Stat mech so far:

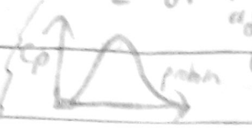
$H\Psi = E\Psi$

$P_i = \frac{1}{W_i}$

$\Delta S_{tot} > 0$

$PV = nRT$

$E = \frac{1}{2} k_B T$ per active "degree of freedom"



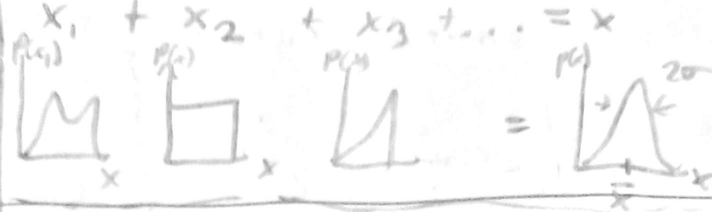
$G = H - TS = -TS_{tot}$ (const T, P)

$\frac{\partial G}{\partial x} = \Delta G = \Delta G^0 + RT \ln\left(\frac{c_c^{\nu_c} c_D^{\nu_D}}{c_a^{\nu_a} c_b^{\nu_b}}\right)$

K_{eq} for protein folding, etc.

Review: Central Limit Theorem (random variables)

$x_1 + x_2 + x_3 + \dots = x$



Gaussian

$\bar{x} = \sum_i \bar{x}_i$

$\sigma^2 = \sum_i \sigma_i^2$

Lecture 30: Time-Dependent Stat. Mech

• Brownian motion, drift velocity

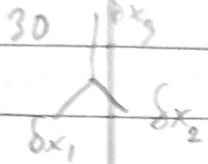
1. Brownian

• short time → Newtonian dynamics predict where particle goes

$V = \frac{\Delta x}{\Delta t}$; $F = ma = m\frac{\Delta v}{\Delta t}$

$\cancel{x(\Delta t) = x(0) + v(0)\Delta t}$; $V(\Delta t) = \frac{F(0)}{m}\Delta t + V(0)$

Assume $F = F_{random}$ is random in every ~~time interval~~ Δt.

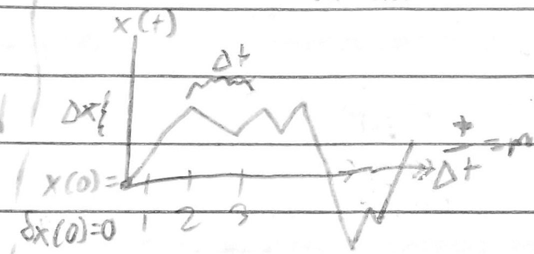


δx_1, δx_2, δx_3

$\delta x^2 = \delta x_1^2 + \delta x_2^2 + \delta x_3^2$

If we assume brownian motion in the x_1, x_2, and x_3 direction is independent,

$\langle \delta x(t)^2 \rangle = 6Dt$ in 3D



$\delta x(t) = \sum_{j=1}^{m} \Delta x_j$

$\frac{t}{\Delta t} = m$

$x(0) = \delta x(0) = 0$

↓ Central Limit theorem:

$\delta x(t)$ is gaussian distribution of random variables, with

$\langle \delta x(t) \rangle = 0$

$\langle (\delta x(t))^2 \rangle = \sum_i (\Delta x_i)^2$

$= m \langle \Delta x_i^2 \rangle$ ← analogous to σ^2, standard deviation.

$= \frac{\langle \Delta x_i^2 \rangle}{\Delta t} t$

constant $= 2D$

$\langle \delta x^2 \rangle = 2Dt$

$\delta x_{RMS} = \sqrt{2Dt}$

Properties of the probability distribution $P(x, \delta x)$ that you start out at x and end up moving an amount δx.

$\int d(\delta x)\, P(x, \delta x) = 1$

$\int d(\delta x)\, P(x, \delta x)\, \delta x = 0$

$\int d(\delta x)\, P(x, \delta x)\, \delta x^2 = 2Dt$