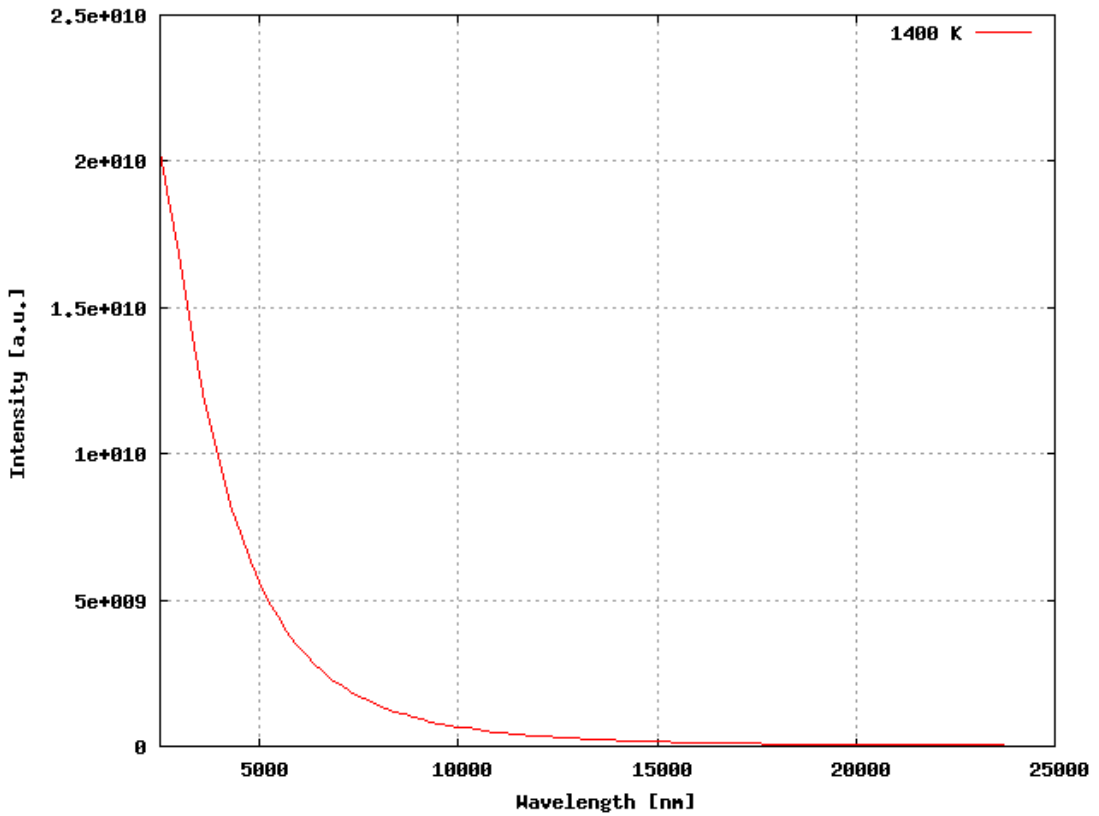


Globar

- Glow + bar = Globar
- composition
  - Silicon carbide
- operating temperature: 1400 K
- no preheating necessary

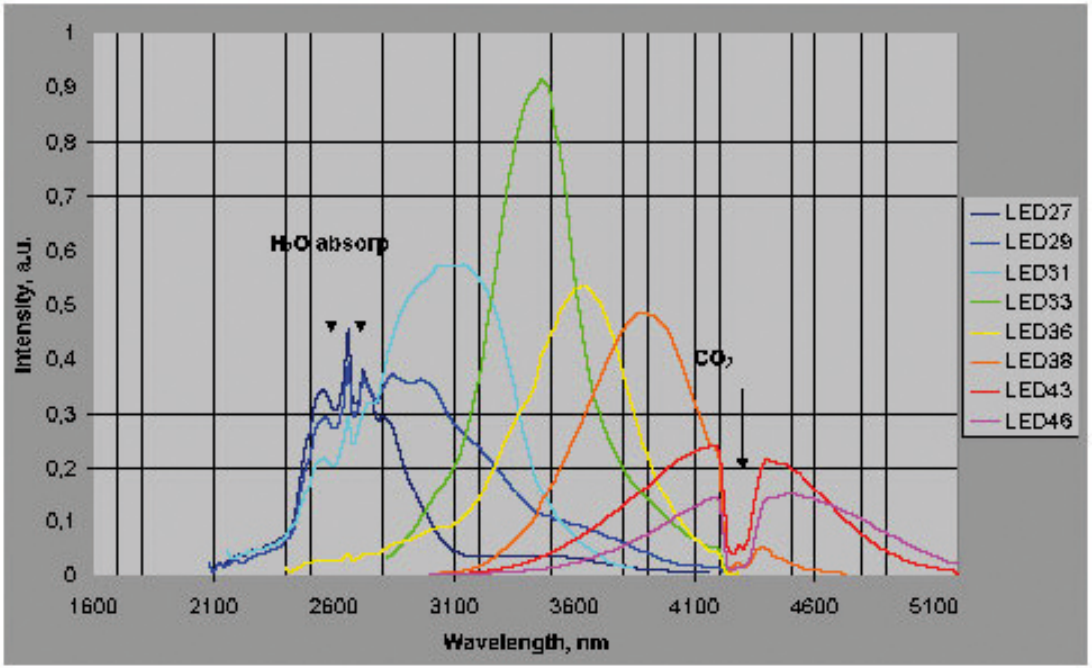
Globar

- peak value = 2.1 µm
  (T = 1400 K)



IR-LEDs

- IR-LEDs can be made out of III/V-semiconductors
- applications
  - remote controls
  - photoelectric sensors



IR-Lasers

- IR-Lasers utilize the following technologically relevant wavelengths
  - 850 nm, 1300 nm, 1310 nm, 1550 nm and 1625 nm
- applications
  - Telecommunication

End

Thanks for your attention.