(low wavelengths). For example, a black body at room temperature (300 K) with one square meter of surface area will emit a photon in the visible range (390-750 nm) at an average rate of one photon every 41 seconds, meaning that for most practical purposes, such a black body does not emit in the visible range.[8]

Blackbody simulators [edit]

A typical industrial "extended source plate" type black body

Although a black body is a theoretical object (i.e. emissivity e = 1.0), common applications define a source of infrared radiation as a black body when the object approaches an emissivity of 1.0 (typically e = 0.99 or better). A source of infrared radiation less than 0.99 is referred to as a "grey body".[10] Applications for black body simulators typically include the testing and calibration of infrared systems and infrared sensor equipment.

Super black is an example of such a material, made from a nickel-phosphorus alloy. More recently, a team of Japanese scientists created a material even closer to a black body, based on vertically aligned single-walled carbon nanotubes, which absorbs between 98% and 99% of the incoming light, in the spectral range from UV to far infrared.[11]

Equations governing black bodies [edit]

Planck's law of blackbody radiation [edit]

Main article: Planck's law

Planck's law states that

$$I(\nu,T)d\nu = \left(\frac{2h\nu^3}{c^2}\right)\frac{1}{e^{\frac{h\nu}{kT}}-1}d\nu$$

where

$I(\nu,T)\,d\nu$ is the amount of energy per unit surface area per unit time per unit solid angle emitted in the frequency range between ν and $\nu + d\nu$ by a black body at temperature T;
h is the Planck constant;
c is the speed of light in a vacuum;
k is the Boltzmann constant;
ν is frequency of electromagnetic radiation; and
T is the temperature in kelvins.

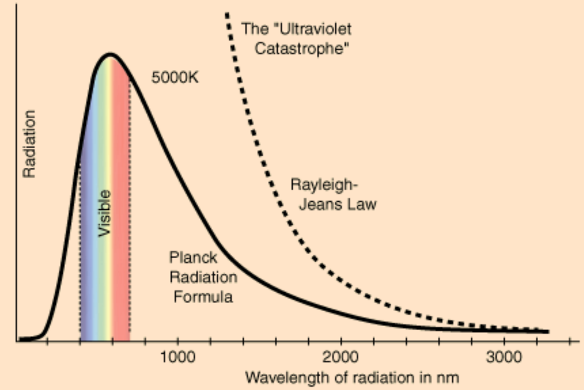
Wien's displacement law [edit]

Main article: Wien's displacement law

Wien's displacement law shows how the spectrum of black body radiation at any temperature is related to the spectrum at any other

Rayleigh-Jeans vs Planck

Comparison of the classical Rayleigh-Jeans Law and the quantum Planck radiation formula. Experiment confirms the Planck relationship.



Comments on the development of the Rayleigh-Jeans Law

Why does the Planck curve drop below the Rayleigh-Jeans?	Frequency plot	Show that the two agree for long wavelengths

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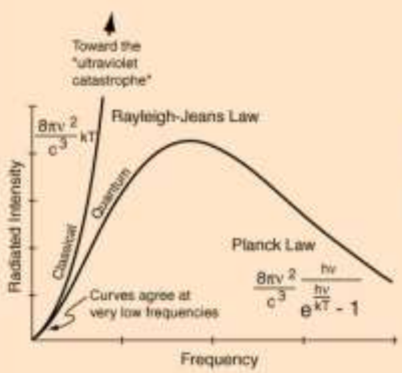
Blackbody radiation concepts

Blackbody Intensity as a Function of Frequency



The Rayleigh-Jeans curve agrees with the Planck radiation formula for long wavelengths, low frequencies.

Show

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Blackbody radiation concepts

Wavelength plot	**Radiation curve examples**

Energy per unit volume per unit frequency	$S_\upsilon = \dfrac{8\pi h}{c^3}\dfrac{\upsilon^3}{e^{h\upsilon/kT}-1}$	**Example**
Energy per unit volume per unit wavelength	$S_\lambda = \dfrac{8\pi hc}{\lambda^5}\dfrac{1}{e^{hc/\lambda kT}-1}$	**Example**