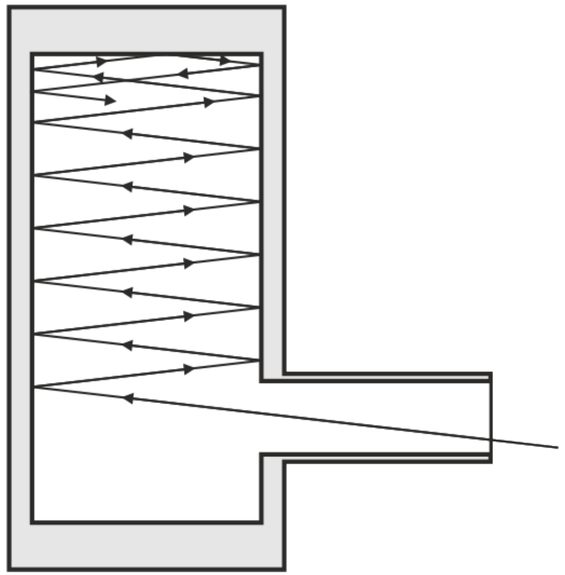
Experimental Physics 3 - Em-Waves,Optics, Quantum mechanics

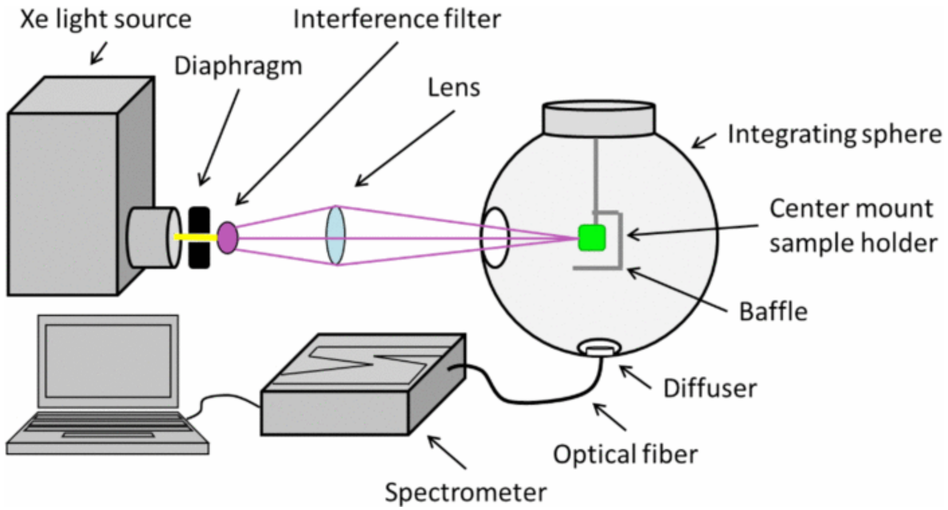
Lecture 21

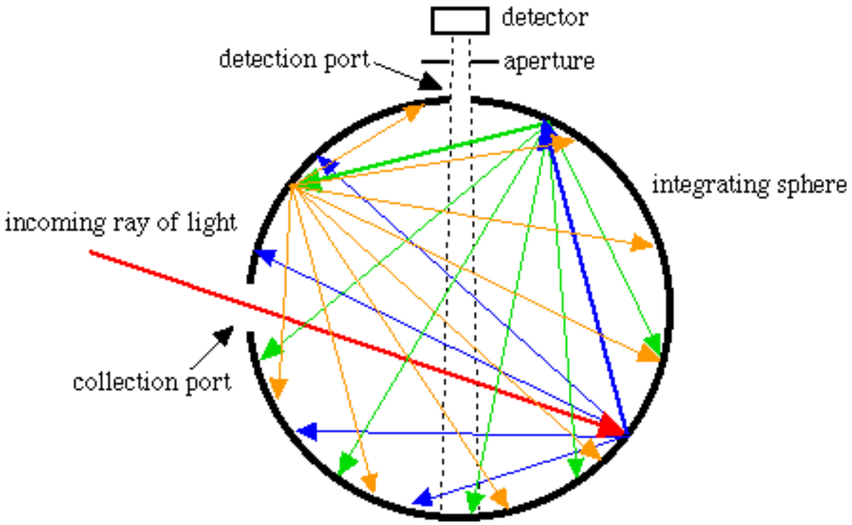
Prof. Dr. Frank Cichos
WS 2022/23

The Birth of Quantum Mechanics

Cavity radiator and integrating or Ulbricht sphere







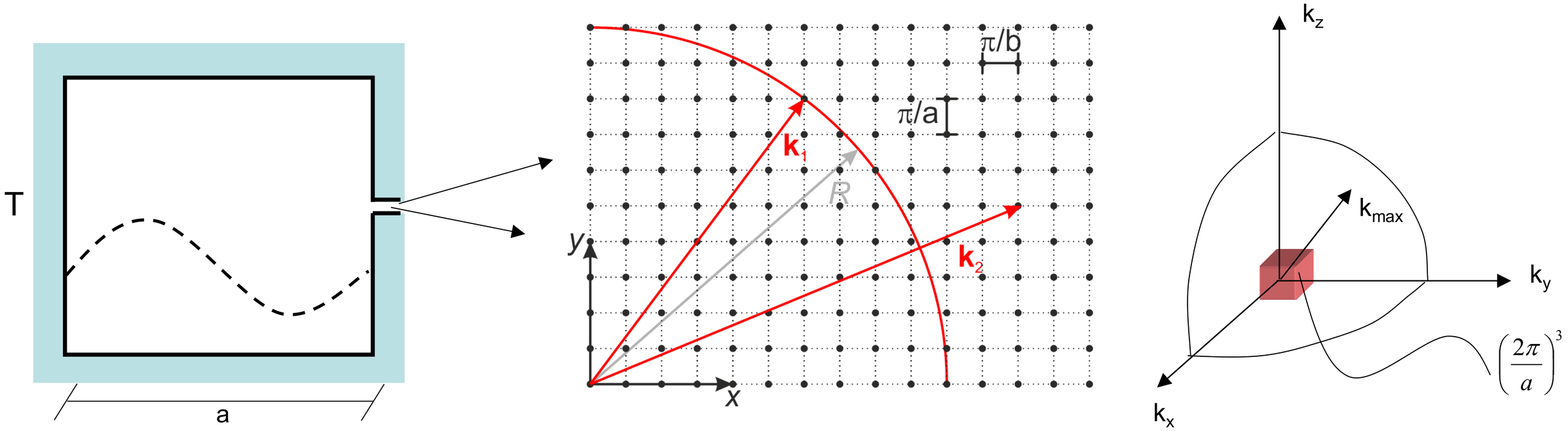
Integrating sphere or Ulbricht sphere

- Total radiant flux collection of
  - emitted and scattered by sample
  - entered through inlet port
- Direction-independent collection

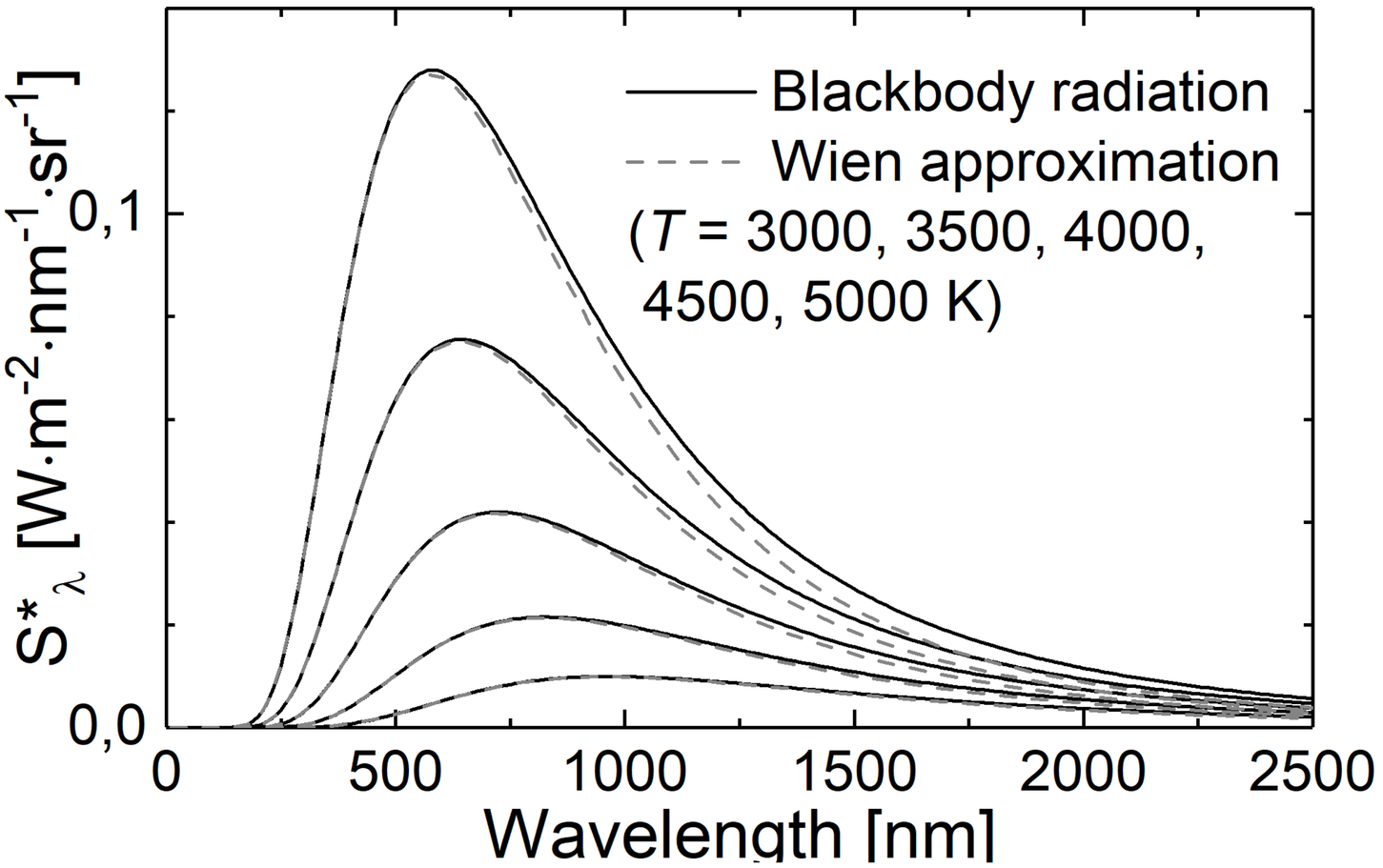
Leyre et al., *Rev. Sci. Instrum.* **85** (2014) 123115

https://physics.stackexchange.com/questions/107152/why-must-an-integrating-sphere-be-a-sphere

Cavity radiator and integrating or Ulbricht sphere



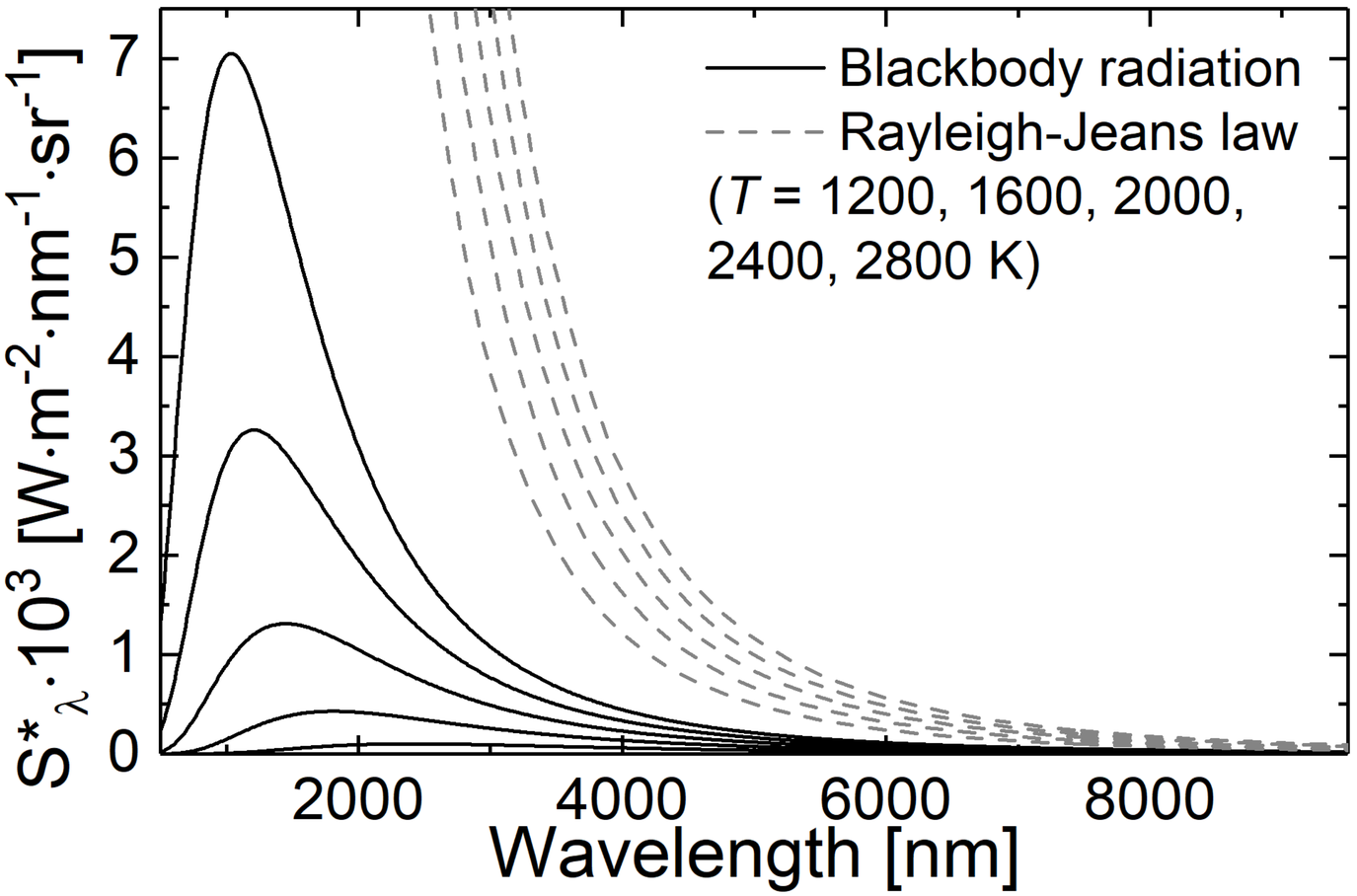
Wien’s displacement law or Wien approximation



Correct representation of
- short wavelength flank
- Peak wavelength

Underestimation of
- long wavelength flank

Rayleigh-Jeans law

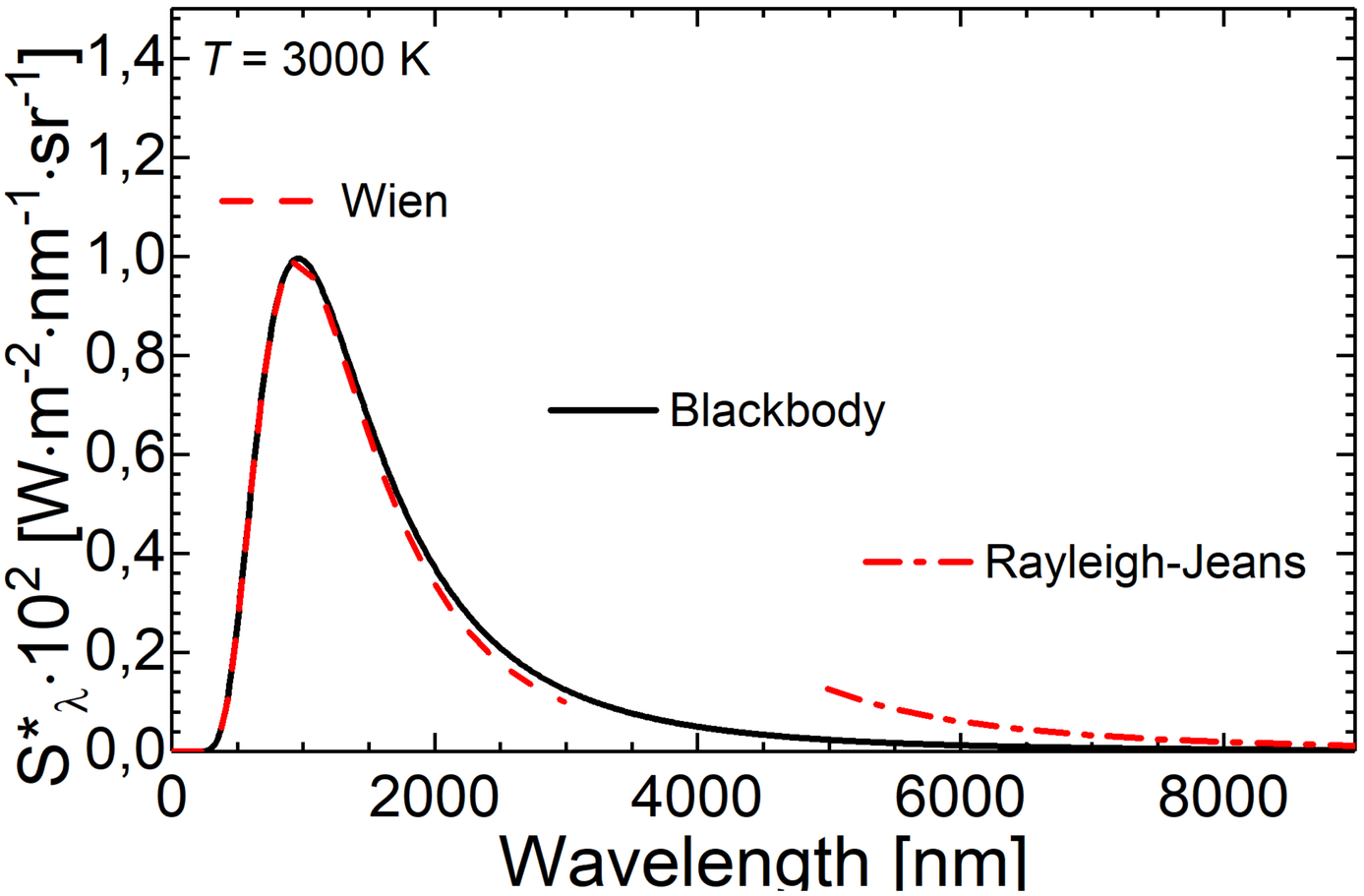


Correct representation of
- Long wavelength flank

Failed to describe
- Peak wavelength

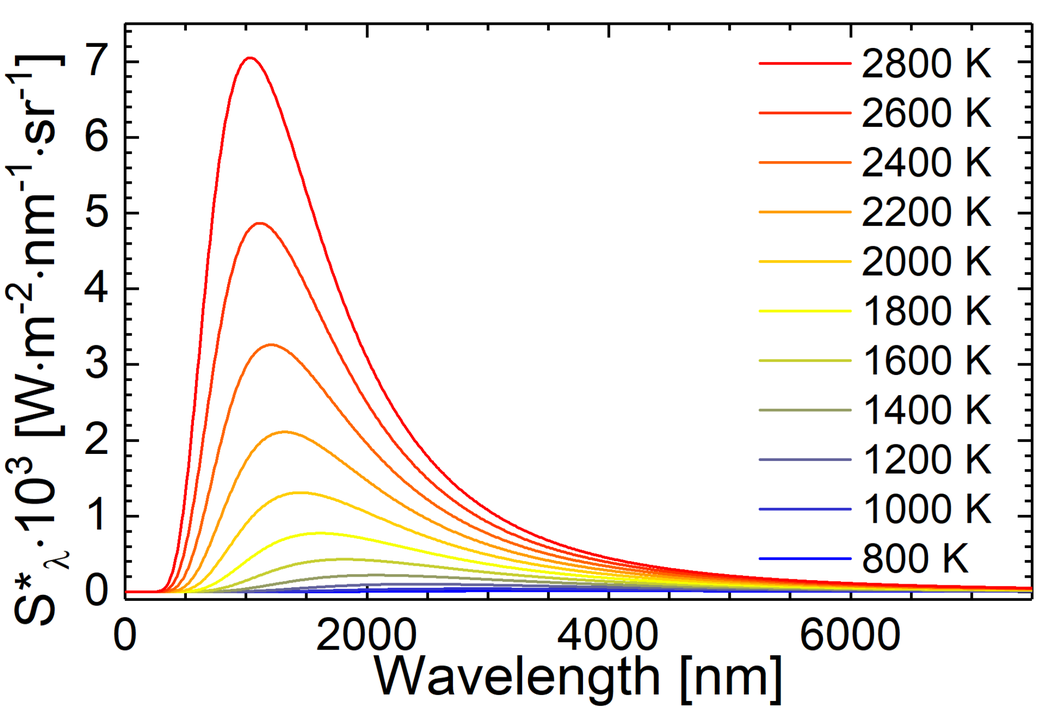
Leads to ultraviolet catastrophe

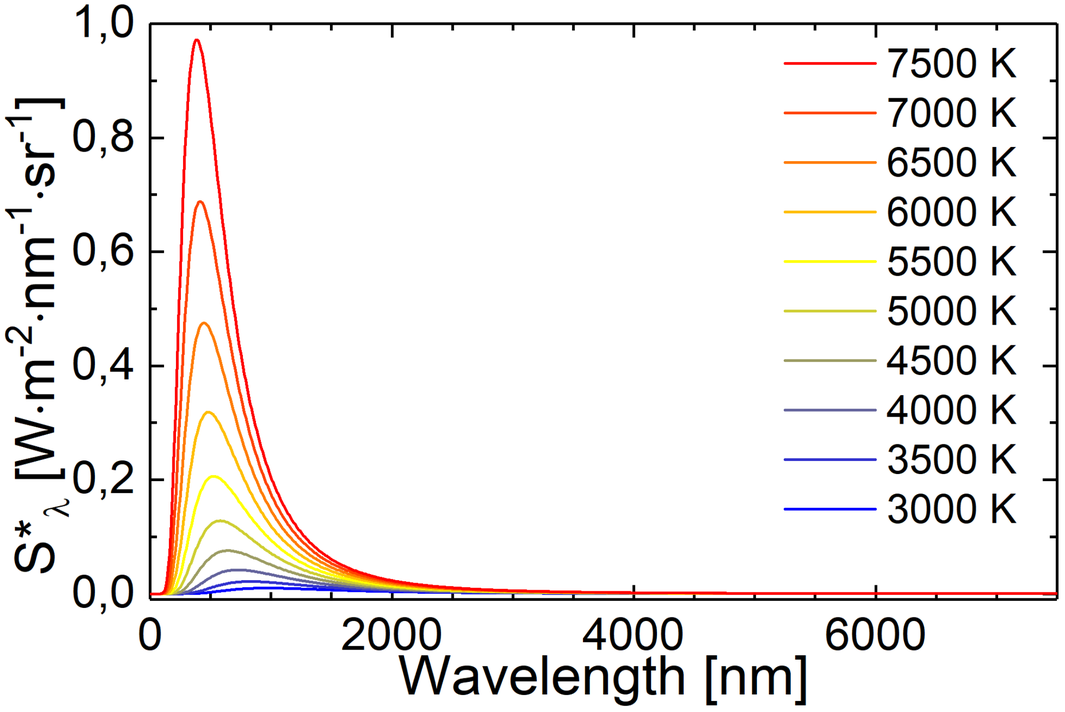
The gap between Wien approximation and Rayleigh-Jeans law



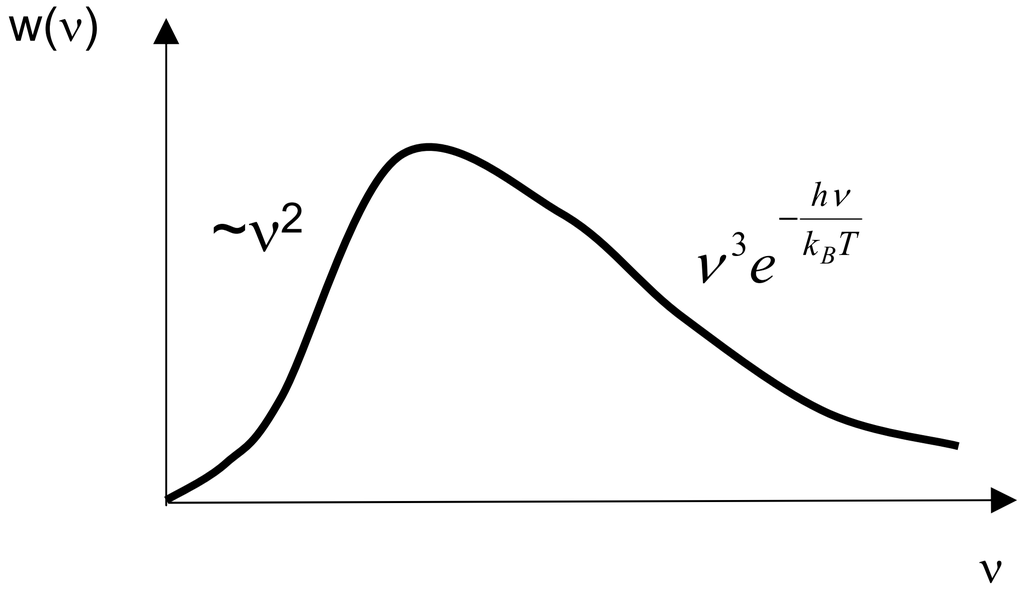
How to close the gap between *Wien approximation* that correctly describes the short wavelength flank and the *Rayleigh-Jeans law* that sufficiently describes the long wavelength flank?

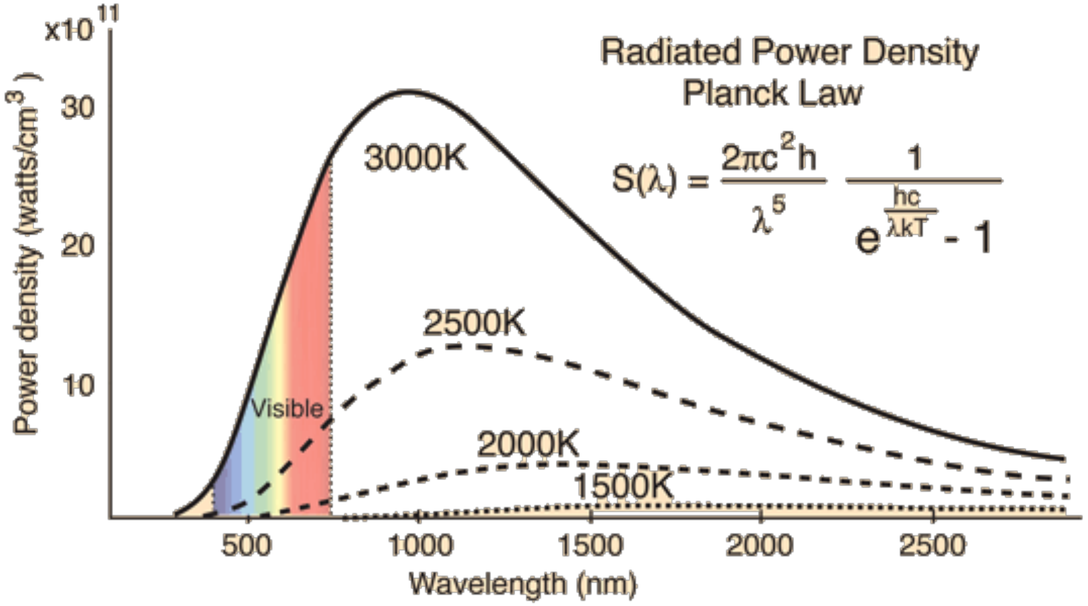
Planck’s law of radiation



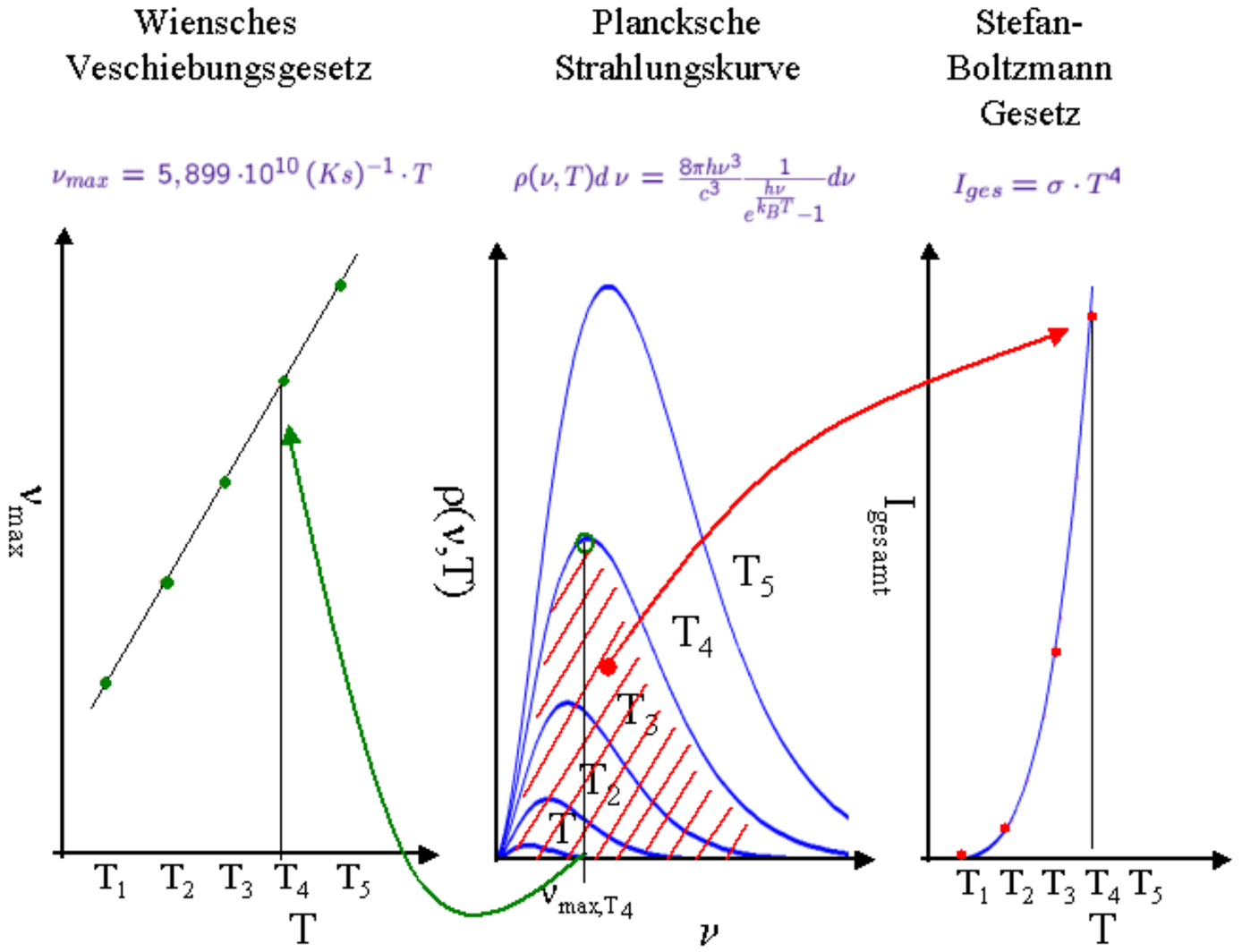


Planck’s law of radiation

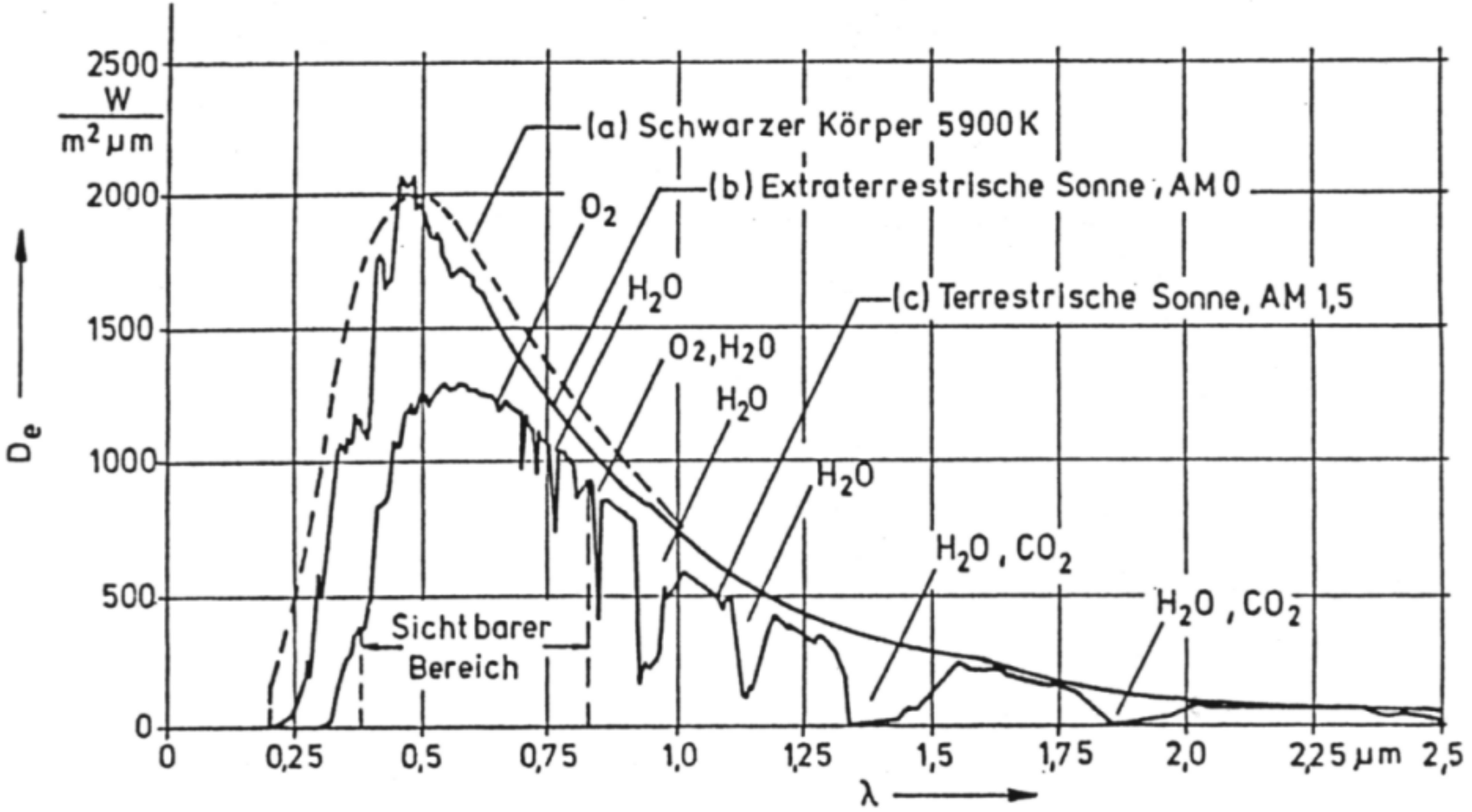




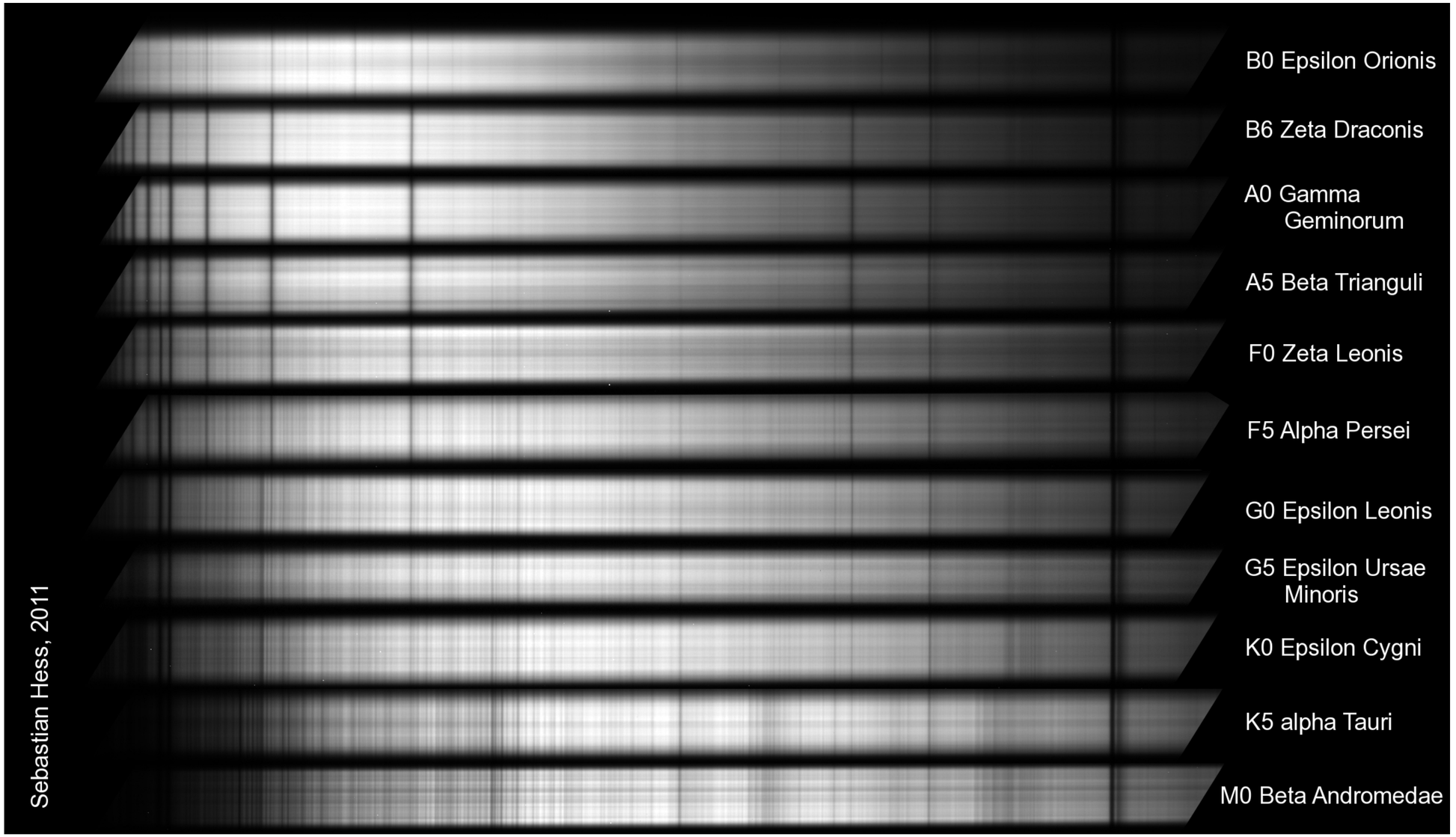
Planck’s law of radiation



Electromagnetic spectrum of the sun

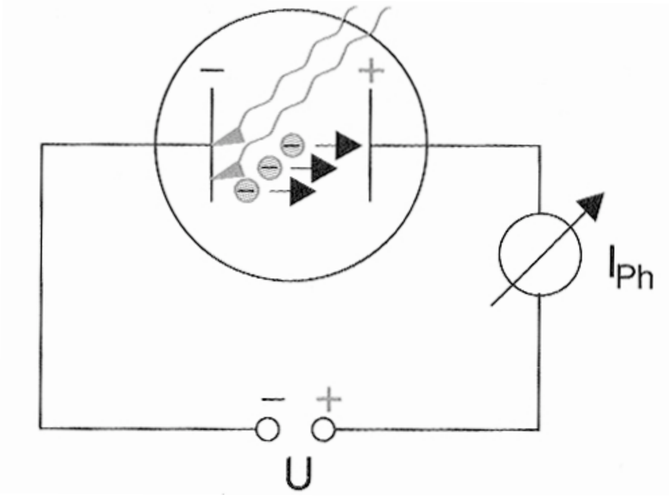


Electromagnetic spectrum of stars



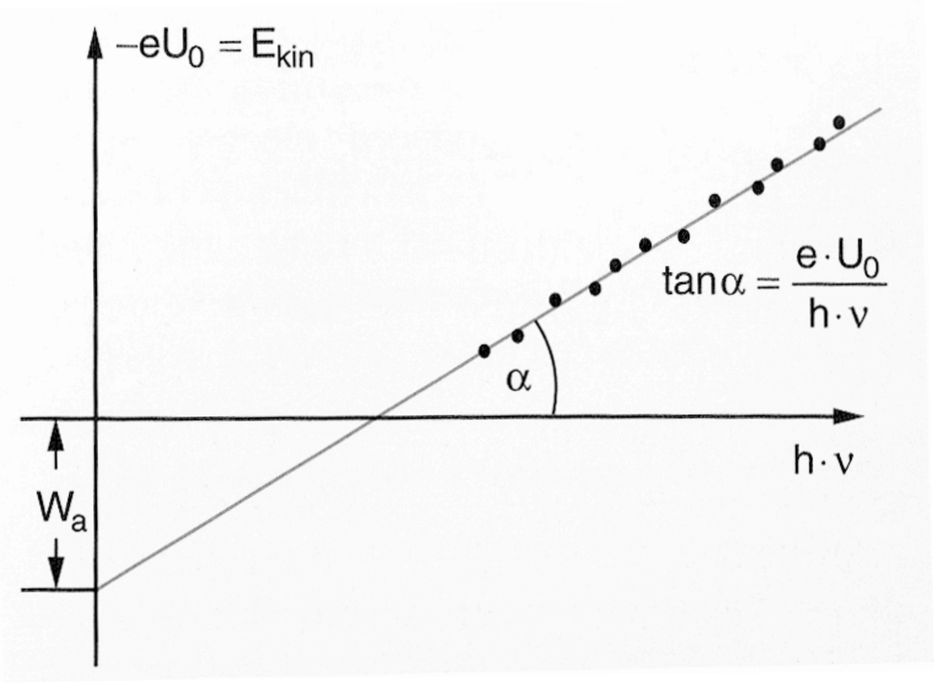
The Particle Nature of light

The photo law of radiation



Lennard 1902

- Kinetic energy of the photo electrons
  only depends on the wavelength of light
- Number of photo electrons only depends on
  the intensety
- Electrons are emitted without retardation



The inner photo law of radiation