Statistical Physics (A1) — A. Schekochihin
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§2. Classical Ideal Gas. $\boxed{\text{SUMMARY}}$

Assumptions:
- no interaction except elastic binary collisions
- point particles (do not occupy significant vol.)
- classical (no quantum correlations)
- non-relativistic

sat'd by dilute hot gas

Collisions $\longrightarrow$ equilibrium indep. of initial conditions

Isotropic, velocity components independent $\qquad \propto e^{-E/k_BT}$ Boltzmann

$\Downarrow$

Maxwell's distribution
$$\boxed{f = \left(\frac{m}{2\pi k_B T}\right)^{3/2} e^{-\frac{mv^2}{2k_BT}}}$$
Boltzmann const

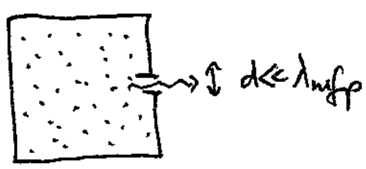
Temperature
$$\frac{1}{2}k_BT \equiv \frac{m\langle v_x^2\rangle}{2}, \qquad \frac{3}{2}k_BT = \frac{m\langle v^2\rangle}{2}$$
mean energy per degree of freedom $\qquad$ mean energy per particle

Ideal gas equation of state
$$\boxed{p = nk_BT} = \frac{1}{3}mn\langle v^2\rangle = \frac{2}{3}\varepsilon$$
energy density

or $\quad pV = n_m RT$

\# of moles $\quad$ gas constant

Effusion



Velocities: $dN(\vec{v}) = nv^3 f(v)\cos\theta\sin\theta\, dv\, d\theta\, d\varphi \qquad \theta\in[0,\frac{\pi}{2}]$

Speeds: $d\hat{N}(v) = \pi n v^3 f(v)\, dv = \frac{1}{4} n v \tilde{f}(v)\, dv$

Flux: $\boxed{\Phi = \int dN(v) = \frac{1}{4}n\langle v\rangle = \frac{p}{\sqrt{2\pi m k_BT}}}$