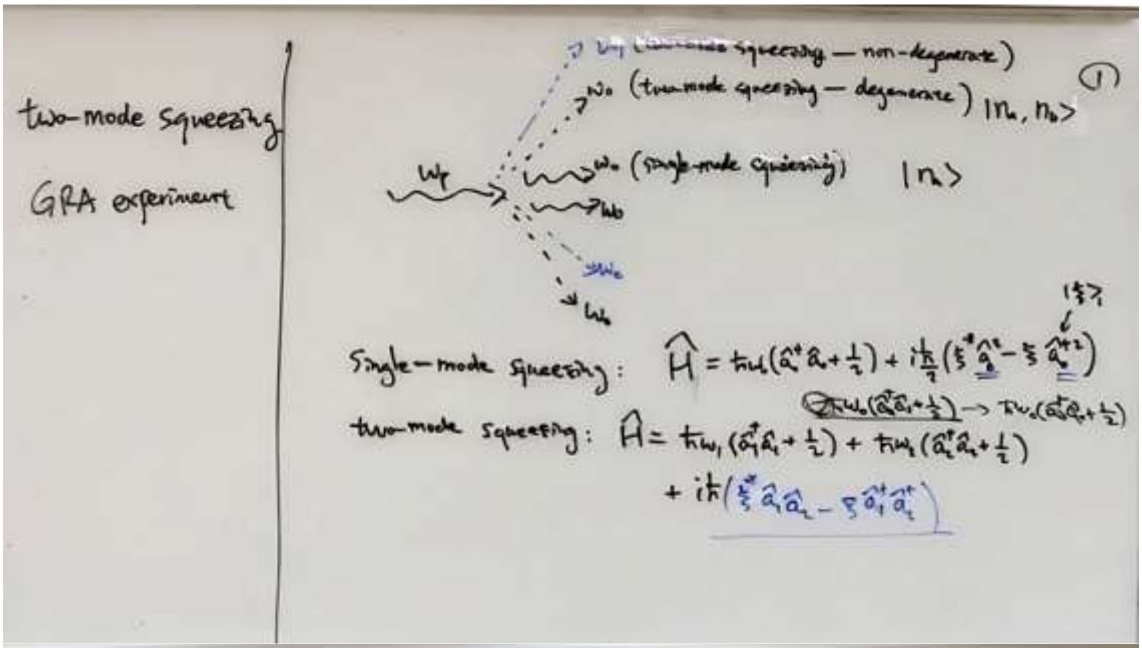
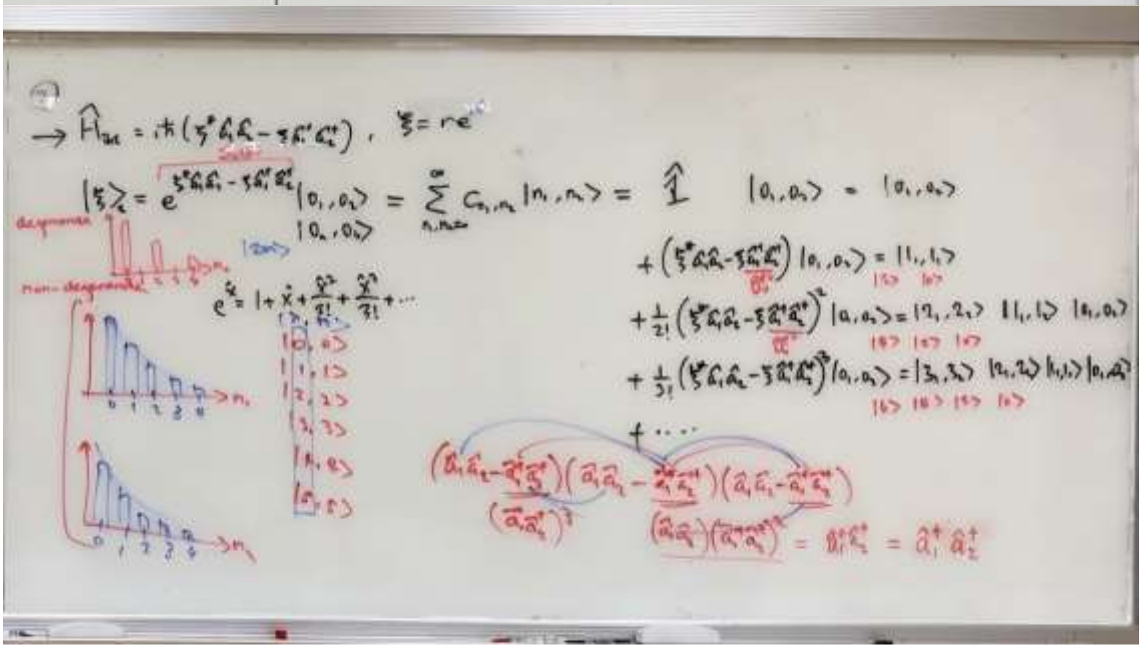
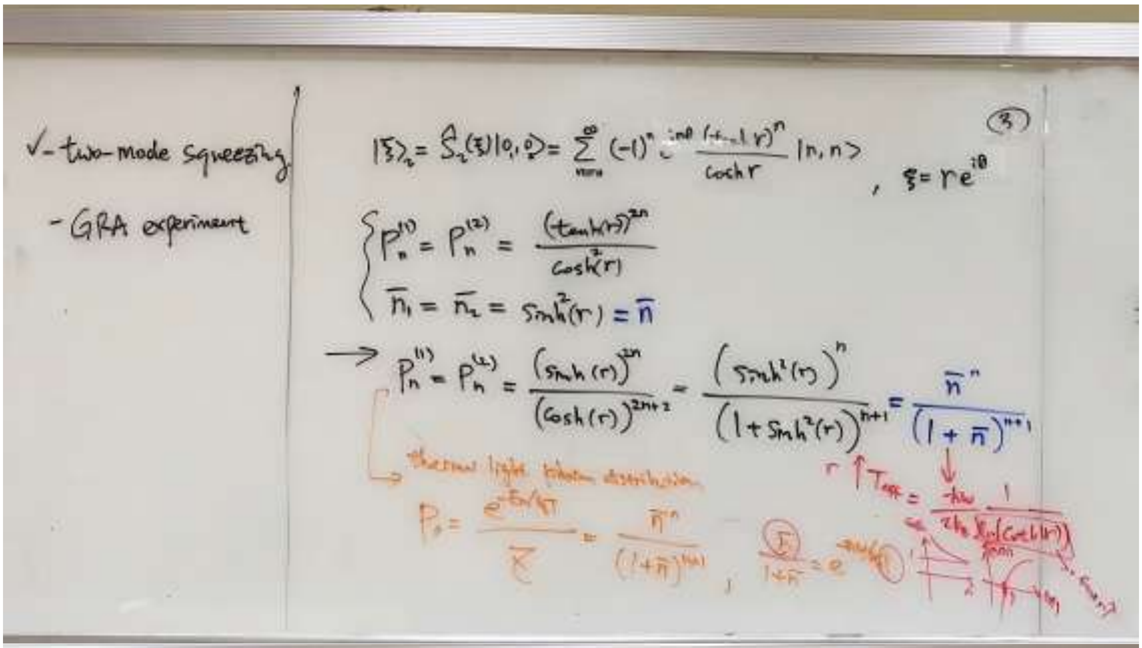
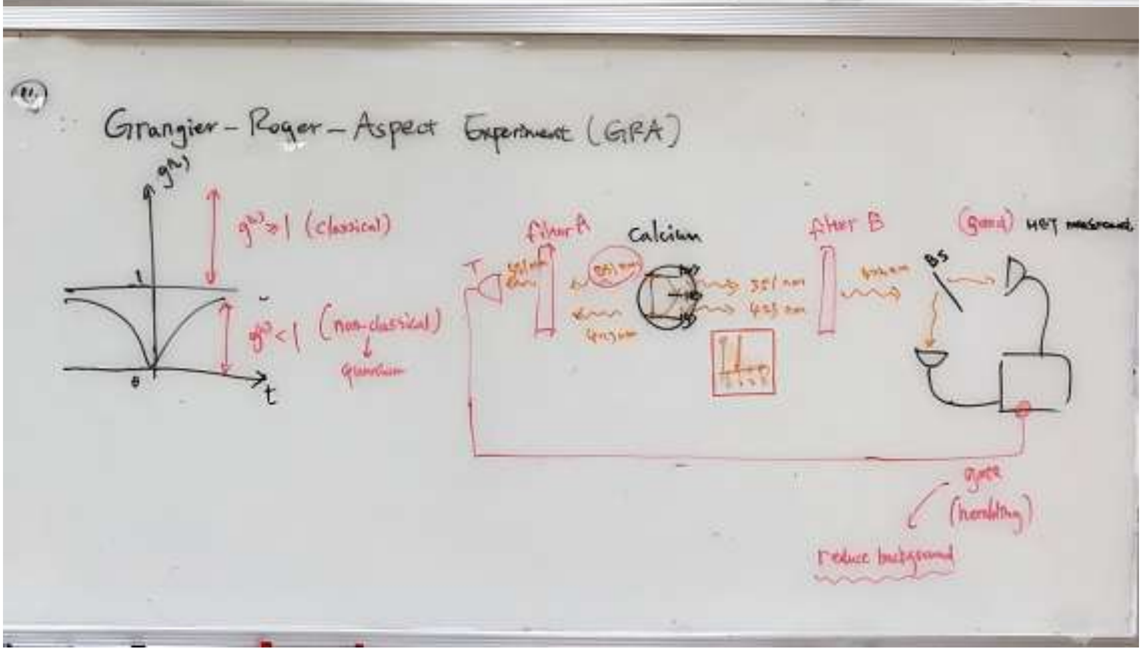
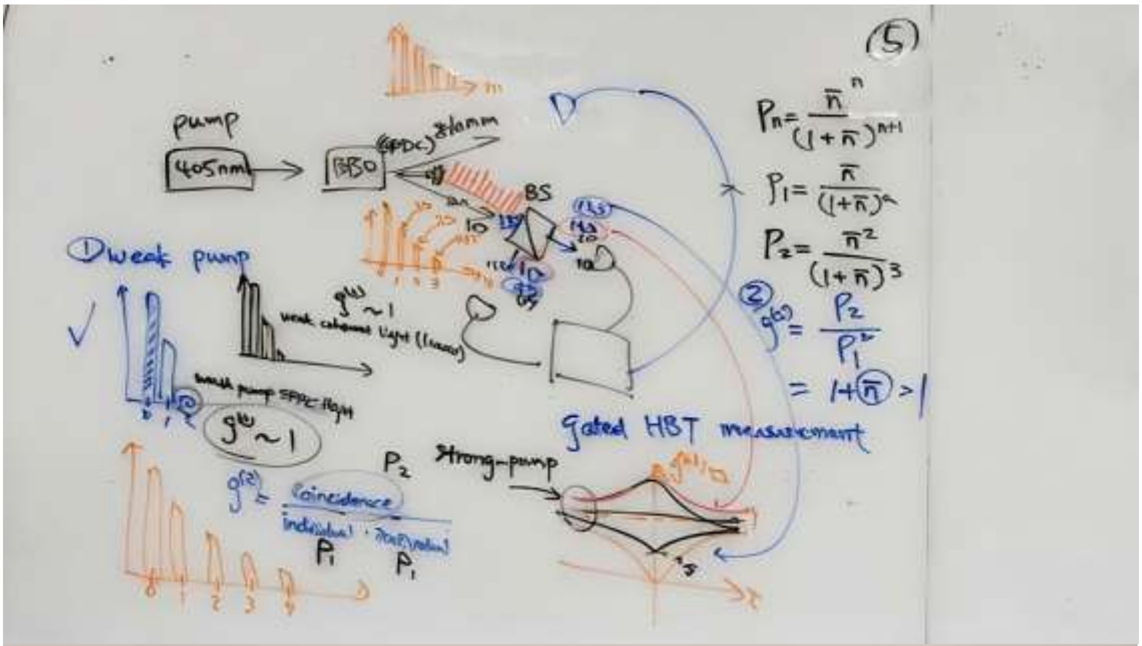
Lecture10 (optics) two-mode squeezing and GRA experiment

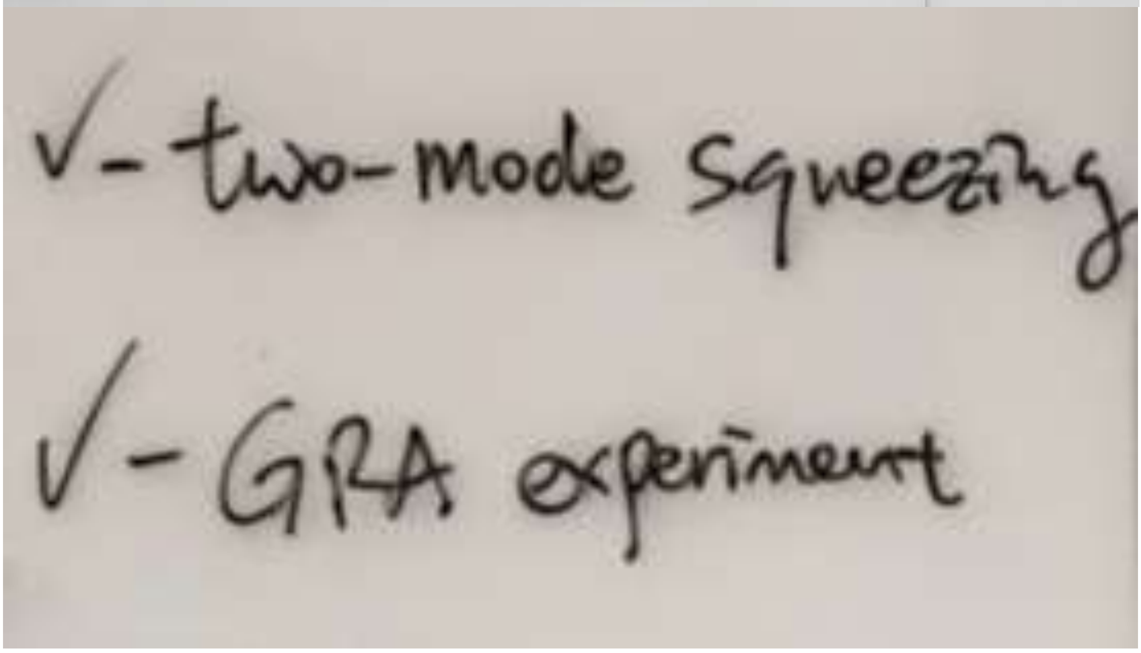





3
two-mode squeezing
- GRA experiment
$|\xi\rangle_2 = \hat{S}_2(\xi)|0,0\rangle = \sum_{n=0}^{\infty} (-1)^n e^{in\theta} \frac{(\tanh r)^n}{\cosh r} |n,n\rangle$, $\xi = re^{i\theta}$
$P_n^{(1)} = P_n^{(2)} = \frac{(\tanh(r))^{2n}}{\cosh^2(r)}$
$\bar{n}_1 = \bar{n}_2 = \sinh^2(r) = \bar{n}$
$P_n^{(1)} = P_n^{(2)} = \frac{(\sinh(r))^{2n}}{(\cosh(r))^{2n+2}} = \frac{(\sinh^2(r))^n}{(1+\sinh^2(r))^{n+1}} = \frac{\bar{n}^n}{(1+\bar{n})^{n+1}}$
thermal light photon distribution
$P_n = \frac{e^{-E_n/k_BT}}{Z} = \frac{\bar{n}^n}{(1+\bar{n})^{n+1}}$


Grangier – Roger – Aspect Experiment (GRA)
$g^{(2)}$
$g^{(2)} > 1$ (classical)
$g^{(2)} < 1$ (non-classical)
quantum
t
filter A
Calcium
filter B
BS
gate
(heralding)
reduce background


⑤
pump
405nm
BBO
SPDC
BS
① weak pump
$g^{(2)}\sim 1$
weak coherent light (laser)
weak pump SPDC
$g^{(2)}\sim 1$
P_2
Strong-pump
$g^{(2)} = \frac{\text{coincidence}}{\text{individual} \cdot \text{individual}}$
P_1 P_1
Gated HBT measurement
$P_n = \frac{\bar{n}^n}{(1+\bar{n})^{n+1}}$
$P_1 = \frac{\bar{n}}{(1+\bar{n})^2}$
$P_2 = \frac{\bar{n}^2}{(1+\bar{n})^3}$
② $g^{(2)} = \frac{P_2}{P_1^2} = 1+\bar{n} > 1$


✓- two-mode squeezing
✓- GRA experiment