



L2 (spin) nitrogen-vacancy center in diamond

(color-center)
Nitrogen-Vacancy Center in diamond

room temperature
atmospheric condition

→ qubit (quantum bit)

- electronic structure
- fluorescence spectrum
- optical pumping

tetrahedral

109.5°

^{14}N 7 proton, 7 neutron, 7 electron

^{12}C 6 proton, 6 neutron, 6 electron

valence electron

(2)

NV molecule (center) → NV^0 (charge neutral)
 NV^- (charged state)





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Spin-Statistics Theorem
 $|\psi\rangle = |\text{motion}\rangle |\text{spin}\rangle$
fermion (lion) $\rightarrow$ fermion statistics
boson (sheep) $\rightarrow$ Bose-Einstein Statistics

energy $\uparrow$
Conduction band
Valence band
 $> 2\text{eV}$
5 eV (diamond) ex
Hund's Rule
① / lowest energy

NV-molecule (NV⁻)

③

④

$|\uparrow\uparrow\rangle$
 $|\downarrow\downarrow\rangle$

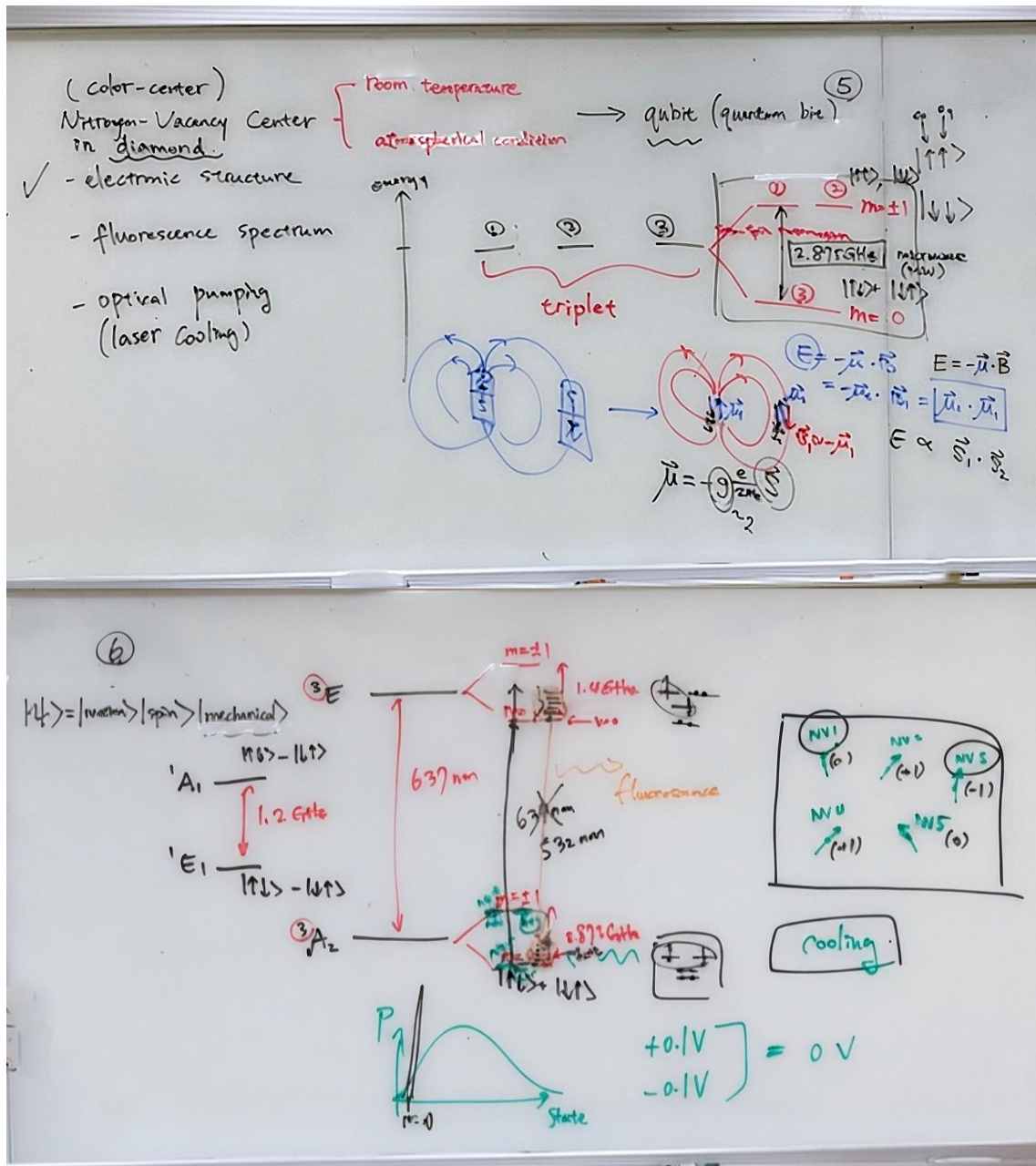
① $e_x \uparrow e_y \uparrow$ ($m=+1$)
② $e_x \downarrow e_y \downarrow$ ($m=-1$)
③ $e_x \uparrow e_y \downarrow$
④ $e_x \downarrow e_y \uparrow$
 $|\uparrow\downarrow\rangle - |\downarrow\uparrow\rangle$
 $m=0$

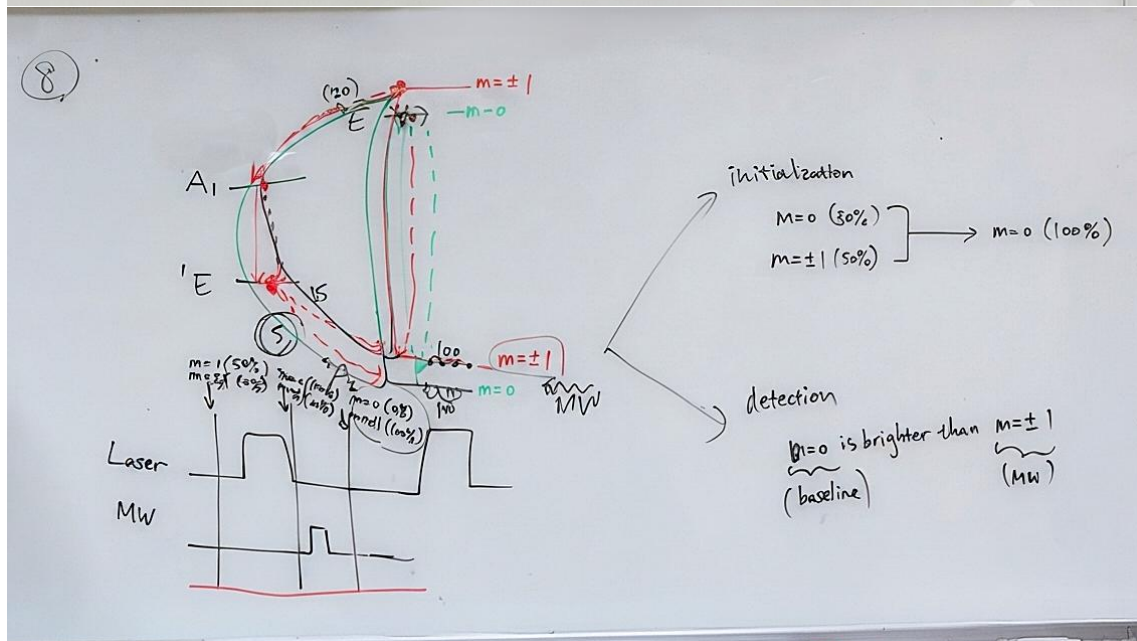
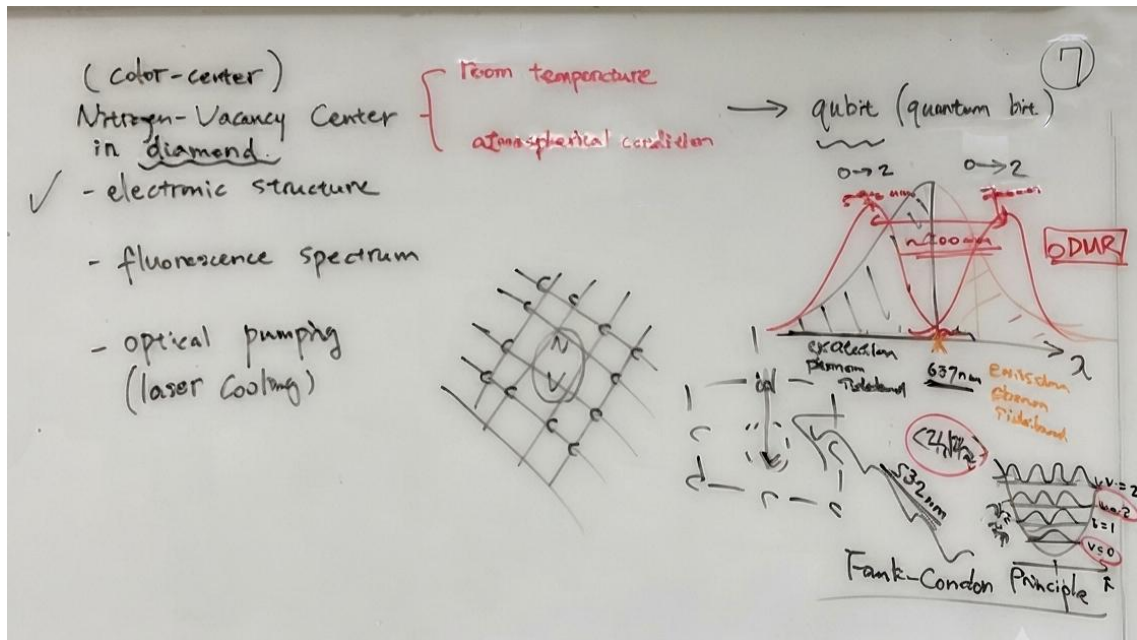
Two-electron state triplet
(Spin configurations in a two-electron system)

③ $e_x \uparrow e_y \downarrow + e_x \downarrow e_y \uparrow$
 $|\uparrow\downarrow\rangle + |\downarrow\uparrow\rangle$
 $(m=0)$

$m=1$
 $m=0$
 $m=-1$









(color-center)
Nitrogen-Vacancy Center
in diamond

✓ - electronic structure
✓ - fluorescence spectrum
✓ - optical pumping
(laser cooling)

{ room temperature
atmospherical condition

→ qubit (quantum bit)

