Diffusion coefficient

- The net flux from left to right therefore is: $J_z = J(L \rightarrow R) - J(L \leftarrow R) = \frac{1}{4} v_{mean}\{\mathcal{N}(-\lambda) - \mathcal{N}(\lambda)\} = \frac{1}{4} v_{mean}\left\{\left[\mathcal{N}(0) - \lambda\left(\frac{d\mathcal{N}}{dz}\right)_0\right] - \left[\mathcal{N}(0) + \lambda\left(\frac{d\mathcal{N}}{dz}\right)_0\right]\right\} = -\frac{1}{2} v_{mean}\lambda\left(\frac{d\mathcal{N}}{dz}\right)_0$, in accord with Fick's 1st law.
- From this we should be able pick out the diffusion coefficient as: $\frac{1}{2} v_{mean}\lambda$, however, even if a MQ begins its journey near the window it could have a long flight before it gets there so in reality we have to multiply by a factor of 2/3, so:
- $D = \frac{1}{3}\lambda\, v_{mean}$, diffusion coefficient.

Thermal conductivity (reminder)

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- According to equipartition theorem, each MQ carried an average energy $\varepsilon = \nu kT$, where ν is a number of the order of 1. For atoms, ν=3/2.
- When a MQ passes through the imaginary window, it transports that average energy. We assume uniform $\mathcal{N}$ and a T gradient.
- MQs arriving from the left travel a λ from their last collision in a hotter region, and so with higher energy. MQs also arrive from the right after travelling a λ from a cooler region.
- The 2 opposing energy fluxes are: $J(L \rightarrow R) = \frac{1}{4}\mathcal{N} v_{mean}\varepsilon(-\lambda)$ and $J(L \leftarrow R) = \frac{1}{4}\mathcal{N} v_{mean}\varepsilon(\lambda)$, with Z_W
- The net flux is : $J_z = J(L \rightarrow R) - J(L \leftarrow R) = \frac{1}{4} v_{mean}\mathcal{N}\{\varepsilon(-\lambda) - \varepsilon(\lambda)\} = \frac{1}{4} v_{mean}\mathcal{N}\left\{\left[\varepsilon(0) - \lambda\left(\frac{d\varepsilon}{dz}\right)_0\right] - \left[\varepsilon(0) + \lambda\left(\frac{d\varepsilon}{dz}\right)_0\right]\right\} = -\frac{1}{2} v_{mean}\lambda\mathcal{N}\left(\frac{d\varepsilon}{dz}\right)_0 = -\frac{1}{2}\nu v_{mean}\lambda\mathcal{N}k\left(\frac{dT}{dz}\right)_0$, J(energy)α$T$ grad.
- ν is a number of the order of 1; for atoms it's 3/2.