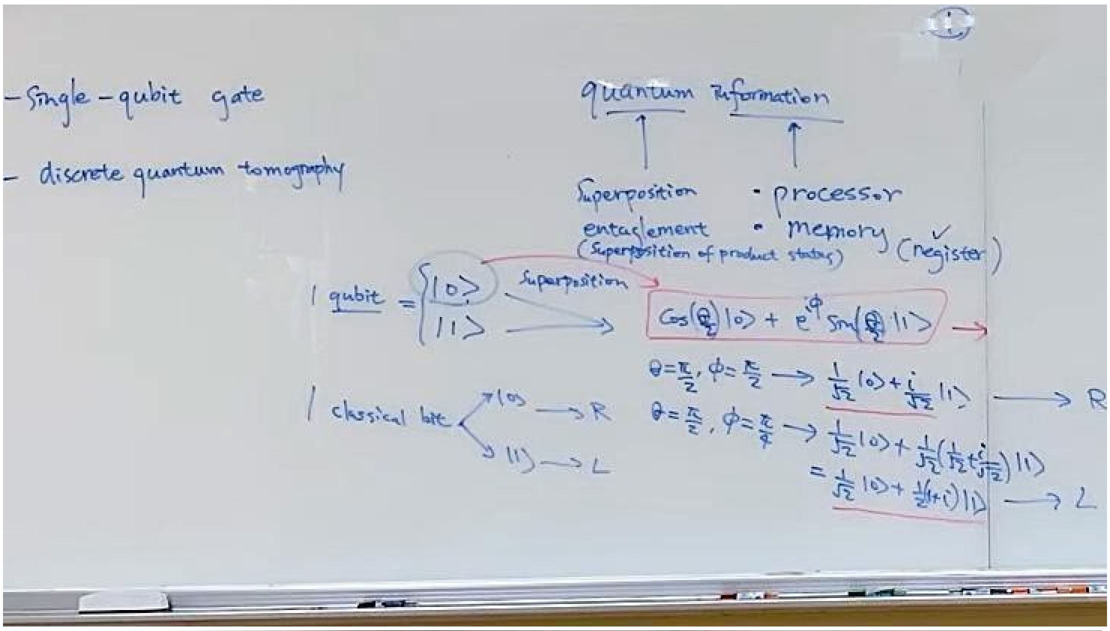
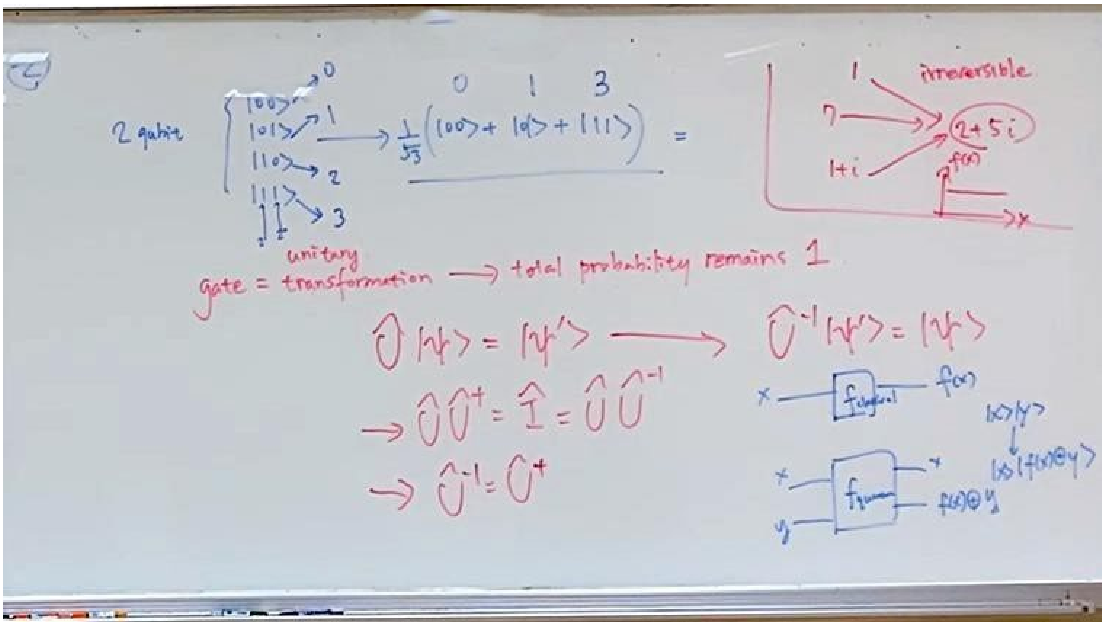
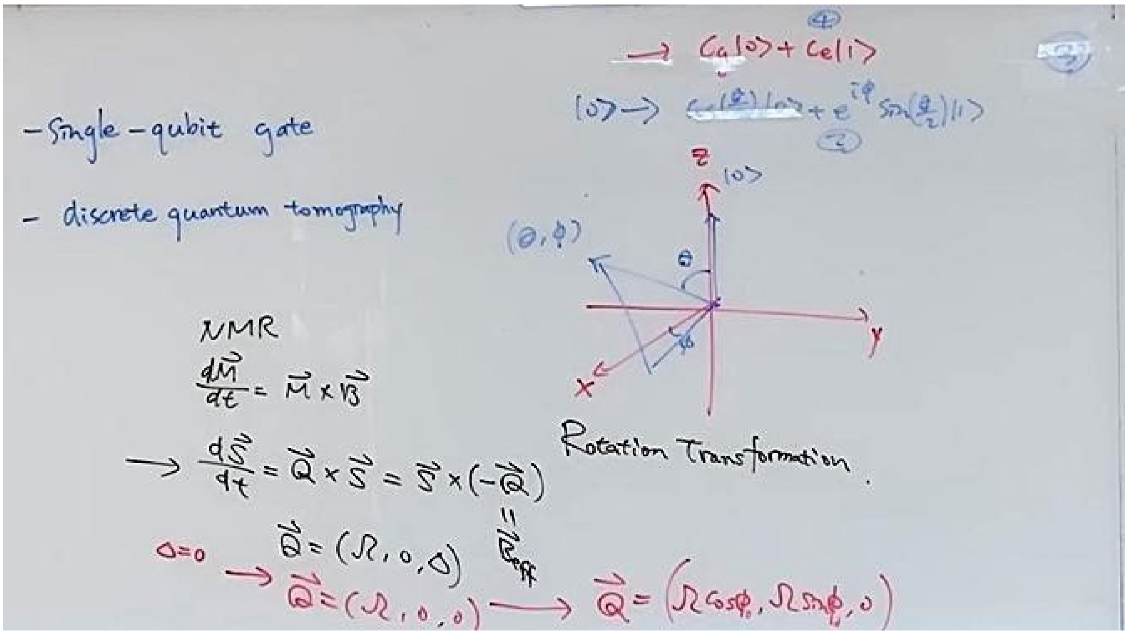
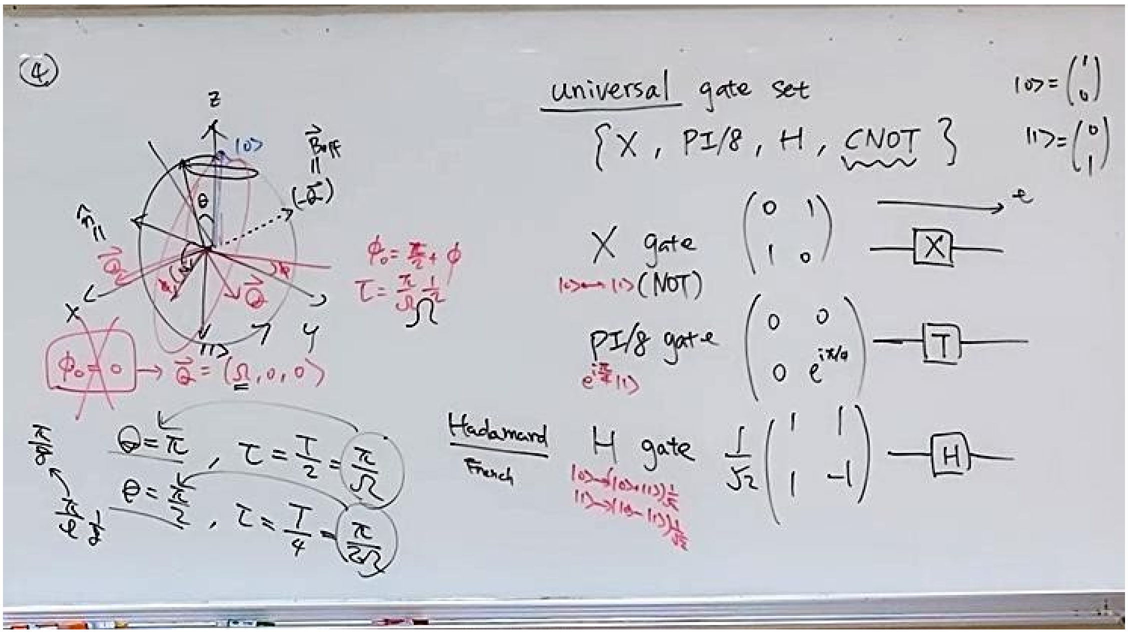
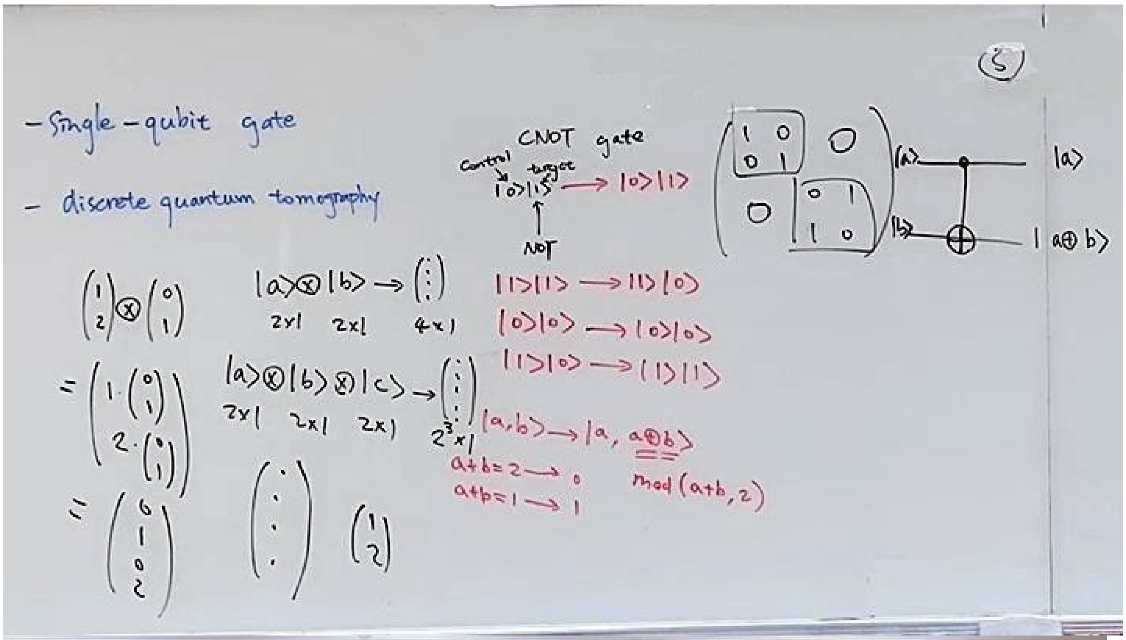
Lecture12 Single-qubit gates and discrete quantum tomography

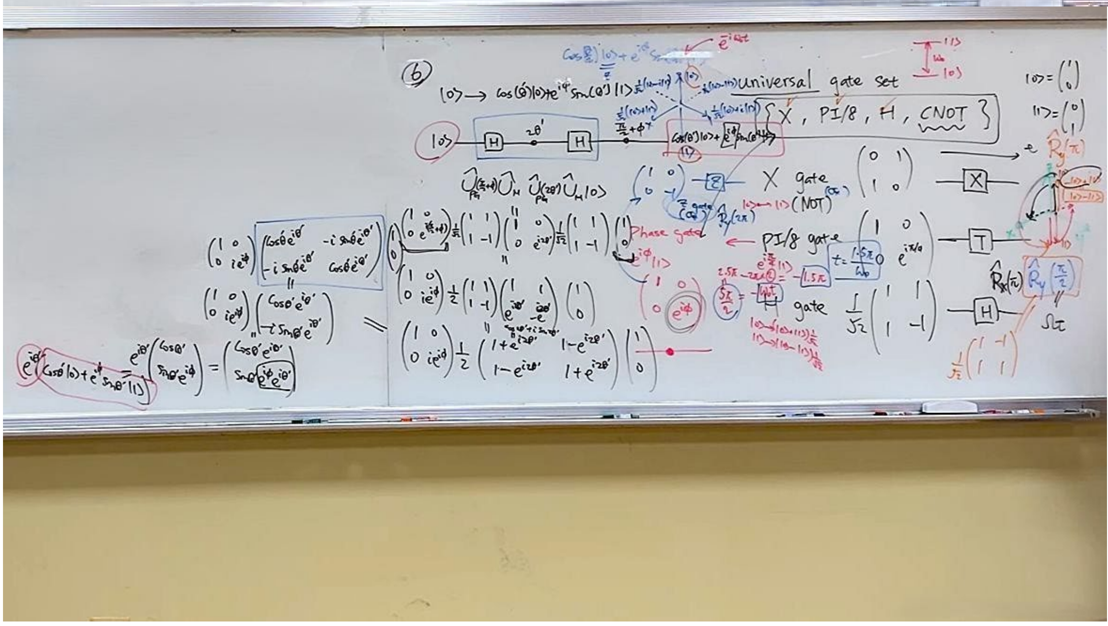


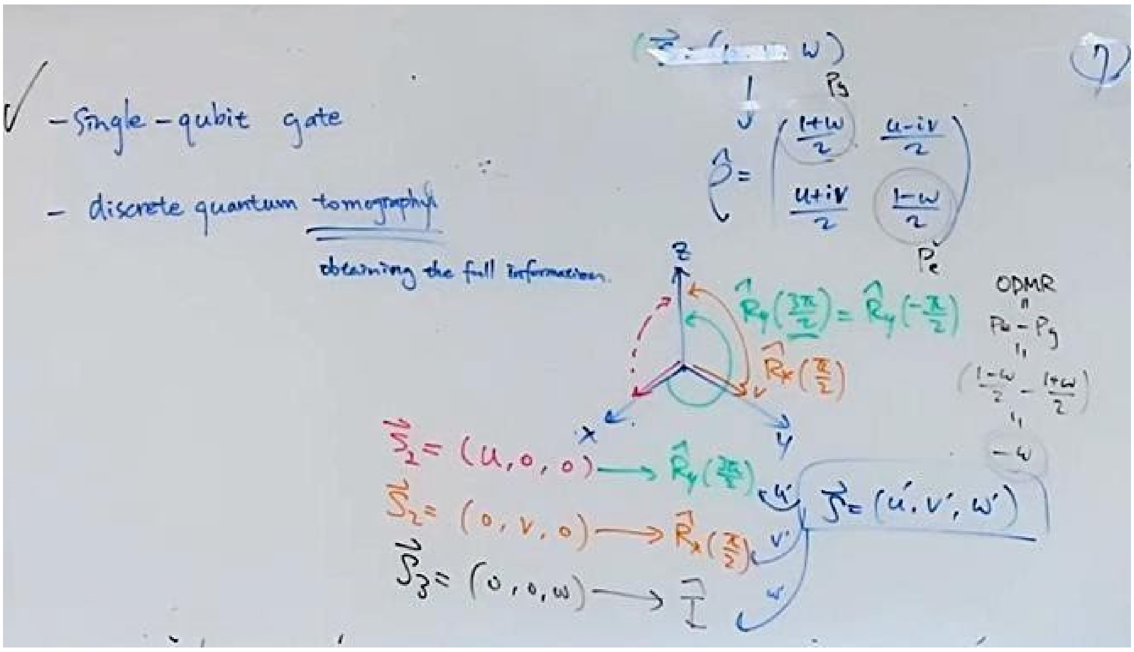


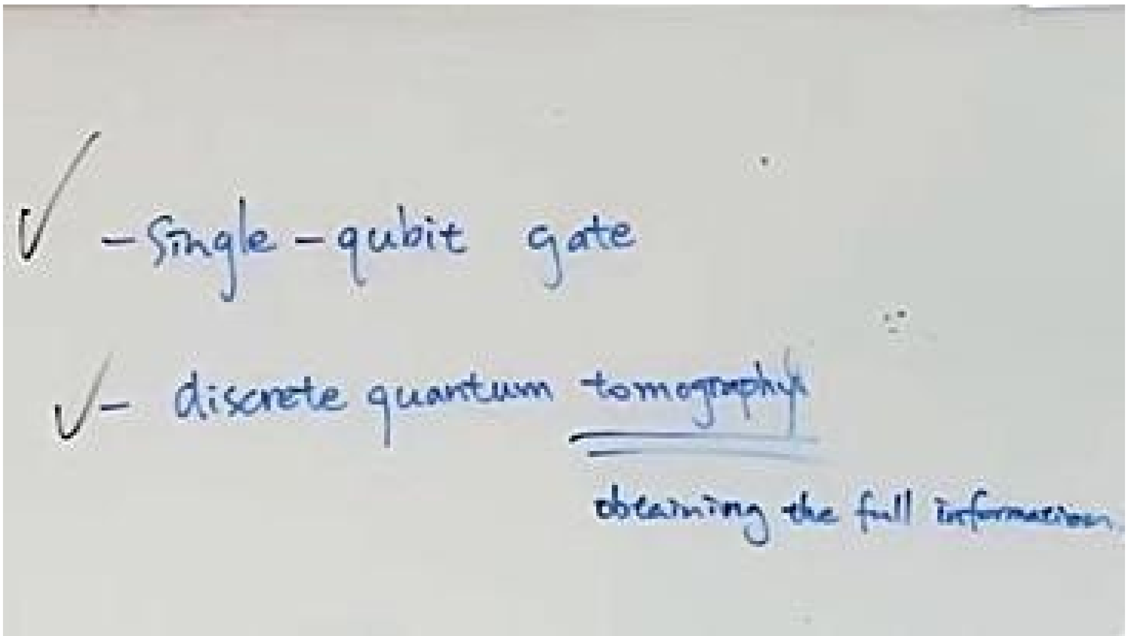

- Single-qubit gate
- discrete quantum tomography
NMR
Rotation Transformation
(θ, φ)
z
|0>
x
y
θ
φ


④
universal gate set
{X, PI/8, H, CNOT}
|0> = (1 0)
|1> = (0 1)
X gate
(NOT)
PI/8 gate
Hadamard
French
H gate
z
|0>
|1>
x
y


⑤
- Single-qubit gate
- discrete quantum tomography
CNOT gate
control
target
NOT
|1>|1> → |1>|0>
|0>|0> → |0>|0>
|1>|0> → |1>|1>
|a,b> → |a, a⊕b>
a+b=2 → 0
a+b=1 → 1
mod(a+b, 2)
|a>⊗|b> →
2x1 2x1 4x1
|a>⊗|b>⊗|c> →
|a>
|a⊕b>


⑥
universal gate set
{X, PI/8, H, CNOT}
X gate
(NOT)
Phase gate
PI/8 gate
gate


- single - qubit gate
- discrete quantum tomography
obtaining the full information.
$\rho = \begin{pmatrix} \frac{1+w}{2} & \frac{u-iv}{2} \\ \frac{u+iv}{2} & \frac{1-w}{2} \end{pmatrix}$
P_g
P_e
ODMR
$P_e - P_g$
$\frac{1-w}{2} - \frac{1+w}{2}$
$-w$
$\hat{R}_y(\frac{3\pi}{2}) = \hat{R}_y(-\frac{\pi}{2})$
$\hat{R}_x(\frac{\pi}{2})$
z
x
y
$\vec{S}_1 = (u, 0, 0) \longrightarrow \hat{R}_y(\frac{3\pi}{2})$
$\vec{S}_2 = (0, v, 0) \longrightarrow \hat{R}_x(\frac{\pi}{2})$
$\vec{S}_3 = (0, 0, w) \longrightarrow \hat{I}$
u'
v'
w'
$\vec{S} = (u', v', w')$


- single - qubit gate
- discrete quantum tomography
obtaining the full information.