State Space & Boltzmann Factor

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

Av^2 ↑ State Space factor

$e^{-\frac{1}{2}\frac{mv^2}{k_B T}}$ ↑ Boltzmann factor

Boltzmann Factor in Thermal Equilibrium

- If particles are free to exchange energy among themselves thermal equilibrium is attained when particles are spread among possible energies by this exponential distribution.

State Space : v^2

- v^2 comes in because there are more states of a given energy at higher values of v.
- The number of states in some regions of this momentum space is proportional to the volume of the region.

Consider the range : $v \to v + dv$.

then momentum: $mv \to m(v+dv)$

Locate these states in momentum space.

Spherical shell : r : $mv \to m(v+dv)$.

Volume of the shell : $4\pi m^3 v^2 \, dv$.

$V \propto v^2$