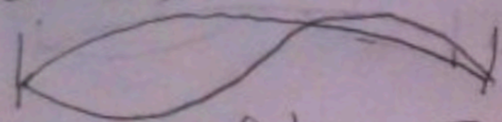
Quantum Stat. Mech.

density of states

1-d box



limit of large Energies

density of states $\frac{dn}{dE}$

for one particle

add a particle

for each level of 1st part all levels of 2nd ... N

$$\frac{dn}{dE} \to \left(\frac{dn}{dE}\right)^2 \to \left(\frac{dn}{dE}\right)^N$$

In limit of many part. density of states is enormous

levels are very close.

→ levels are very small

$$\delta E = E^{(n+1)} - E^{n} \text{ very small}$$

On the other hand must uncertinty princ. $\Delta E \Delta t \sim \hbar$

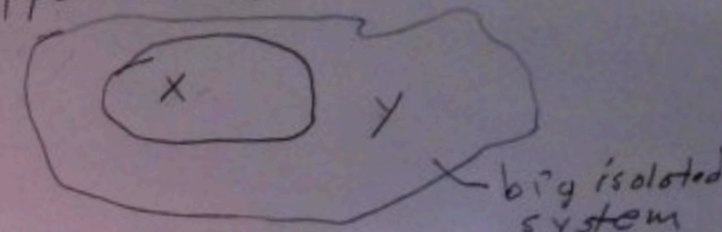
$$\Delta t \gg \frac{\hbar}{\delta E} \quad \text{huge}$$

conclusion: macroscopic system cannot be in pure quantum state

always in a mixed state

→ density matrix

Appendix B READ



$\Psi(x,y)$

suppose have operator $\hat{F}(x)$

$$\bar{f} = \int \Psi^*(x,y)\,\hat{F}(x)\,\Psi(x,y)\,dx\,dy$$

$$= \int \hat{f}(x)\,dx \left[\int dy\, \Psi^*(x',y)\,\Psi(x,y)\right]_{x' \to x}$$

$$= \int \hat{f}(x)\,\rho(x,x')\Big|_{x \to x'}$$

$$\rho(x,x') = \int \Psi^*(x',y)\,\Psi(x,y)\,dy$$

density matrix

Landau von Neuman

system in contact with a large system DOES NOT HAVE a WAVE F'N (only a density matrix)

matrix continuous

Rep. in Energy discrete matrix