Thermal Equilibrium

Kinetic energy of a particle: \( KE = \frac{1}{2} m_{\text{particle}} v^2 \).

Temperature is related to the average kinetic energy of a group of particles:

\[
\overline{\frac{1}{2} m v^2} = \frac{3}{2} kT, \text{ where } k=\text{Boltzmann’s constant.}
\]

For blackbody radiation (Planck’s law) at temperature \( T \), the peak of the energy distribution comes at a wavelength \( \lambda_{\text{peak}} \) such that \( \lambda_{\text{peak}} = \frac{1}{T} \).

When matter and radiation are in equilibrium, such as they were in the early times of the universe’s history, both values of temperature are equal.