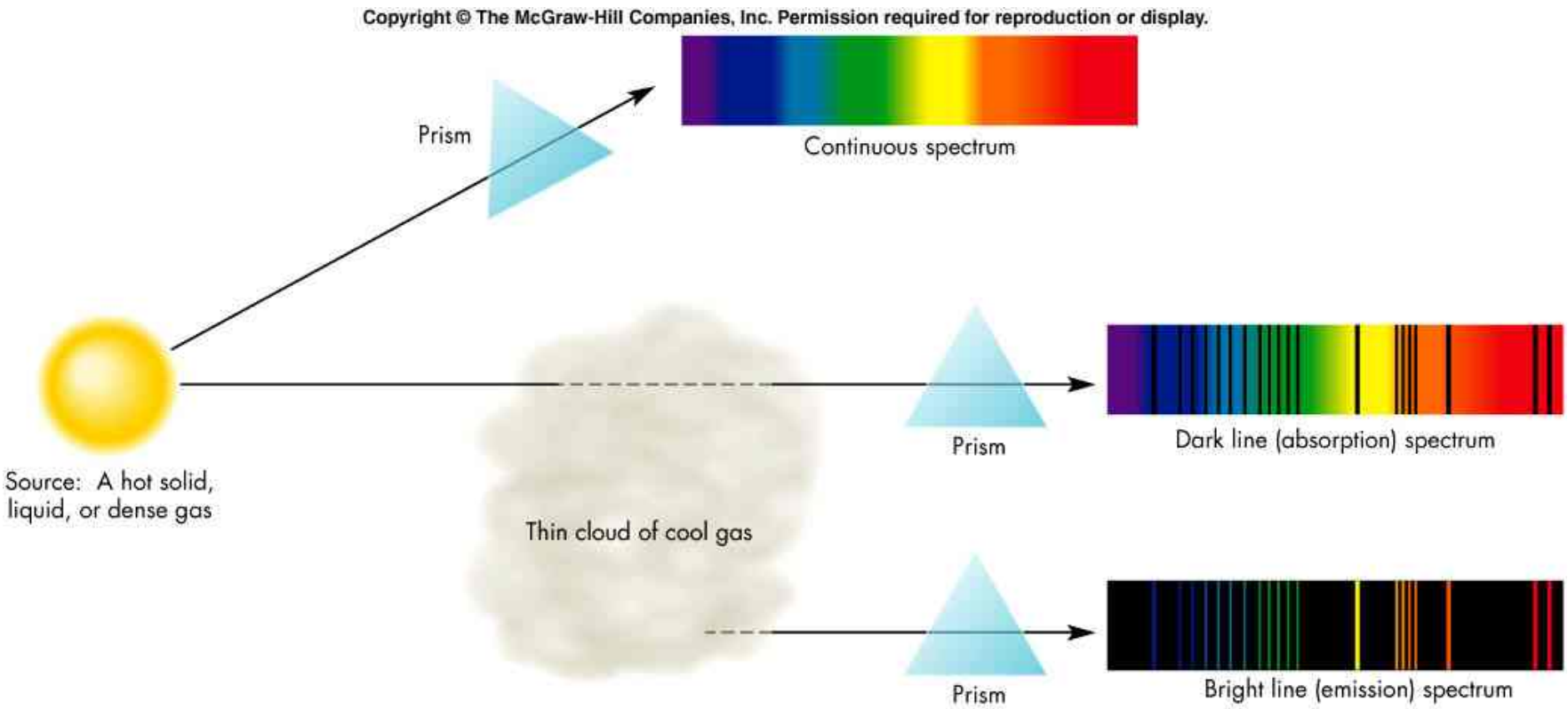
The Physics of Spectrum Formation, Kirchoff's Laws and Wien's Law

- Hot opaque solid or liquid produces a continuous spectrum
- Hot, tenuous gas observed against dark background produces emission line spectrum
- Cold, tenuous gas observed against bright background produces absorption spectrum

Kirchoff's Laws of Radiation



Kirchoff's First Law + Wien's Law

- Hot, opaque objects produce *continuous spectrum*
- The hotter the object, the bluer it is
- Wien's Law $w_{max} = 2.9E\text{-}03/T$
- The hotter an object, the brighter it is
- demo

Why does Wien's Law look like that?

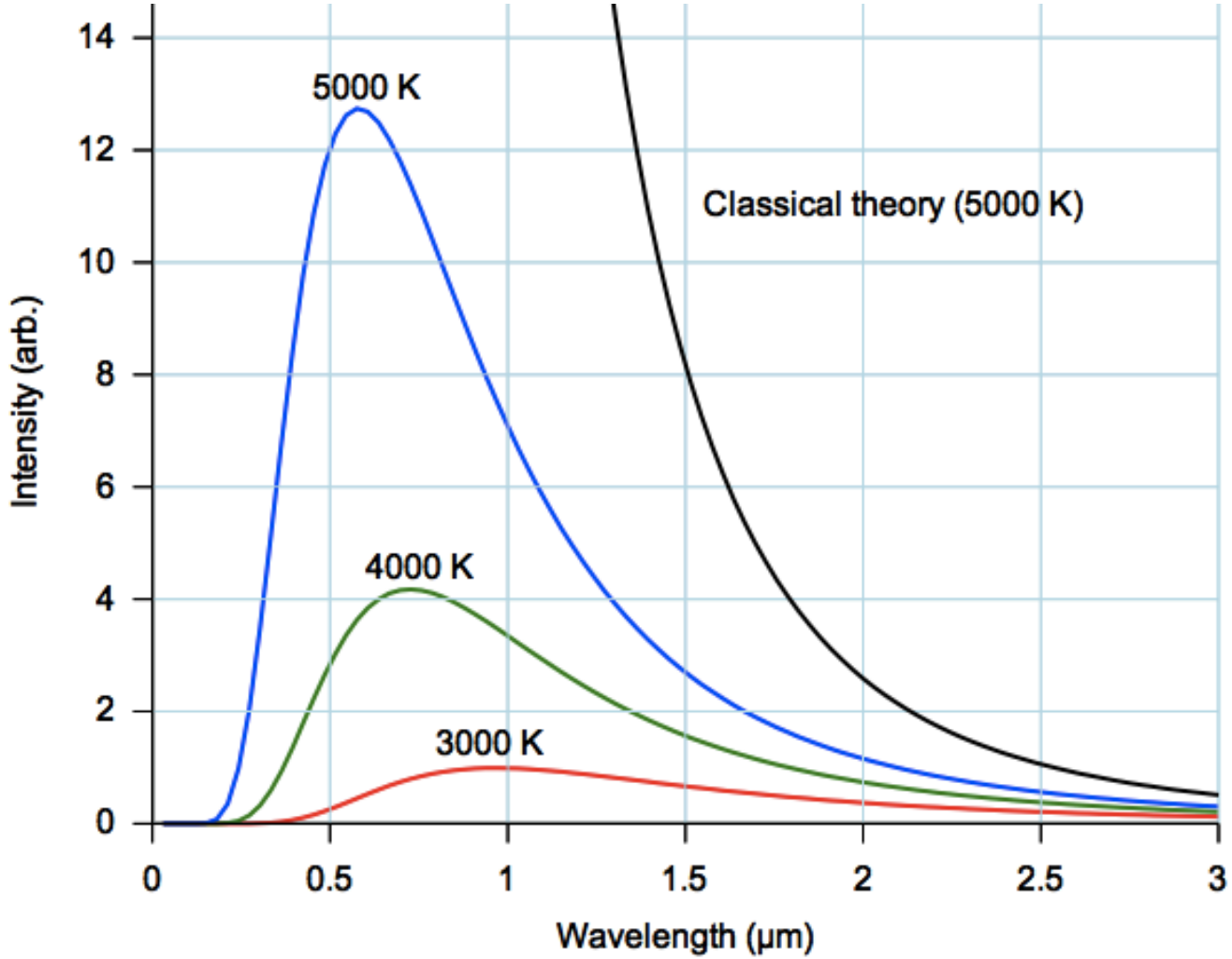
A physicist is bothered when he or she sees an equation like:

$$w_{max} = \frac{2.90 \times 10^{-3}}{T} \text{ meters}$$

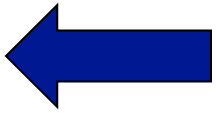
The form which emerges from fundamental equations of physics is:

$$w_{max} = \frac{0.201hc}{k_B T}$$

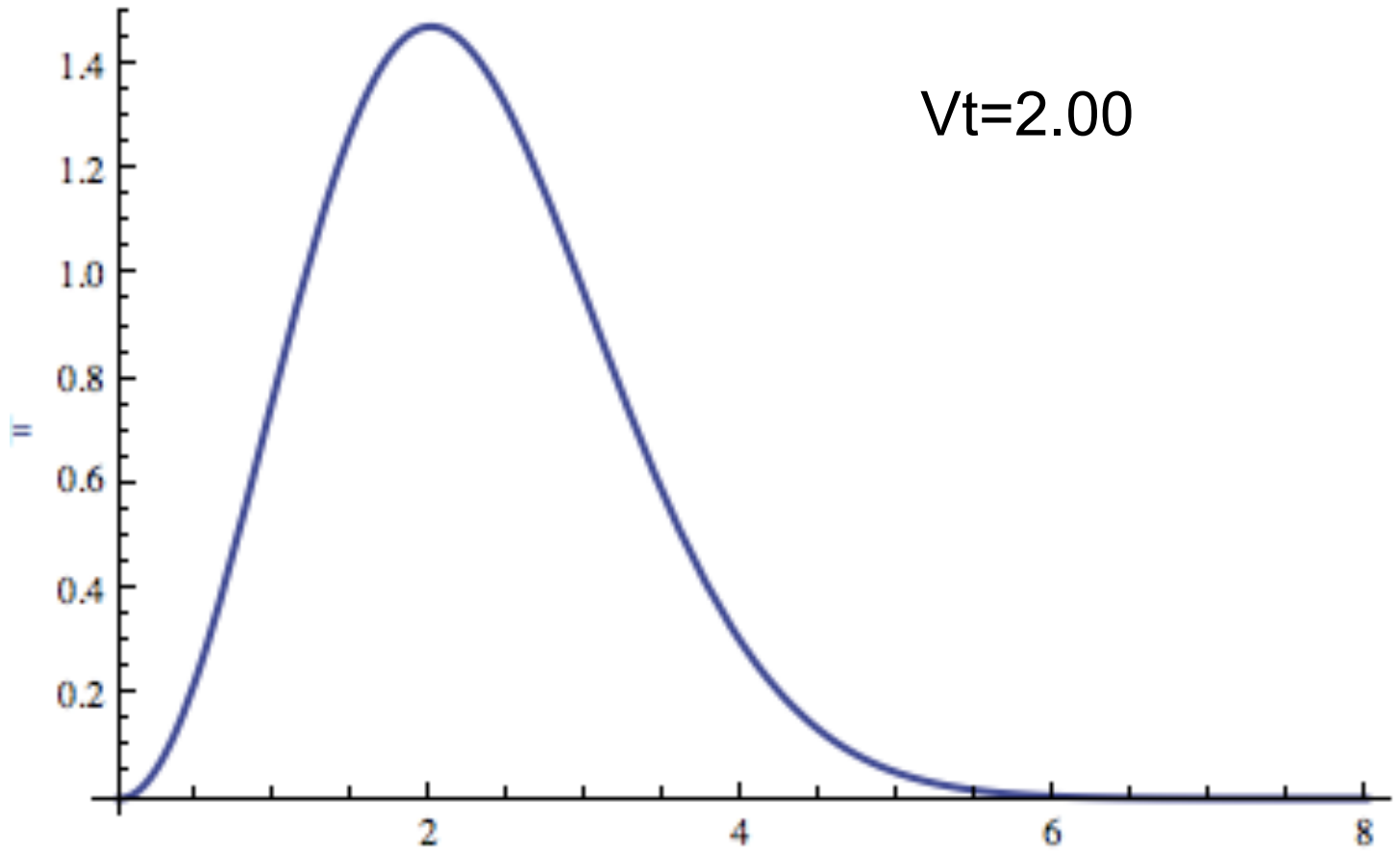
The Planck Function…how radiation is distributed by a hot, radiating object



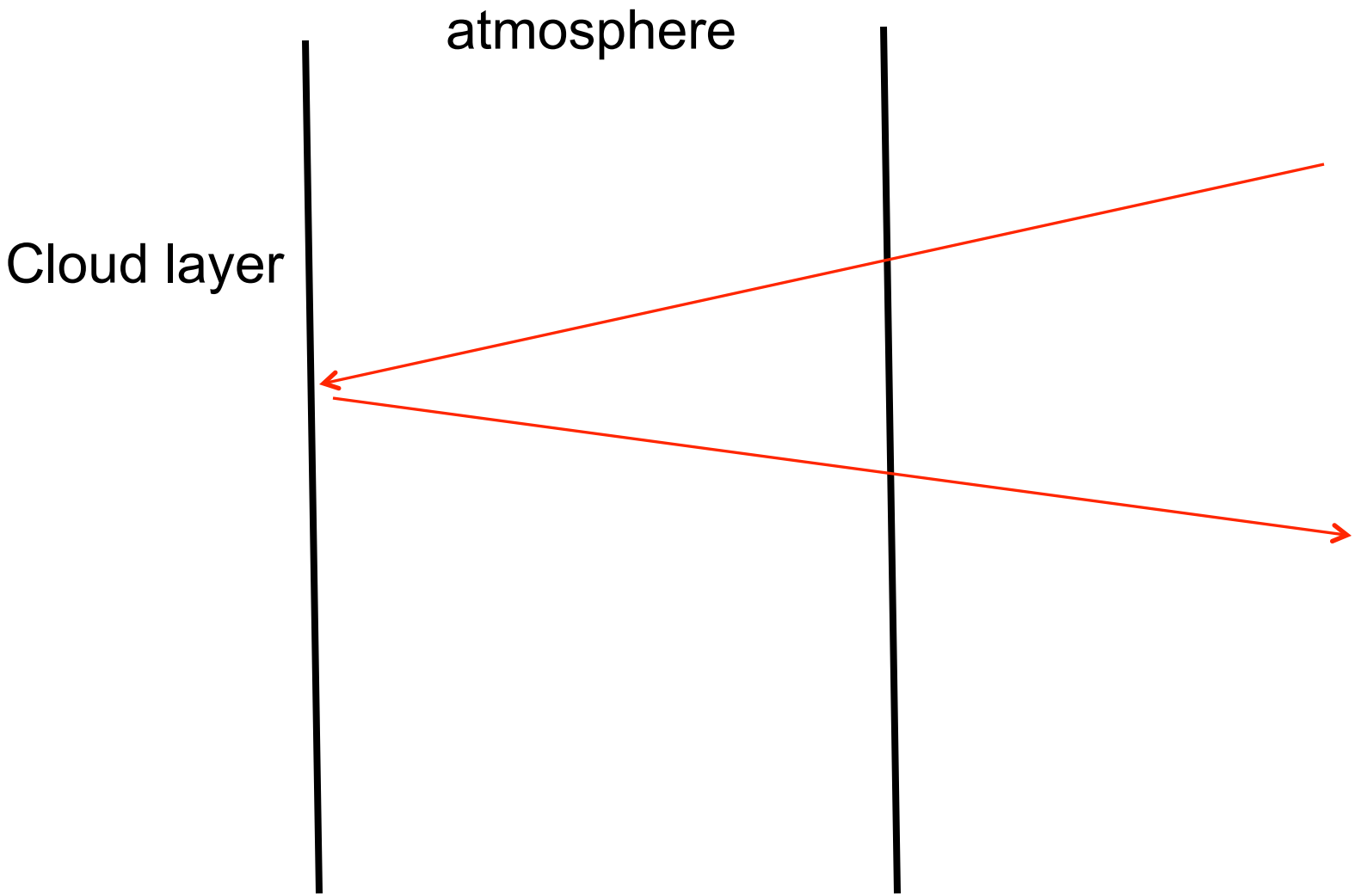
Kirchoff's Third Law: Absorption Spectra



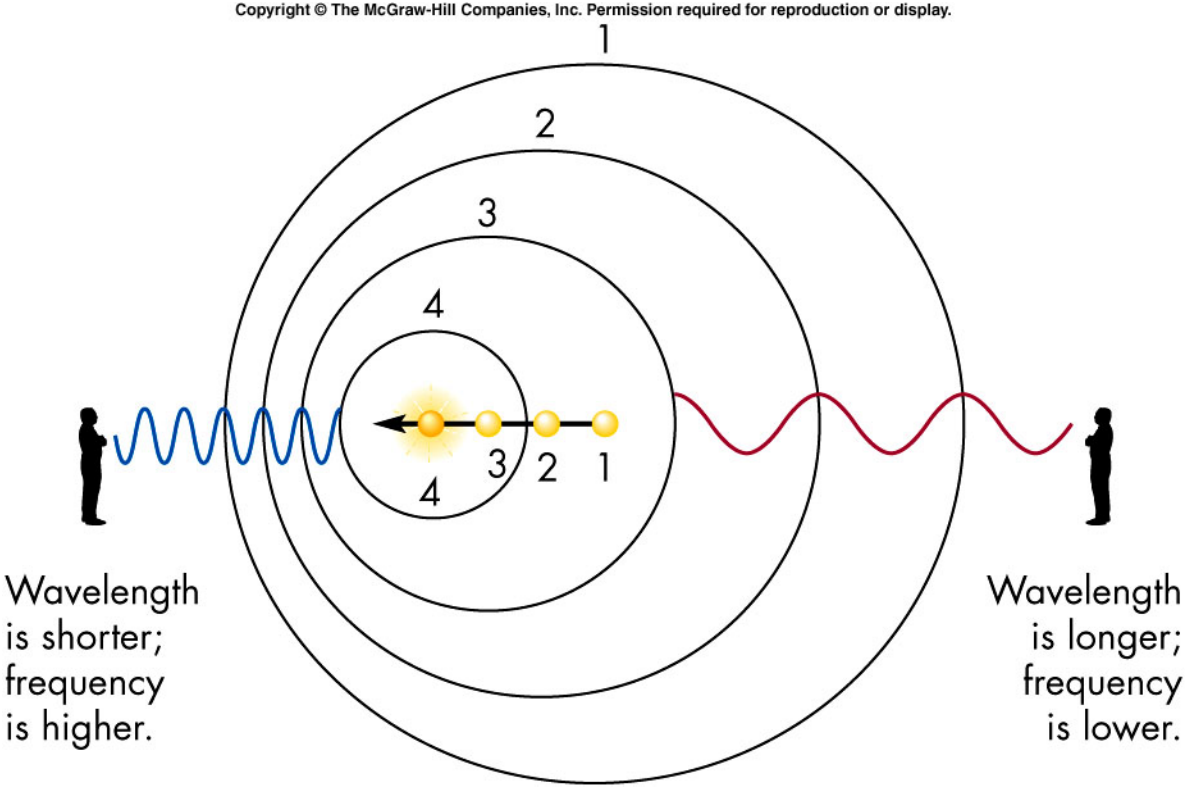
The Maxwell-Boltzmann distribution of atomic speeds



Absorption lines in planetary atmospheres



The final class of binary stars: spectroscopic binaries



demo

Spectroscopic binaries (3rd class of binaries); known to be binaries only because of periodic variations in the spectrum