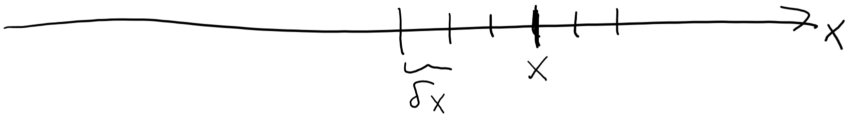
Random-walk



$$\rho(x, t+\delta t) = \frac{1}{2}\Big(\rho(x-\delta x, t) + \rho(x+\delta x, t)\Big)$$

$$\rho(x, t+\delta t) - \rho(x,t) = \frac{1}{2}\Big(\rho(x-\delta x, t) + \rho(x+\delta x, t)\Big) - \rho(x,t)$$

$$\frac{\rho(x, t+\delta t) - \rho(x,t)}{\delta t} = \frac{1}{2}\left(\frac{\rho(x+\delta x, t) - \rho(x,t)}{\delta x} - \frac{\rho(x,t) - \rho(x-\delta x, t)}{\delta x}\right)\frac{\delta x}{\delta t}$$

$$\frac{\partial \rho}{\partial t}(x,t) = \frac{1}{2}\left(\frac{\frac{\partial \rho}{\partial x}(x+\delta x, t) - \frac{\partial \rho}{\partial x}(x,t)}{\delta x}\right)\frac{\delta x^2}{\delta t}$$

$$\frac{\partial \rho}{\partial t}(x,t) = \frac{\delta x^2}{2\,\delta t}\,\frac{\partial^2 \rho}{\partial x^2}(x,t) \longrightarrow \text{Diffusions-Gleichung}$$

$\downarrow$

D : Diffusionskonstante

$\hookrightarrow \; 2Dt = \langle x^2 \rangle$

Diffusionskonstante

$$\boxed{D} = \frac{\Delta x^2}{2\Delta t} = \frac{1}{2}\,\frac{\Delta x^2}{\Delta t^2}\cdot \Delta t = \frac{1}{2}\langle v^2 \rangle \cdot \frac{2m}{f} = \boxed{\frac{kT}{f}}$$

$$D_{O_2} \simeq 10^{-5}\,m^2/s \qquad \boxed{\langle x^2 \rangle = 6Dt}$$

$$L = 10\,m \qquad L^2 = 6Dt \qquad t = \frac{L^2}{6D} = \frac{10^2\,m^2}{6 \cdot 10^{-5}\,m^2/s}$$

$$= \frac{1}{6} \cdot 10^7\,s$$

Fick'sche Gesetze

$$\vec{j}_D = -D\vec{\nabla}\rho \quad \longleftrightarrow \quad \frac{\partial}{\partial t}\rho = D\,\vec{\nabla}^2\rho$$

↳ Kontinuitätsgleichung: $\frac{\partial \rho}{\partial t} = -\vec{\nabla}\cdot\vec{j} = -\vec{\nabla}\cdot\left(-D\vec{\nabla}\rho\right)$

$$= D \cdot \vec{\nabla}^2 \rho$$