

# Infrared radiation

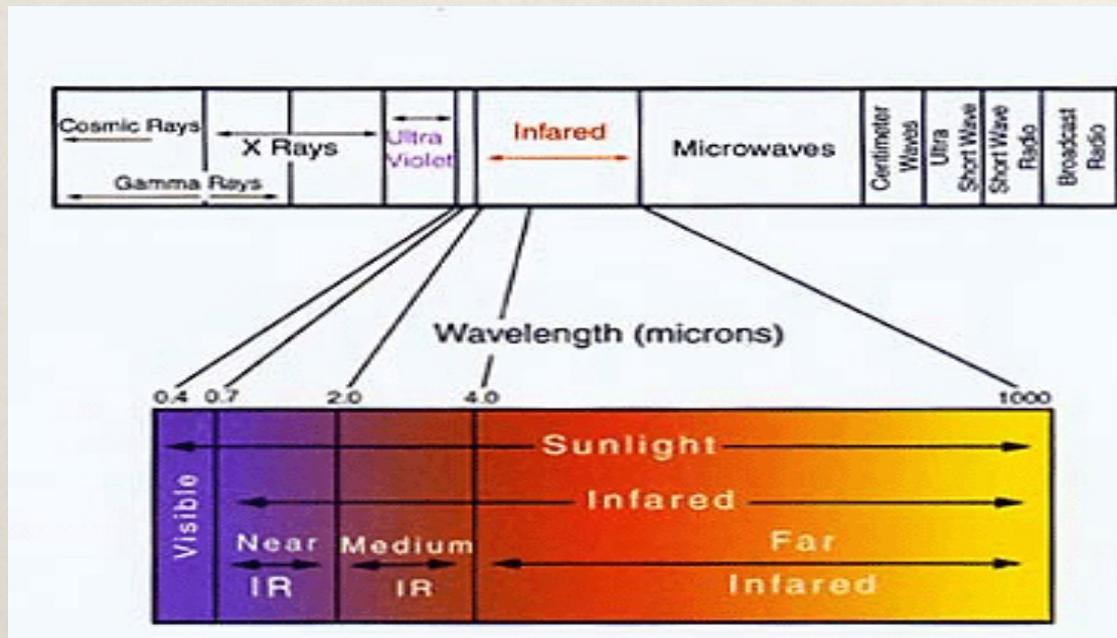
by Christoph Wieschendorf  
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# Introduction

- \* Historical Background
- \* The spectrum of light
- \* Sources of Infrared radiation
  - \* Black body radiation
  - \* Nernst glower
  - \* Incandescent bulb
  - \* LED's
- \* Application of Infrared radiation
  - \* Spectroscopy
  - \* Optical data transmission

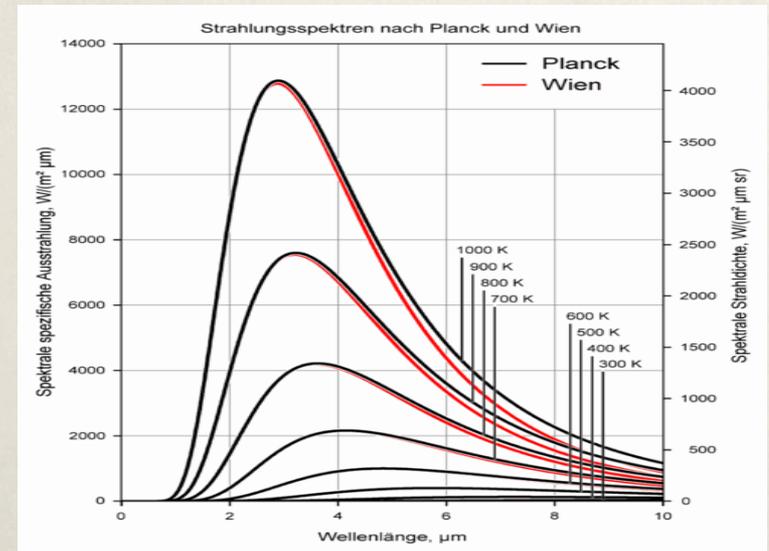
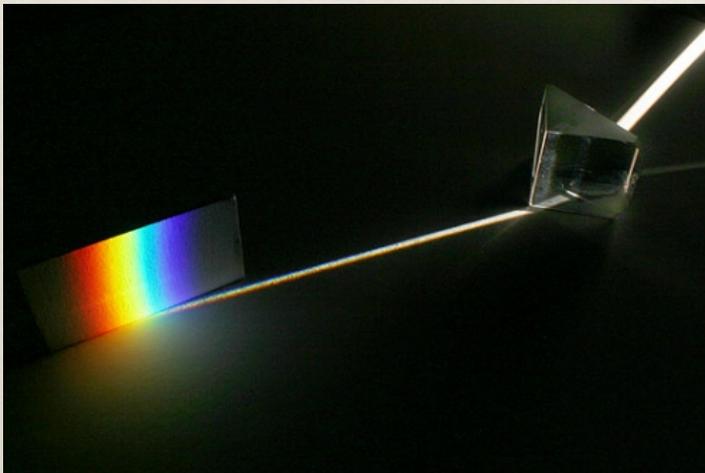
# What is Infrared radiation?

- \* IR light is electromagnetic radiation with a characteristic wavelength range
- \* We distinguish between near Infrared, Medium Infrared and far infrared
- \* For further discussions we have a look to the NIR-Range



# Historical Background

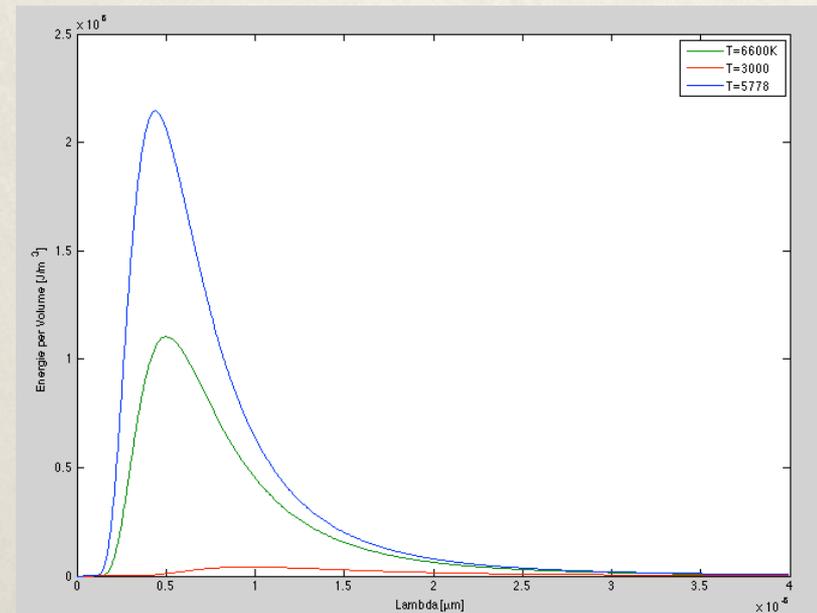
- \* 1704: Isaac Newton Spectrum of white light
- \* 1800: Wilhelm Herschel discovered Infrared Radiation
- \* 1859: Gustav Kirchhoff: Law of thermal radiation
- \* 1893: Wilhelm Wien: Derives the displacement law
- \* 1901: Max Planck: Derives Planck's law



# Black-Body radiation

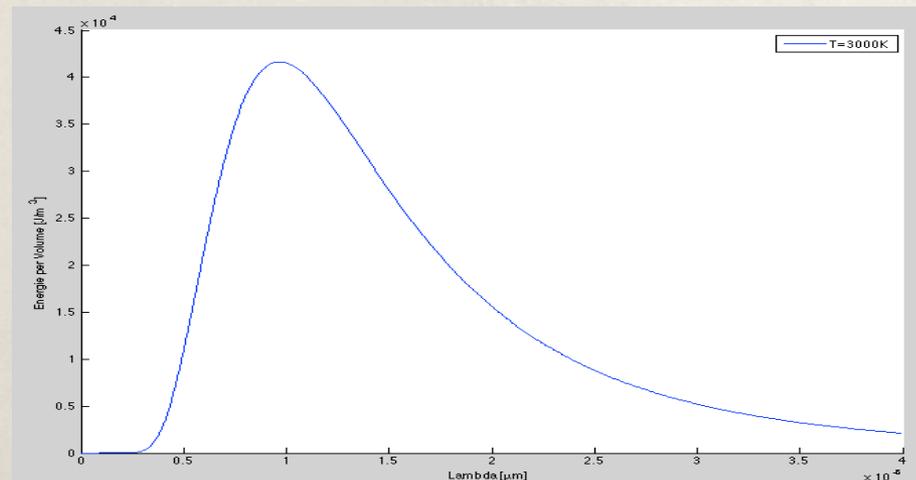
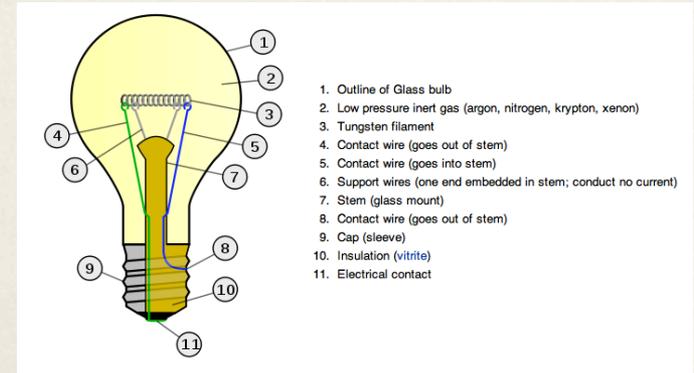
- \* Black-Body radiation has a continuous frequency spectrum
- \* Spectrum can be calculated out of Planck's law
- \* Body's at a certain Temperature emit light with the characteristic spectrum

$$U(\nu, T) = \frac{8 * \pi * h * c}{\lambda^5} * \frac{1}{e^{\frac{hc}{k_b T \lambda}} - 1} d\lambda$$



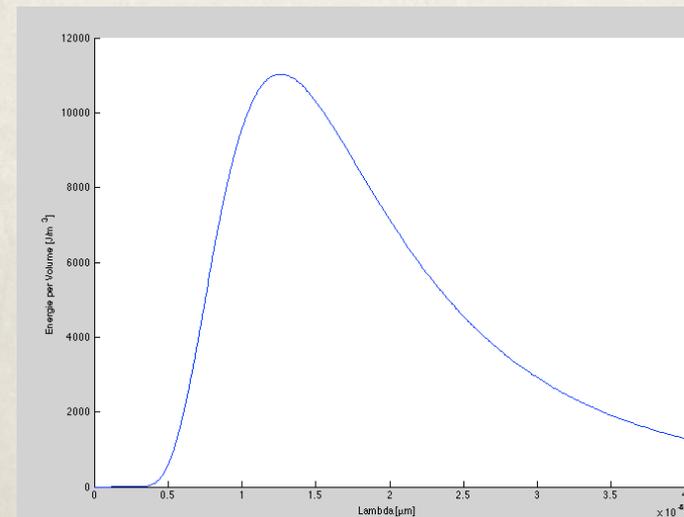
# Incandescent Bulb

- \* Emission of visible radiation and infrared radiation
- \* Visible light part is very small -> very inefficient
- \* Beside using an incandescent Bulb as a light source it get used as a infrared heater



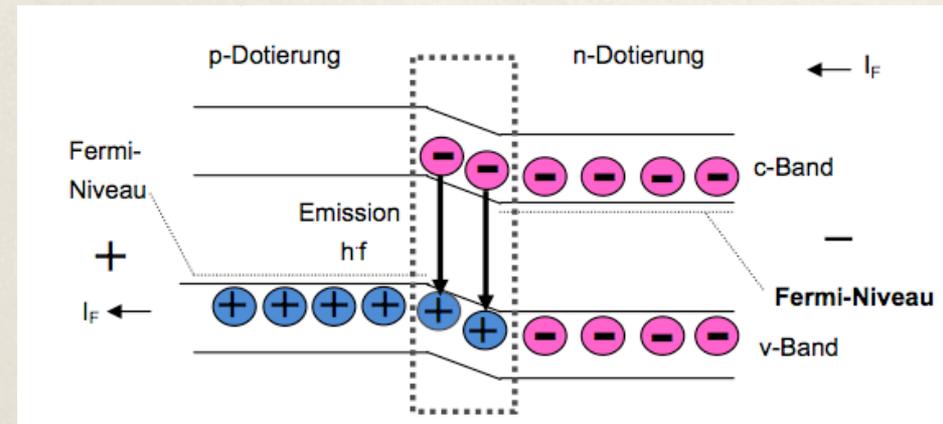
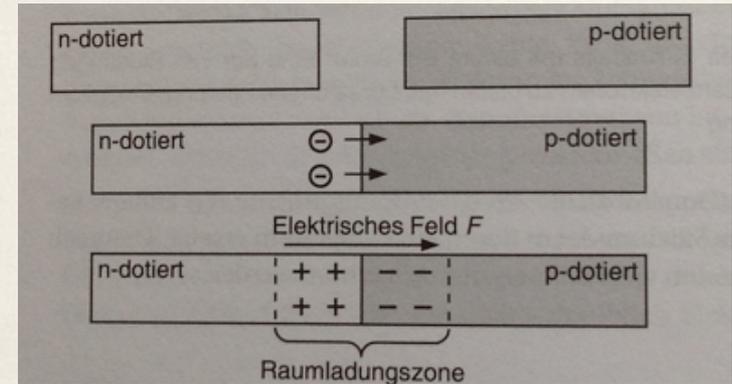
# Nernst glower

- \* Nernst glower is a cylindrical rod
- \* Made of  $ZrO_2$ ,  $Y_2O_3$  and  $Er_2O_3$
- \* Emit at  $T=2300K$
- \* Used in IR spectroscopy



# LED's

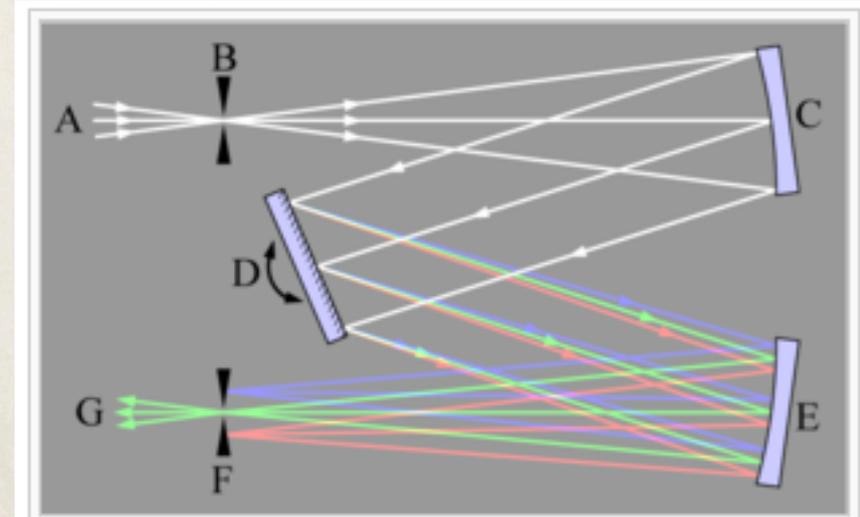
- \* Semiconductor light source
- \* The pn-contact leads to emitting photons in a concentrated place
- \* LEDs have a very small bandwidth
- \* Efficiency is much higher than common light sources



Halbleiter	$E_g$ (eV)	$\lambda_g$ ( $\mu\text{m}$ )	direkt/indirekt	Gitterkonstante ( $\text{\AA}$ )
GaAs	1,424	0,871	direkt	5,64
InP	1,351	0,918	direkt	5,87

# Infrared spectroscopy

- \* Used to identify and study chemicals
- \* Especially to study Molecules
- \* Principle:
  - \* Recording infrared spectrum which is passing through a sample
  - \* Absorbing occurs when a certain wavelength of the spectrum has the same energy as the vibrational frequency
  - \* Transmitted spectrum gets studied with a monochromatic





Thank you for your  
attention!