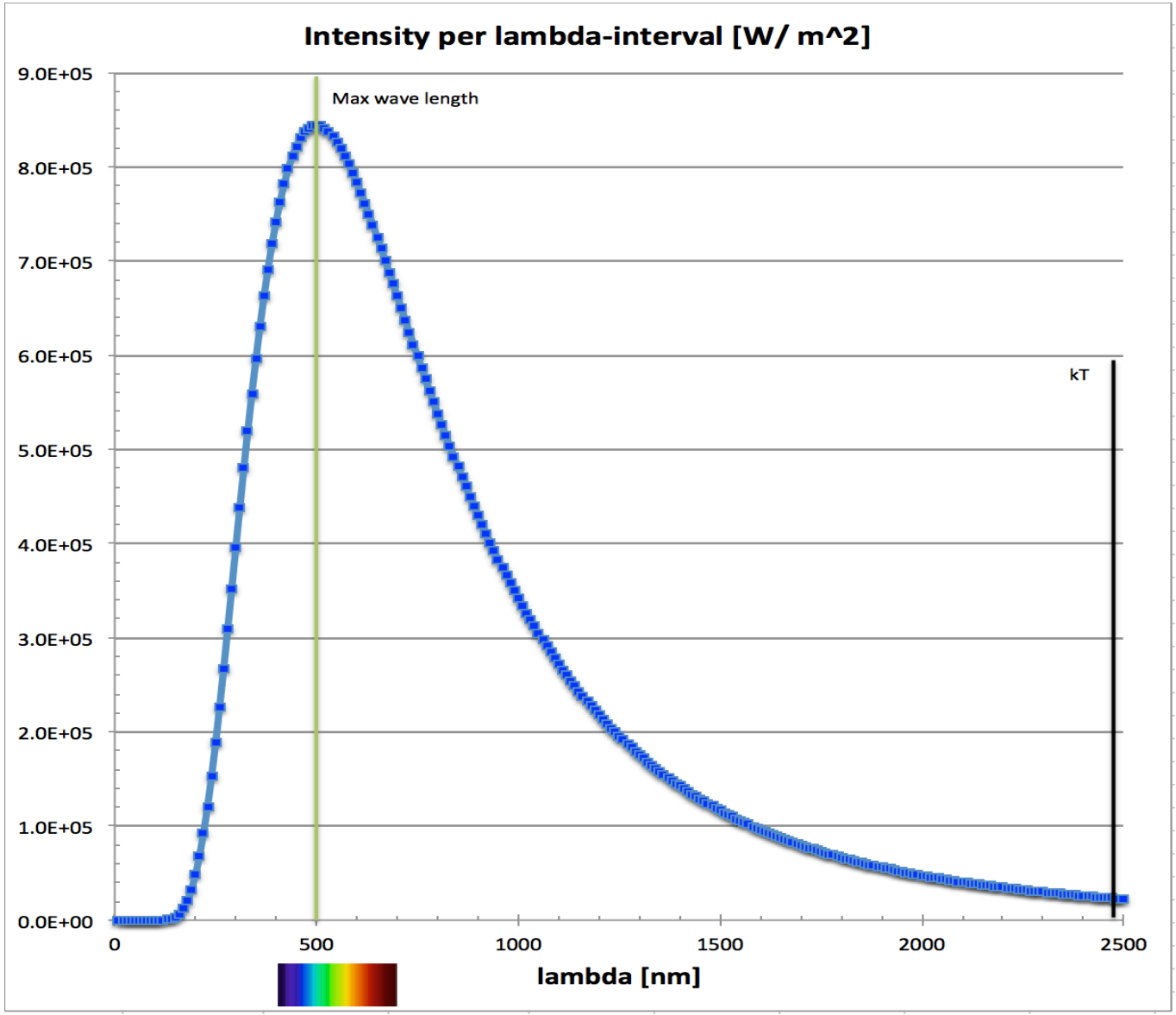
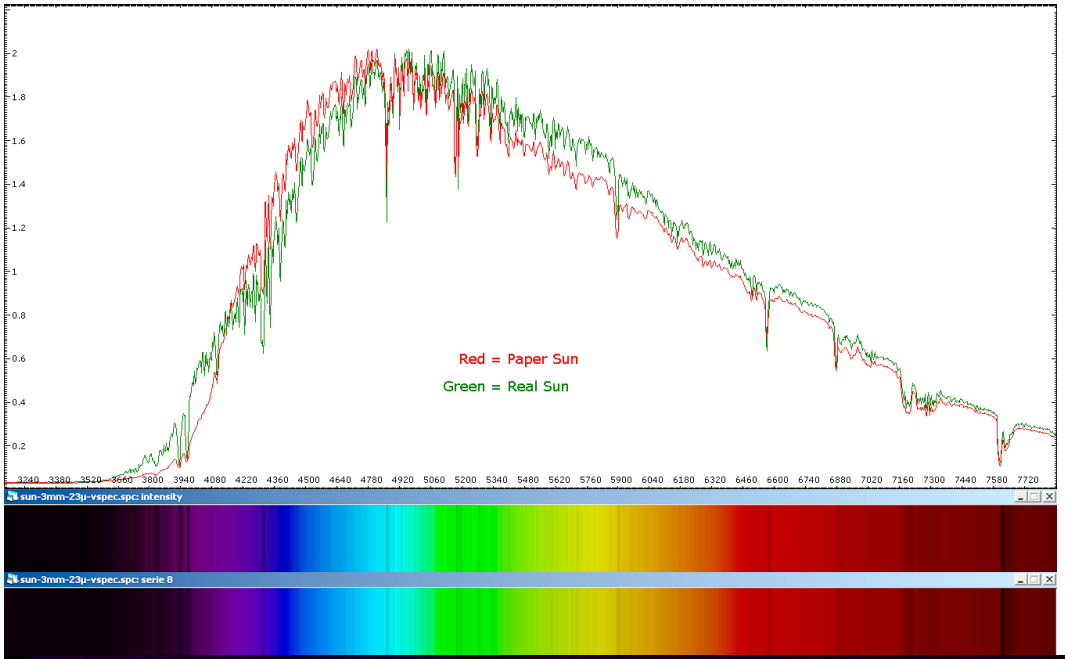
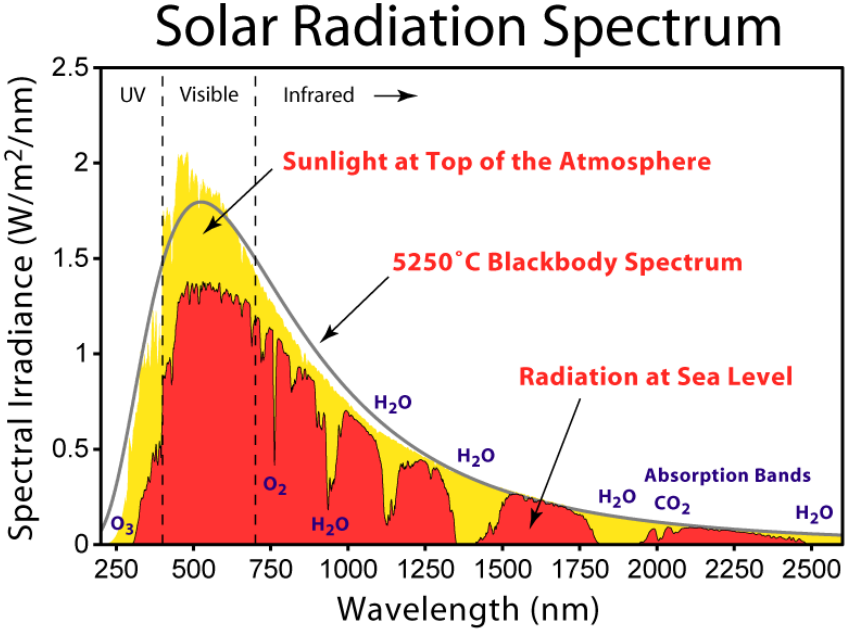
Perfect Blackbody Spectrum

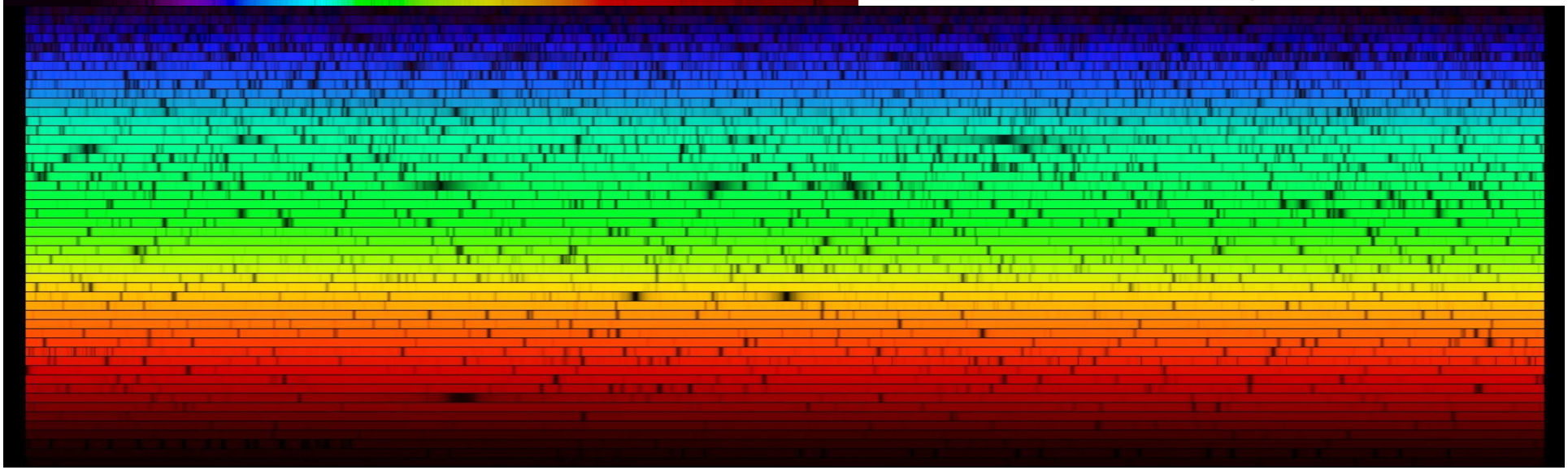


Real Sun


Red = Paper Sun
Green = Real Sun

sun-3mm-23µ-vspec.spc: intensity
sun-3mm-23µ-vspec.spc: serie 8


Solar Radiation Spectrum
Spectral Irradiance (W/m2/nm)
Wavelength (nm)
UV
Visible
Infrared
Sunlight at Top of the Atmosphere
5250˚C Blackbody Spectrum
Radiation at Sea Level
Absorption Bands
O3
O2
H2O
H2O
H2O
H2O
CO2
H2O



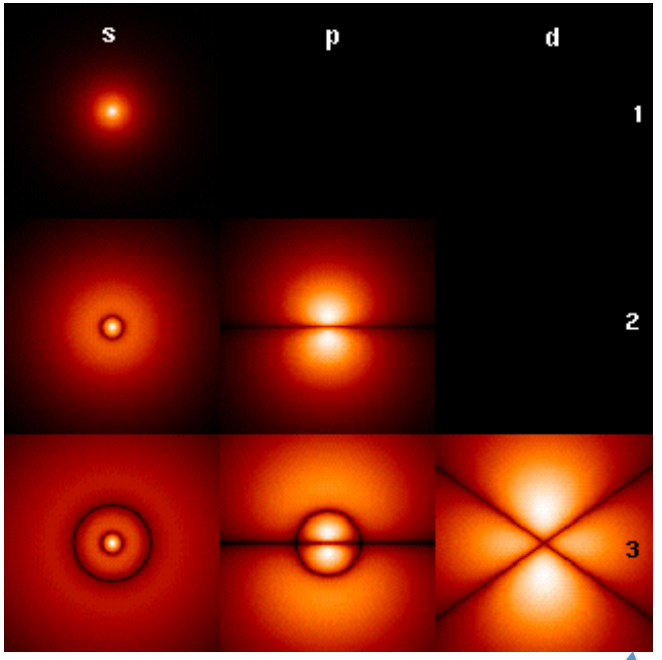
Quantum Mechanics in 20 min

① Many observables are quantized (i.e., cannot change by an arbitrarily small amount)
   ① Light waves: Energy for a specific frequency f can only be absorbed or emitted in chunks (photons) of $E = hf$
   ② Possible energy for hydrogen atom can only assume values $E_n = -Ry/n^2$ (see next slide)
   ③ Angular momentum can only change by multiples of $\hbar = h/2\pi$

② All other observables are intrinsically uncertain
   ① Position: $x \ldots x+\Delta x$
   ② Momentum: $p \ldots p+\Delta p$
   ③ Heisenberg: $\Delta x \cdot \Delta p \geq \hbar/2$

③ Picture: particle motion described by waves ("wave function" ψ) that cannot be located precisely.
Quantization $\rightleftharpoons$ Standing Waves

Quantum Mechanics in 20 min



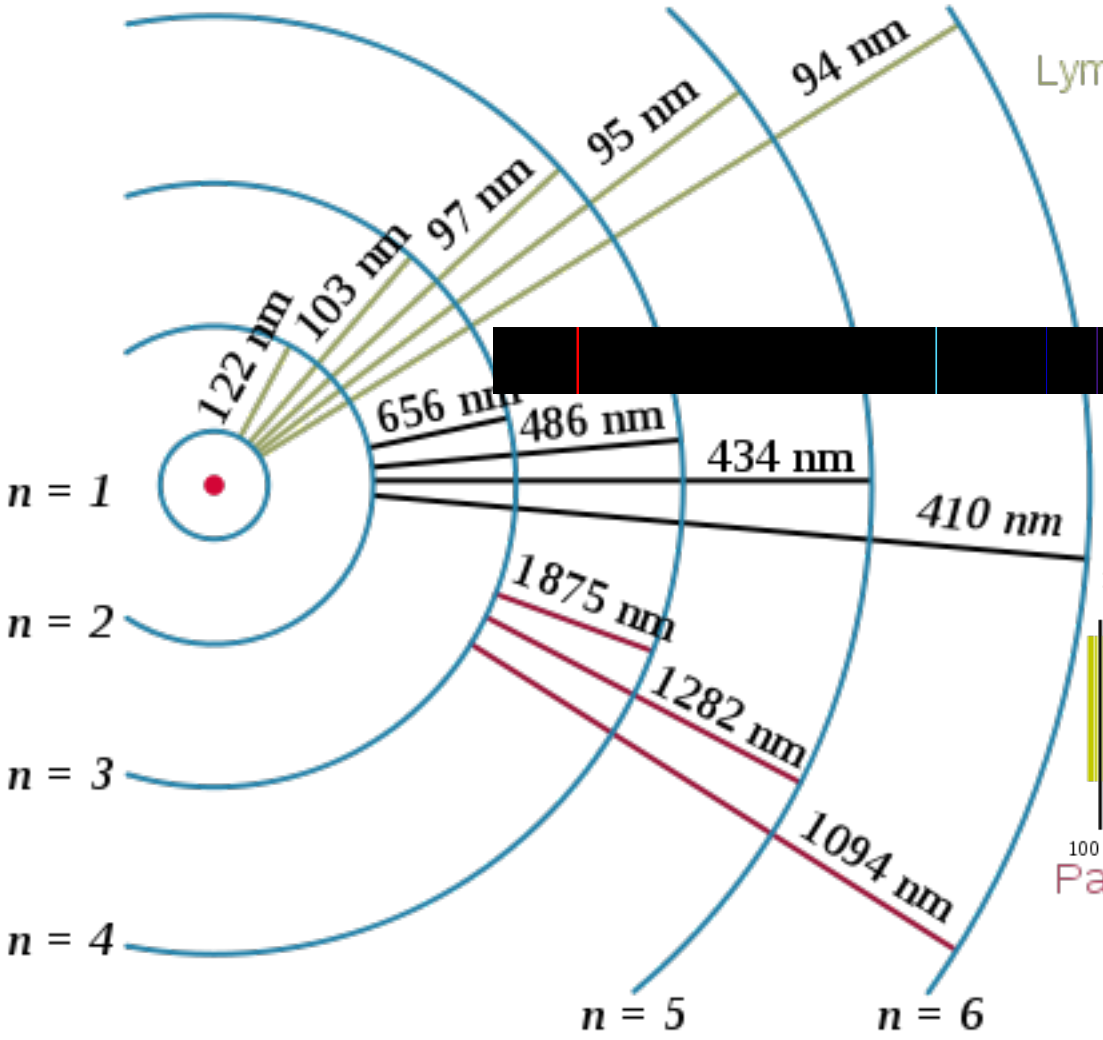
① Electron "motion" in hydrogen atom (nucleus = proton): standing wave described by wave function $\psi(\mathbf{r})$

② Schrödinger: Wave function is solution of the equation $\mathbf{H}\psi(\mathbf{r}) = E\psi(\mathbf{r})$, where E is a possible energy "eigenvalue" and **H** is a differential operator ("The Hamiltonian")

③ Hydrogen atom: Only possible energies are $E_n = -Ry/n^2$ with Ry = 13.6 eV and n = integer. In general all atoms have a fixed series of possible energies E_n

Light can only be emitted with frequencies given by $hf = E_n - E_m$

Quantum Mechanics and Line Spectra

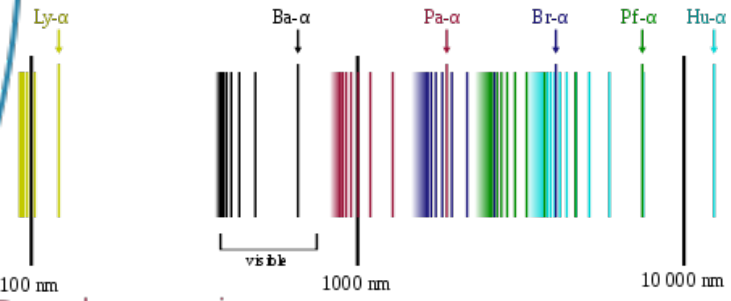


Lyman series

$$\Delta E\left(n \rightarrow m\right) = Ry\left(\frac{1}{m^2} - \frac{1}{n^2}\right)$$

$$\lambda = \frac{hc}{\Delta E}$$

Balmer series



Paschen series