# COMPAS

Partner DTU

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# A quantum information processor?

## Quantum operations / gates

Gaussian gates (Clifford group)

- Displacement gates, Z
- Single mode squeezing gate, S
- Fourier gate, F
- Phase gate, P
- SUM gate, CX
- Controlled Phase gate, CZ
- Beam splitter gate, BS

Non – Gaussian operations, V

- Highly nonlinear operation such as the Kerr effect

- Non-Gaussian measurements (APD or PNR detector)

- Non-Gaussian resources (Cat, cubic phase state)

Arbitrary Gaussian operation can be implemeted with e.g. Z, F, P, CZ, V

Arbitrary unitary operation requires a set of single and two-mode Gaussians and a single **single-mode** non-Gaussian.

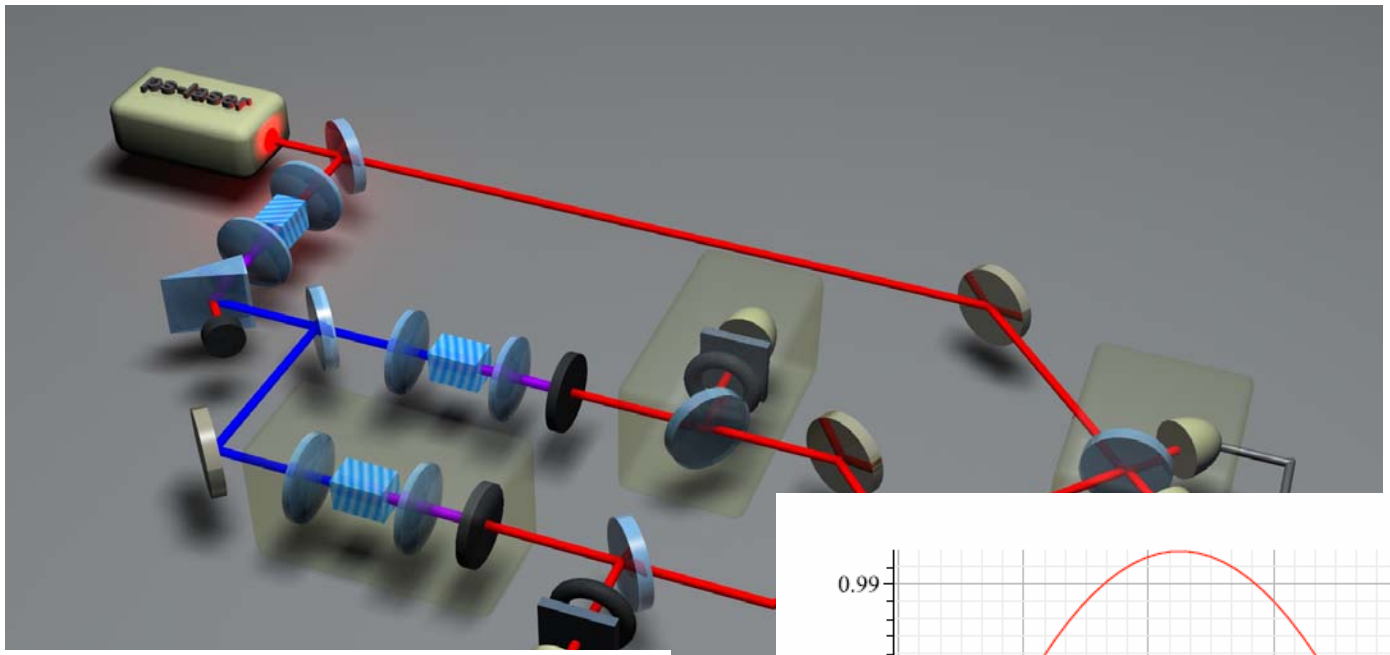
# Non-Gaussian

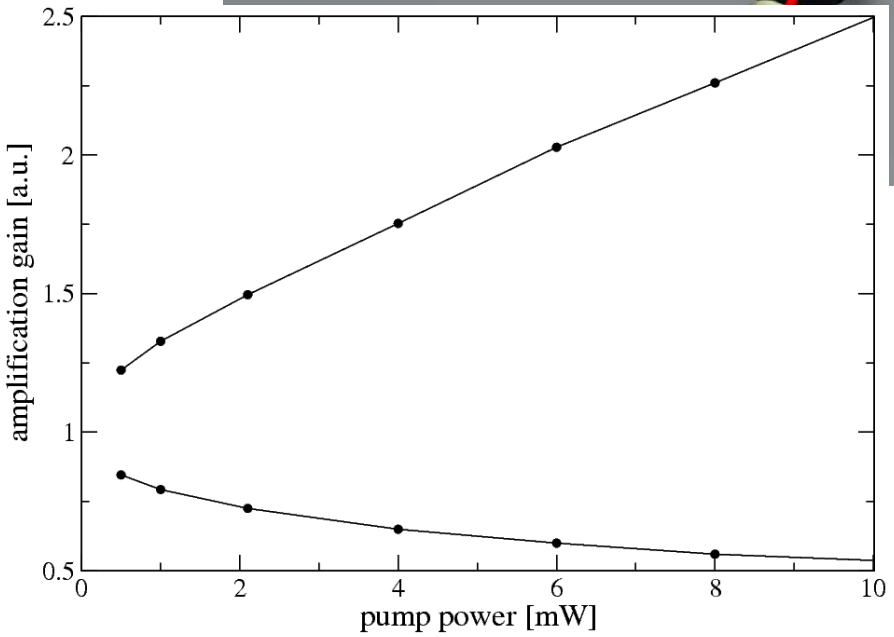
All Gaussian gates have been implemented experimentally.
The challenge is to control the non-Gaussian operation
and combine it with the Gaussian operations.

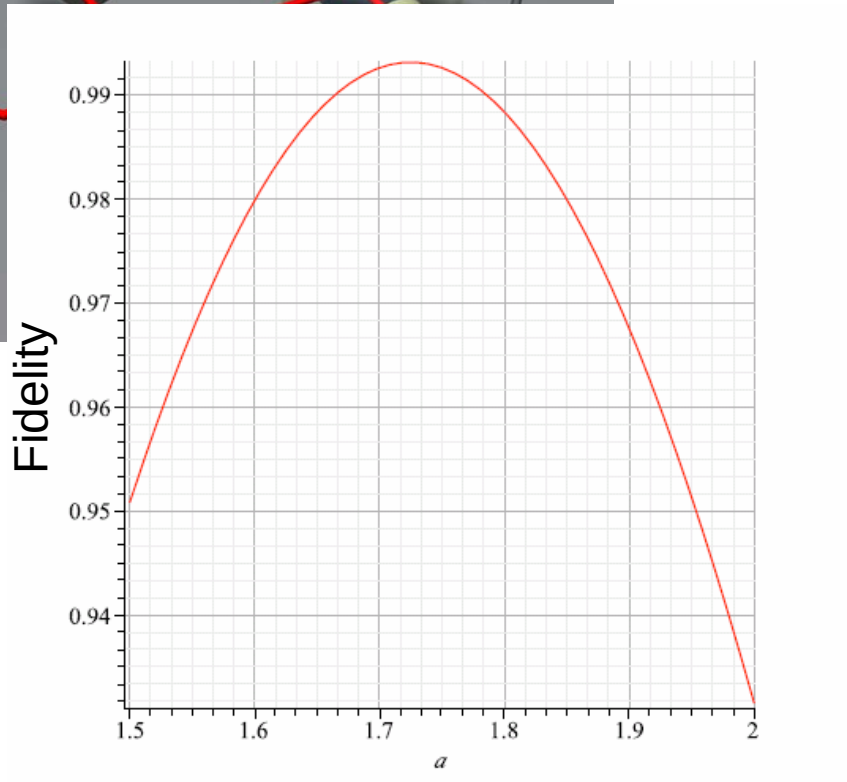
We try to access the non-Gaussian regime using
non-Gaussian measurements:

- Photon subtraction → Cat state generation
- PNR detectors → Coherent state discrimination; Phase concentration

# Generation of large cat states

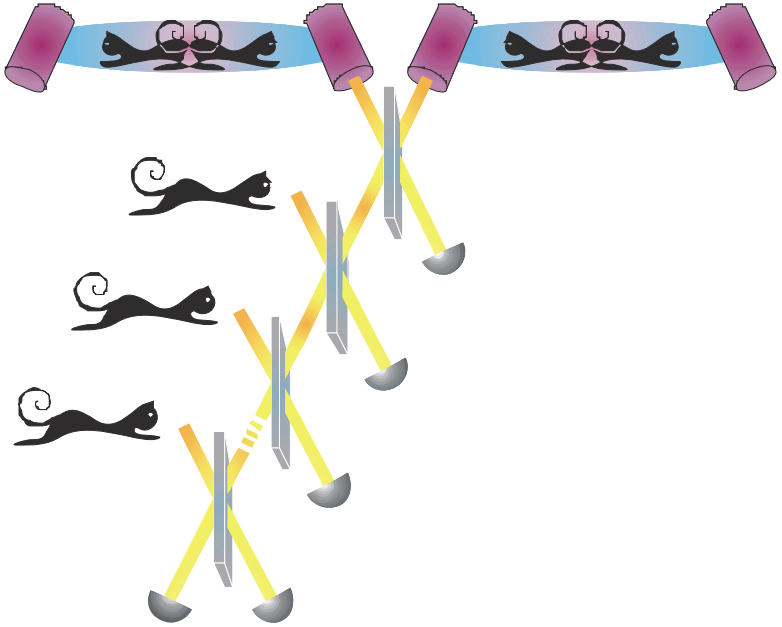




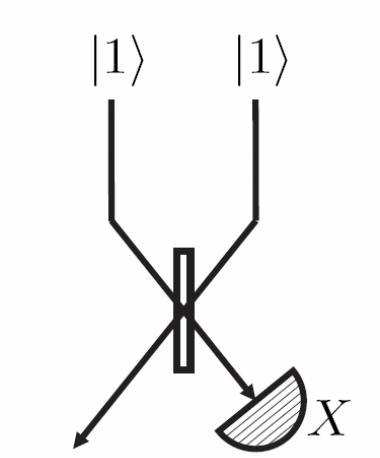
# Applications of cats?

- Quantum computing (overhead efficient and with $\alpha > 1.2$)
- Quantum repeaters

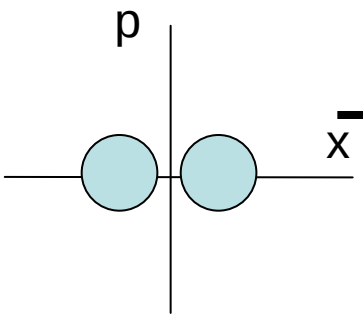


We need single-mode and two-mode cat states

Related states:



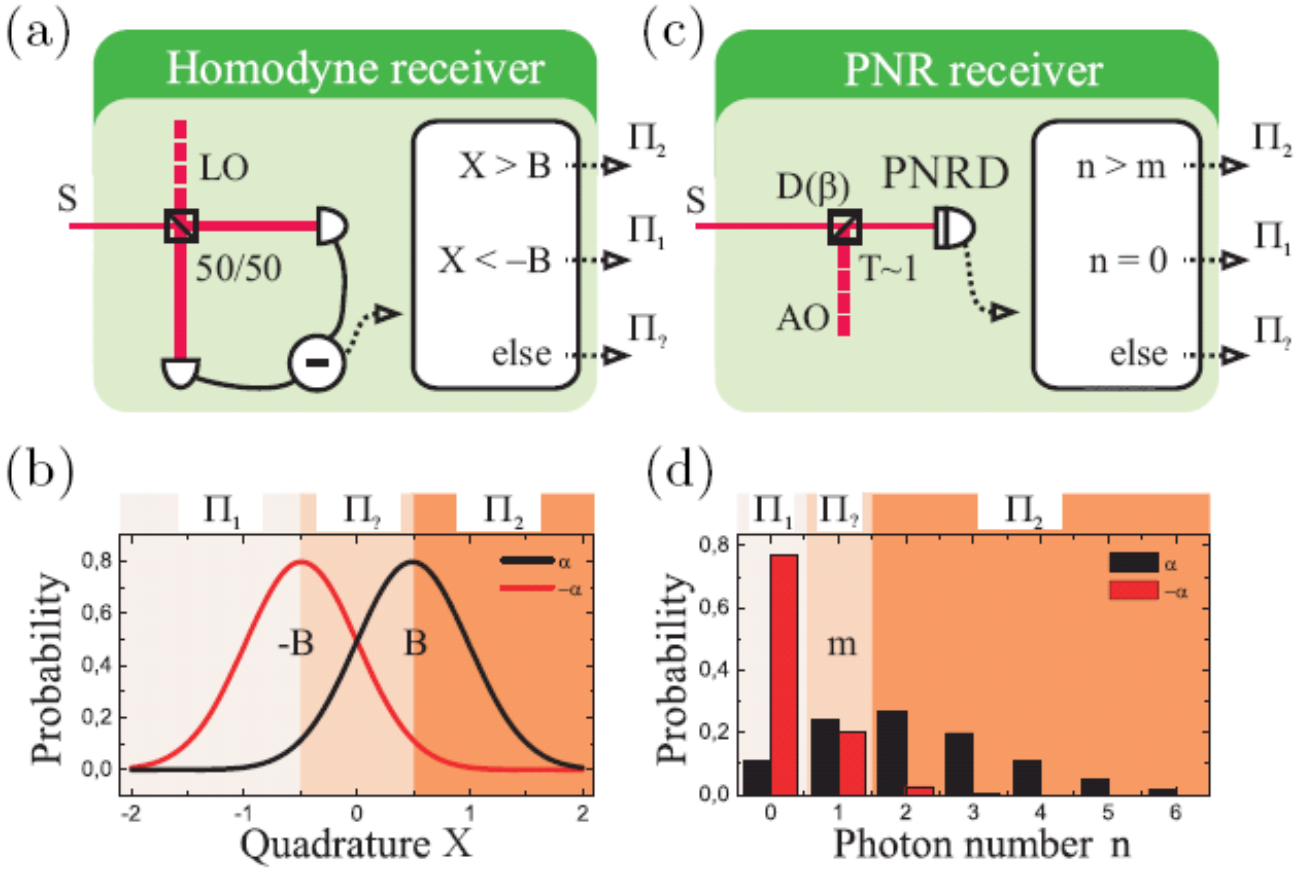
# Coherent state discrimination with errors




Deterministic discrimination (with min errors):
Homodyning, Kennedy, Modified Kennedy, and Dolinar (Helstrom)

Probabilistic discrimination (no errors) or unamb. disc.

Probabilistic discrimination (with errors): Post-selective Homodyning and PNR



# Phase concentration using PNRD