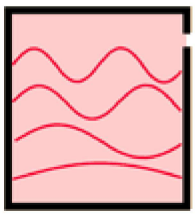
Blackbody Radiation

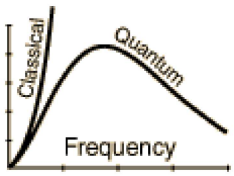
"Blackbody radiation" or "cavity radiation" refers to an object or system which absorbs all radiation incident upon it and re-radiates energy which is characteristic of this radiating system only, not dependent upon the type of radiation which is incident upon it. The radiated energy can be considered to be produced by standing wave or resonant modes of the cavity which is radiating.

Radiation modes in a hot cavity provide a test of quantum theory



	#Modes per unit frequency per unit volume	Probability of occupying modes	Average energy per mode
CLASSICAL	$\frac{8\pi\nu^2}{c^3}$	Equal for all modes	kT
QUANTUM	$\frac{8\pi\nu^2}{c^3}$	Quantized modes: require hν energy to excite upper modes, less probable	$\frac{h\nu}{e^{\frac{h\nu}{kT}} - 1}$

The amount of radiation emitted in a given frequency range should be proportional to the number of modes in that range. The best of classical physics suggested that all modes had an equal chance of being produced, and that the number of modes went up proportional to the square of the frequency.

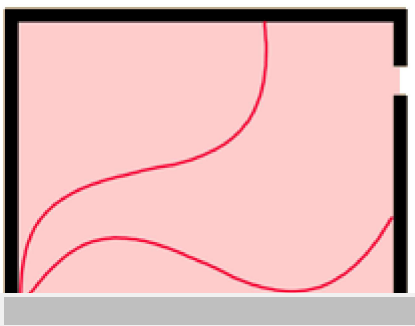


But the predicted continual increase in radiated energy with frequency (dubbed the "ultraviolet catastrophe") did not happen. Nature knew better.

Why more modes at higher frequency?	**The experimental radiation curve.**

Cavity Modes

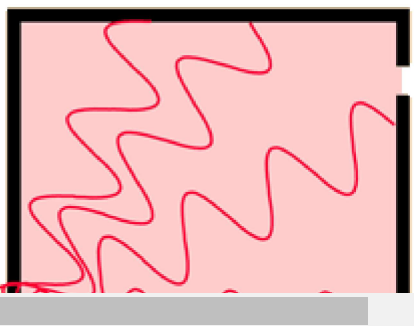
A mode for an electromagnetic wave in a cavity must satisfy the condition of zero electric field at the wall. If the mode is of shorter wavelength, there are more ways you can fit it into the cavity to meet that condition. Careful analysis by Rayleigh and Jeans showed that the number of modes was proportional to the frequency squared.



Number of modes per unit frequency per unit volume

$$\frac{8\pi\nu^2}{c^3}$$

For higher frequencies



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