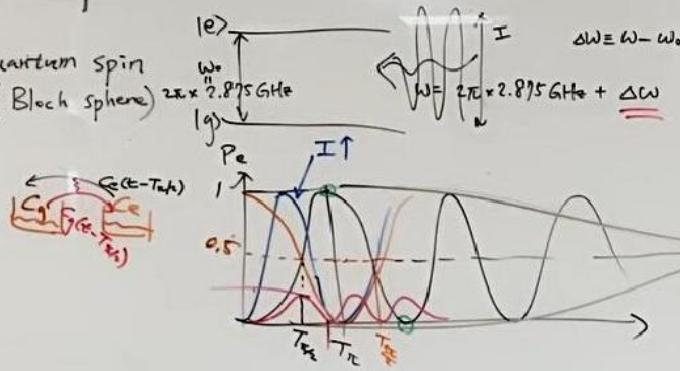


Lecture6 Ramsey interferometry

- Ramsey interferometry

- classical and quantum spin
(Bloch sphere)



②

$$C_g(t) = e^{-\frac{i\Delta t}{2}} \left[\left[\cos\left(\frac{\Omega t}{2}\right) + \frac{i\Delta}{\Omega} \sin\left(\frac{\Omega t}{2}\right) \right] C_g(0) + \frac{i\Omega t}{\Omega} e^{-i\phi} \sin\left(\frac{\Omega t}{2}\right) C_e(0) \right]$$

$$C_e(t) = e^{\frac{i\Delta t}{2}} \left[\frac{i\Omega t e^{i\phi}}{\Omega} \sin\left(\frac{\Omega t}{2}\right) C_g(0) + \left(\cos\left(\frac{\Omega t}{2}\right) - \frac{i\Delta}{\Omega} \sin\left(\frac{\Omega t}{2}\right) \right) C_e(0) \right]$$

$$\Delta \equiv \omega - \omega_0$$

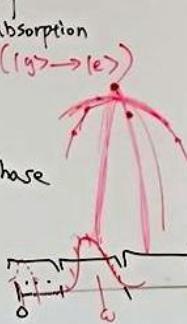
$$\mathcal{R}_e = \frac{1}{\hbar} |V_{ee}|$$

$$\Omega = \sqrt{\mathcal{R}_e^2 + \Delta^2}$$

ϕ = microwave initial phase

$$H_{\text{mic}} \propto e^{-i\omega t + i\phi}$$

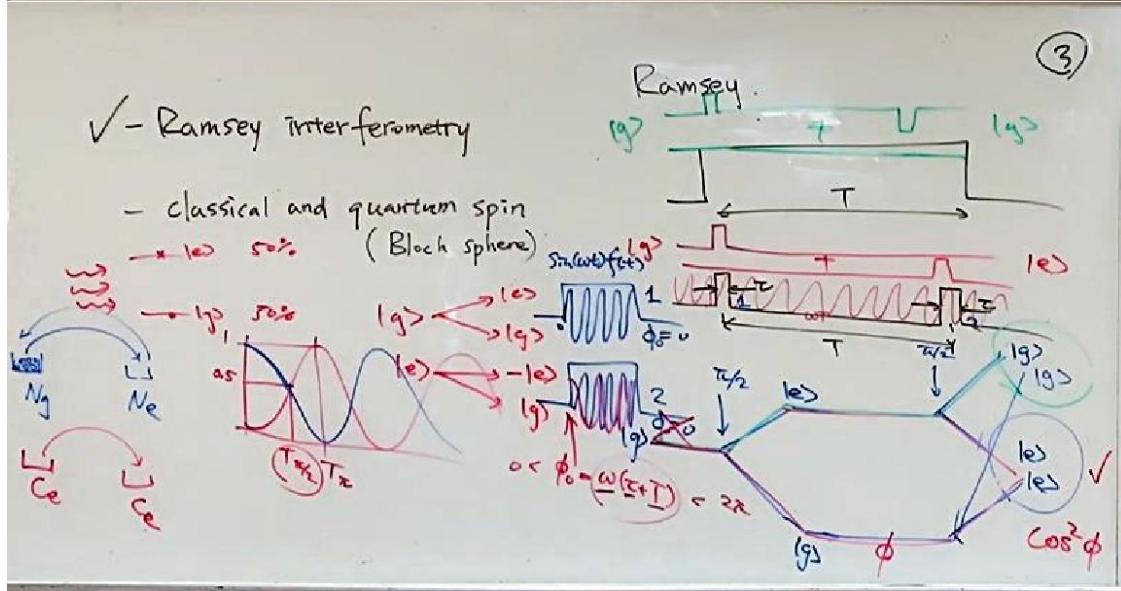
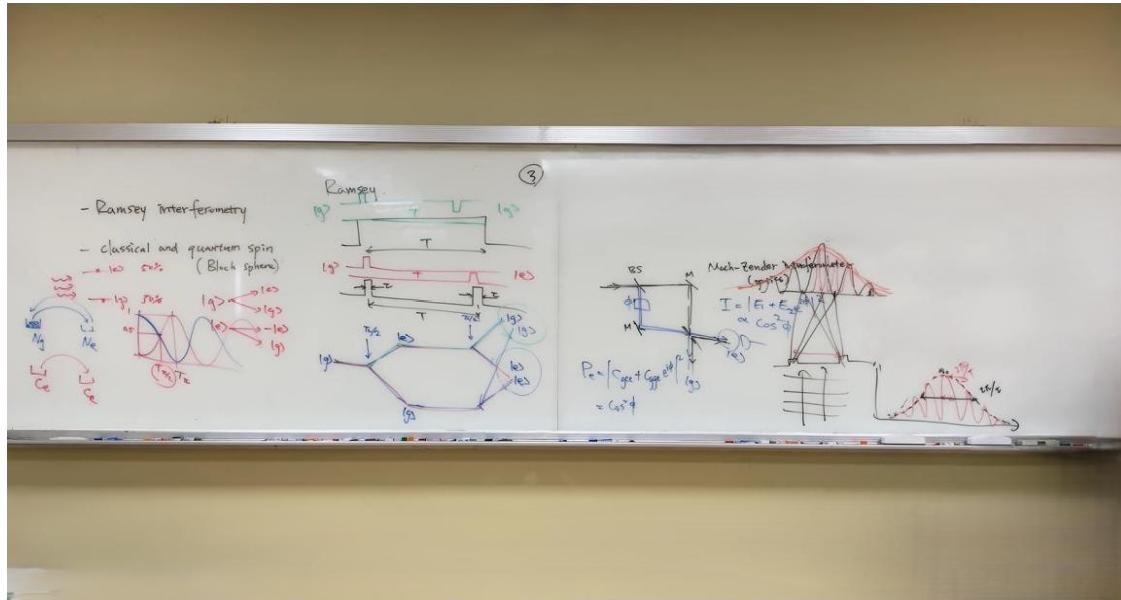
τ = Pulse duration



Rabi spectrum
(single pulse)

transit broadening







(4)

$$C_g(t) = e^{-\frac{i\Delta\tau}{2}} \left[\left[\cos\left(\frac{\Delta\tau}{2}\right) + \frac{i\Delta}{\hbar} \sin\left(\frac{\Delta\tau}{2}\right) \right] C_g(0) + \frac{i\sqrt{\kappa}}{\hbar} e^{i\phi} \sin\left(\frac{\Delta\tau}{2}\right) C_e(0) \right]$$

$$C_e(t) = e^{i\frac{\Delta\tau}{2}} \left[\left[\cos\left(\frac{\Delta\tau}{2}\right) + \frac{i\Delta}{\hbar} \sin\left(\frac{\Delta\tau}{2}\right) \right] C_g(0) + \left(\cos\left(\frac{\Delta\tau}{2}\right) - \frac{i\Delta}{\hbar} \sin\left(\frac{\Delta\tau}{2}\right) \right) C_e(0) \right]$$

absorption

emission ($|e\rangle \rightarrow |g\rangle$)

$\Delta(\omega + \tau)$

$|g\rangle$

$|e\rangle$

$\hbar f_t = C_g(0)|g\rangle + C_e(0)e^{-i\omega\tau}$

$\rho_e = \frac{1}{4} \left(1 + 1 - e^{i\Delta(\tau+T)} - e^{-i\Delta(\tau+T)} \right)$

$\rho_e = \frac{1}{2} e^{-i\omega_0\tau} \left(-e^{-i\omega_0(\tau+T)} + e^{i\Delta(\tau+T)} - e^{-i\Delta(\tau+T)} \right)$

✓- Ramsey interferometry

- classical and quantum spin
(Bloch sphere)

