for coherent state

$$|\langle\alpha|\beta\rangle|^2 = e^{-|\alpha-\beta|^2}$$

recall:

$$|\alpha\rangle = \underline{\underline{D}}(\alpha)|0\rangle = e^{-\frac{1}{2}|\alpha|^2} \sum_n \frac{\alpha^n}{\sqrt{n!}}|n\rangle$$

($|n\rangle$ number states)

$$P\{n=0\} = \mathrm{tr}\{\rho\,|0\rangle\langle 0|\}$$

$$= |\langle 0|\alpha\rangle|^2 = e^{-|\alpha|^2}$$

→ Zero-particle event → computing Gaussian functions

→ scalar product

↳ mix 2 Gaussian states with a beam splitter

$|\alpha\rangle$ & $|\beta\rangle$ can be mixed with 50:50 beam splitter to provide yet another coherent states $|\alpha'\rangle$ & $|\beta'\rangle$

$$\alpha' = \frac{1}{\sqrt{2}}(\alpha - \beta)$$

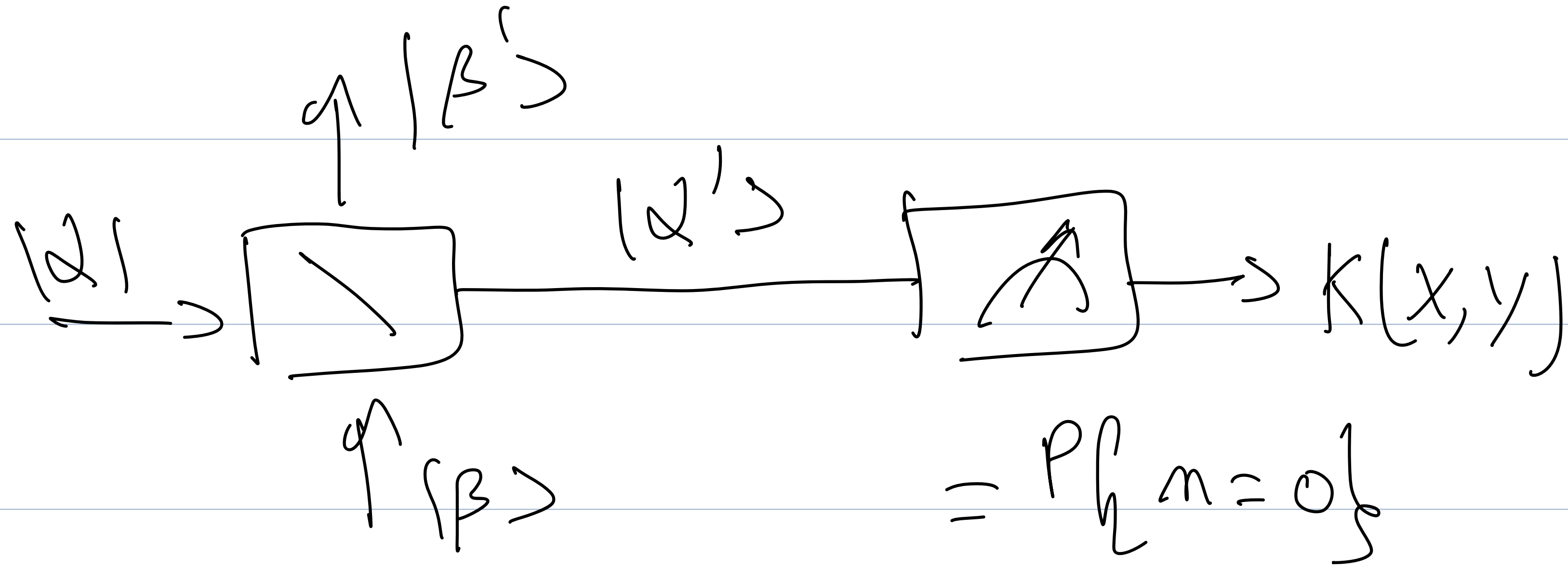
$$\beta' = \frac{1}{\sqrt{2}}(\alpha + \beta)$$

measure $P\{n=0\}$ on $|\alpha'\rangle$

$$\rightarrow \quad P\{n=0\} = e^{-|\alpha'|^2} = e^{-\frac{1}{2}|\alpha-\beta|^2}$$

$$
\begin{tikzcd}
 & X \text{ (data)} \arrow[d] & \\
|0\rangle \arrow[r] & \boxed{\hat{D}(\alpha)} \arrow[r] & |\alpha\rangle
\end{tikzcd}
$$

$$
\begin{tikzcd}
|0\rangle \arrow[r, dash] & \boxed{D(\beta)} \arrow[r, dash] & |\beta\rangle \\
 & Y \text{ (data)} \arrow[u] &
\end{tikzcd}
$$



→ photon counting with coherent
Laser beams → computes the scalar
product

Gram matrix → loop over the dataset