Maxwell - Boltzmann Distribution

In thermal equilibrium, the velocity distribution is isotropic.

Speed probability density function:

$$f(v) = Av^2 e^{-\frac{1}{2}\frac{mv^2}{k_B T}}$$

$A = \sqrt{\frac{2}{\pi}} \left(\frac{m}{k_B T}\right)^{\frac{3}{2}}$ is a normalisation constant.

so $\int_0^\infty f(v)\, dv = 1$

- some properties

$$\langle v \rangle = \int_0^\infty v f(v)\, dv = \sqrt{\frac{8k_B T}{\pi m}}$$

$$\langle v^2 \rangle = \int_0^\infty v^2 f(v)\, dv = \frac{3k_B T}{m}$$

$$V_{rms} = \sqrt{\langle v^2 \rangle}$$

$V_{peak} = \sqrt{\frac{2k_B T}{m}}$ ← most likely speed where $\frac{df}{dv} = 0$.

- Δ

it is the standard deviation of the distribution of any one component of the velocity.

$$\Delta = \sqrt{\frac{k_B T}{m}}$$

$\langle v \rangle = \sqrt{\frac{8}{\pi}}\Delta$.

$V_{rms} = \sqrt{3}\Delta$

$V_{peak} = \sqrt{2}\Delta$