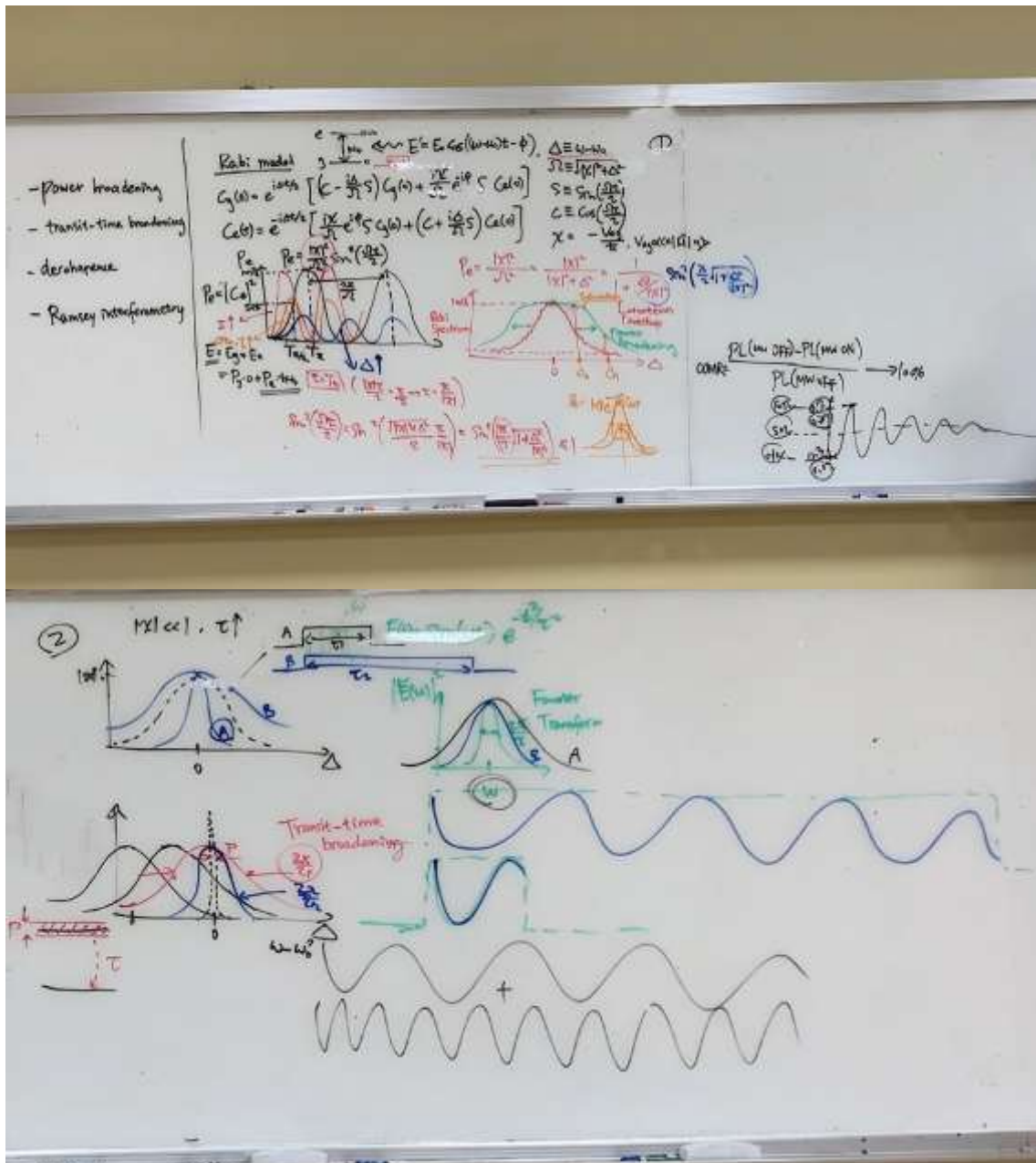
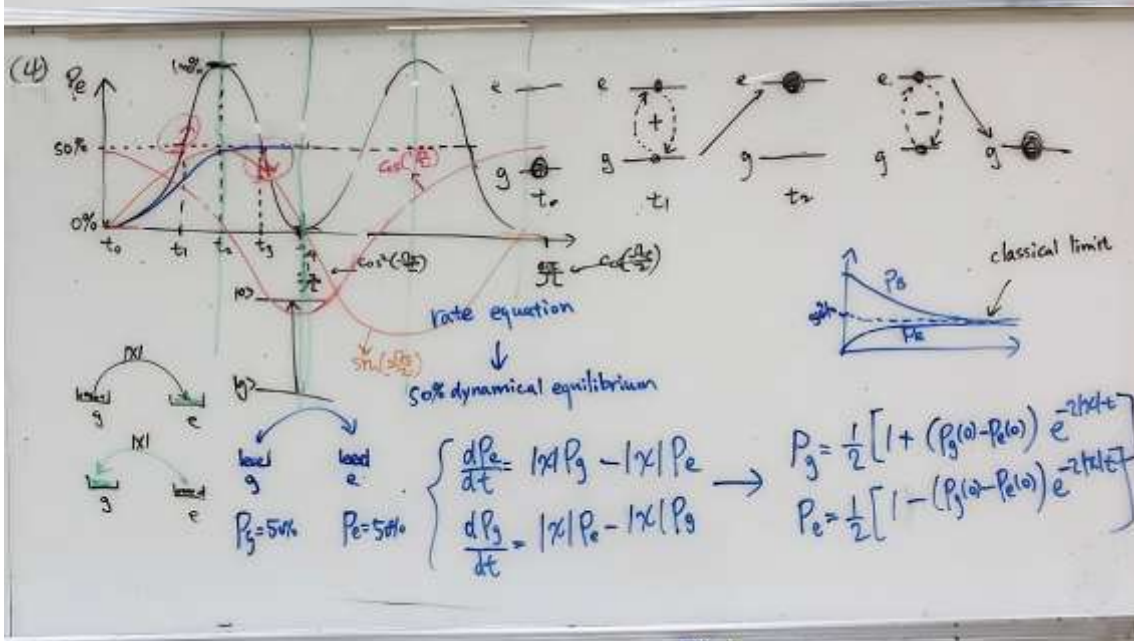
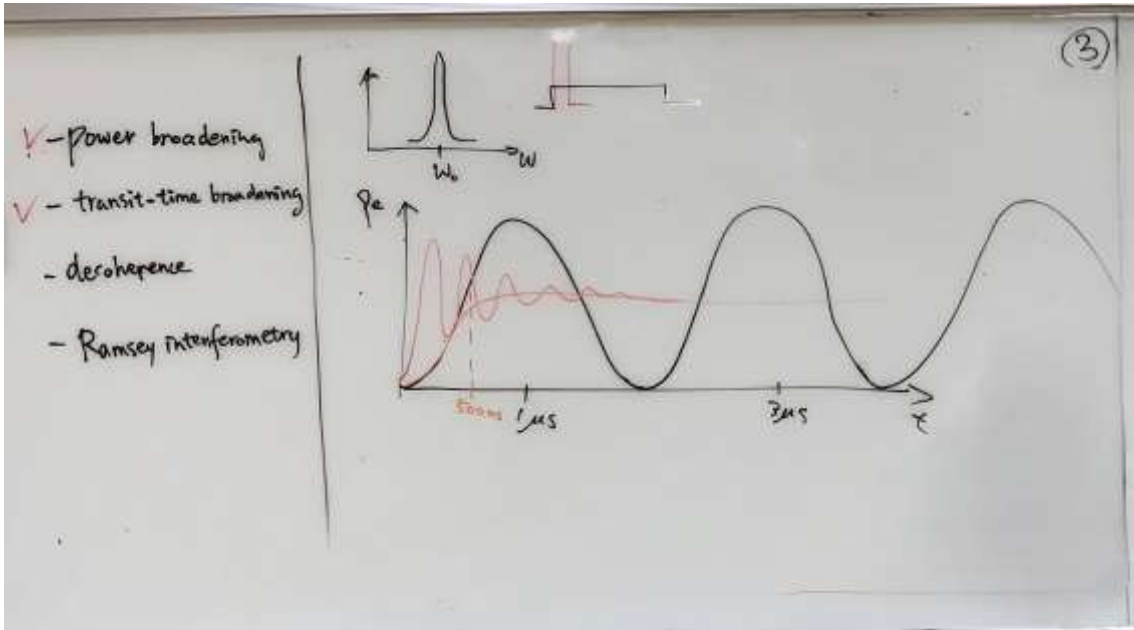
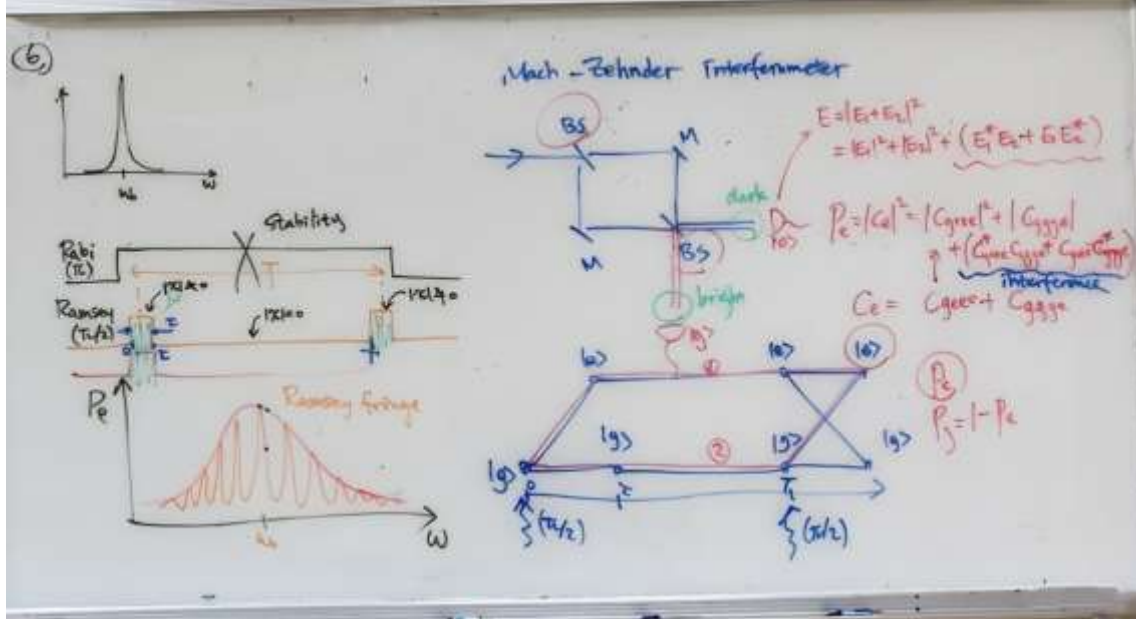
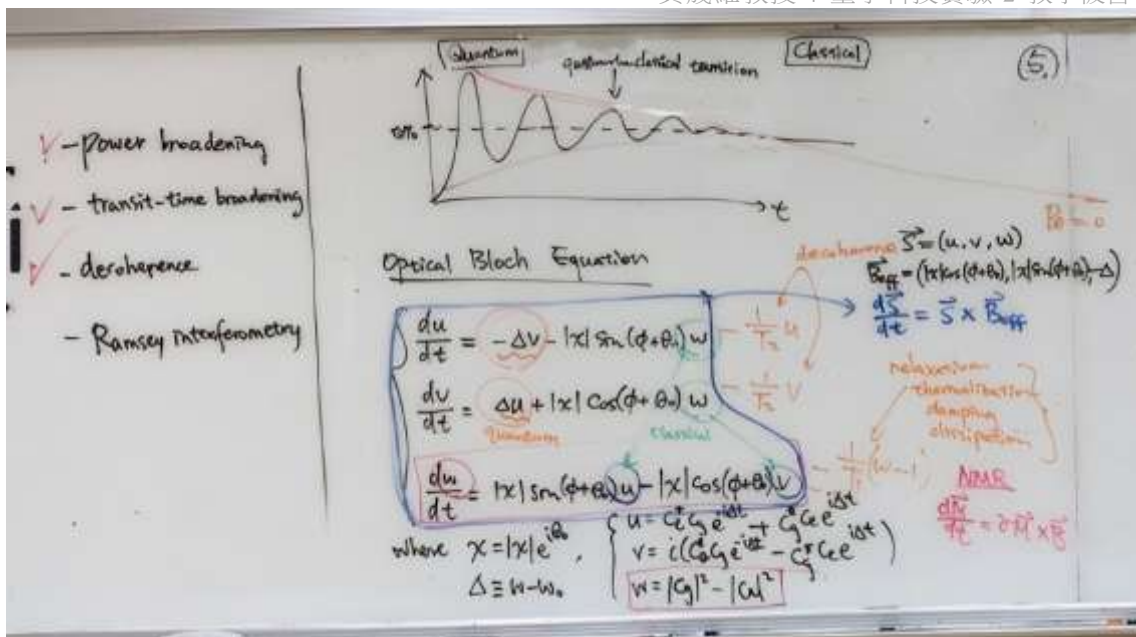


Lecture6 (spin) Ramsey interferometry and decoherence









✓ - power broadening
 ✓ - transit-time broadening
 ✓ - decoherence
 - Ramsey Interferometry

$E = E_0 \cos(\omega t - \phi)$
 $|\psi\rangle = C_g |g\rangle + C_e e^{i\omega t} |e\rangle$
 $|\psi\rangle = C_g |g\rangle + C_e e^{i\omega t} |e\rangle$
 $E' = E_0 \cos((\omega - \omega_0)t - \phi)$
 $\phi = -\omega' T = -(\omega - \omega_0)T = -\Delta T$
 $E' = E_0 \cos((\omega - \omega_0)t)$
 $E' = E_0 \cos(\omega_0 T - \omega T)$
 $E' = E_0 \cos(\omega_0 T - \omega T)$

(6)
 $C_e(T+\tau) = \left(e^{-i\omega_0 \tau} \frac{i\chi}{\Omega} S \right) \cdot 1 \cdot e^{-i\omega_0 T} \left(C + i \frac{\Delta}{\Omega} S \right) \leftarrow \text{path 1}$
 $+ \left(e^{i\omega_0 \tau} \left(C - i \frac{\Delta}{\Omega} S \right) \right) \cdot 1 \cdot \left(e^{-i\omega_0 \tau} \frac{i\chi}{\Omega} e^{-i\Delta T} S \right) \leftarrow \text{path 2}$

$\rightarrow P_e = |C_e(T+\tau)|^2 = \frac{|\chi|^2}{\Omega^2} S^2 \left(1 - \frac{|\chi|^2}{\Omega^2} S^2 \right) + \frac{|\chi|^2}{\Omega^2} S^2 \left(1 - \frac{|\chi|^2}{\Omega^2} S^2 \right)$
 $+ \frac{|\chi|^2}{\Omega^2} S^2 \left(1 - \frac{|\chi|^2}{\Omega^2} S^2 \right) \left(e^{-i(\Delta T - \phi_0)} e^{i(\Delta T + \phi_0)} + e^{i(\Delta T - \phi_0)} e^{-i(\Delta T + \phi_0)} \right)$

interference
 $e^{-i(\Delta T - \phi_0 - \Delta T - \phi_0)} + e^{i(\Delta T - \phi_0 - \Delta T - \phi_0)}$
 $= 2 \cos(\Delta T - \Delta T - 2\phi_0)$

$C + i \frac{\Delta}{\Omega} S = \sqrt{C^2 + \frac{\Delta^2}{\Omega^2} S^2} e^{i\phi_0}$
 $C - i \frac{\Delta}{\Omega} S = \sqrt{C^2 + \frac{\Delta^2}{\Omega^2} S^2} e^{-i\phi_0}$
 $C^2 + \frac{\Delta^2}{\Omega^2} S^2 = 1 - S^2 + \frac{\Delta^2}{\Omega^2} S^2$
 $= 1 + \frac{\Delta^2 - |\chi|^2}{\Omega^2} S^2$
 $= \boxed{1 - \frac{|\chi|^2}{\Omega^2} S^2}$





(7)

$$P_e = \frac{|x|^2}{\Omega^2} S^2 \left(1 - \frac{|x|^2}{\Omega^2} S^2\right) \left(2 + 2 \cos(\Delta T - \Delta T - 2\phi_0)\right)$$

$1 + \cos(\theta) = 2 \cos^2\left(\frac{\theta}{2}\right)$

$$= \frac{4|x|^2}{\Omega^2} S^2 \left(1 - \frac{|x|^2}{\Omega^2} S^2\right) \cos^2\left(\frac{\Delta T - \Delta T}{2} - \phi_0\right)$$

$\Delta \omega = \frac{2\pi}{T - T}$
 $\frac{1}{T - T} = \frac{1}{T - T}$

$= \left(1 - \frac{|x|^2}{\Omega^2} S^2 \sin^2\left(\frac{\Omega T}{2}\right)\right) \left[\frac{|x|^2}{(\Omega/2)^2} \sin^2\left(\frac{\Omega T}{2}\right) \cos^2\left(\Delta\left(\frac{T - T}{2}\right) + \phi_0\right)\right]$

temporal double slit
single-slit envelope
broader profile
oscillation = double-slit diffraction pattern with a broadened envelope
Spatial double slit

- ✓ - power broadening
- ✓ - transit-time broadening
- ✓ - decoherence
- ✓ - Ramsey interferometry

