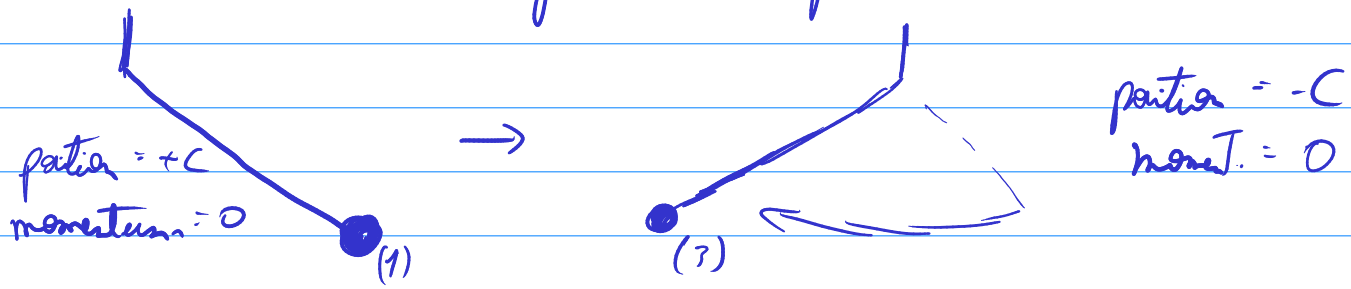
Continuous and Discrete Variable

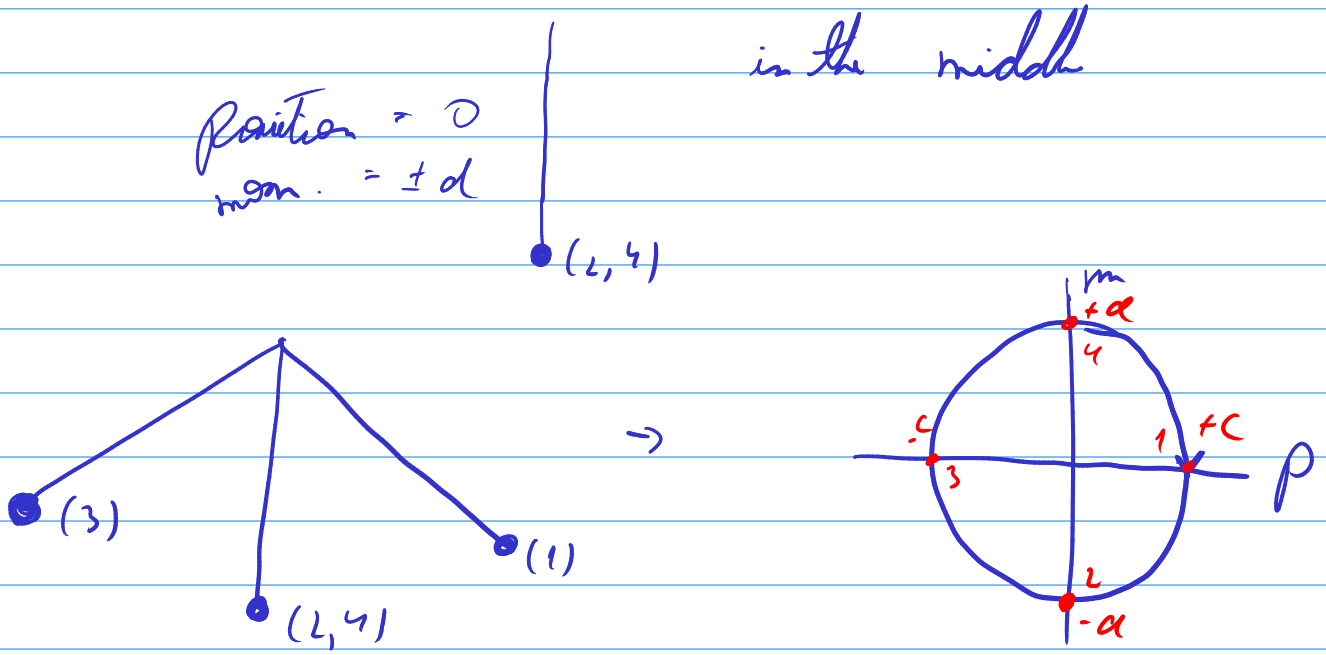
→ discrete → countable variable (# of qubits, click or not click for a photon detector, etc.) $|0\rangle, |1\rangle$

→ Continuous → infinity possible values (momentum, position, etc.)

Classical phase space

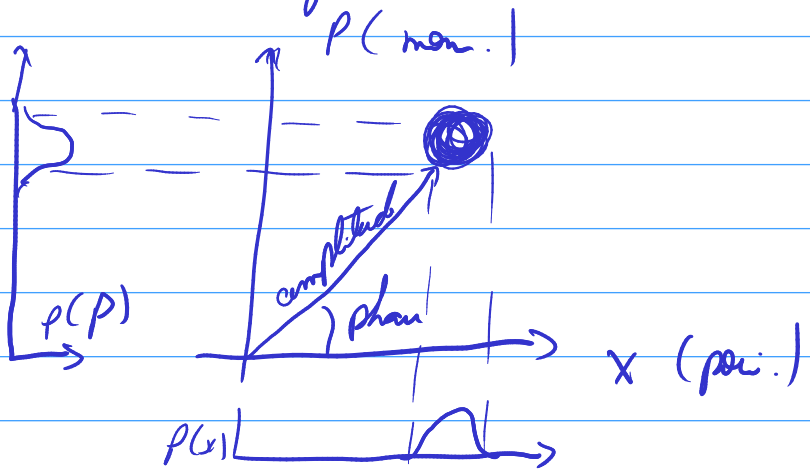
→ what into a space the position and momentum





Optical phase space

→ the electromagnetic field acting on a ⊙ has a cycle close to the pendulum



Due to the uncertainty principle, we can't determine both position and momentum precisely

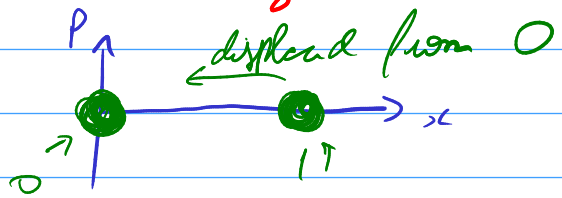
In this case both uncertainties are equal, so it's called a coherent state

the position of the photon is somewhere in the (max) Gaussian distribution and the momentum is somewhere in the sphere

Squeez light

← with that you can reduce the uncertainty for one value but increase for the other

Encode using laser

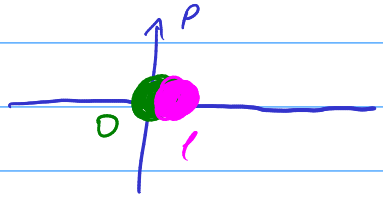


If there's some loss in the way, the key intensity will decrease and the will be closer to the origin (0 value)

For that the amplitud must be some value that distinguishes both values and also compensate the loss in the channel

Attack

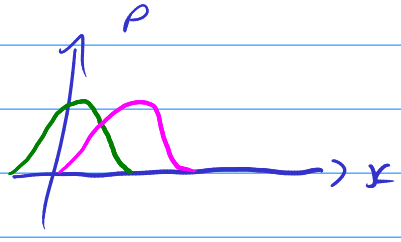
to test attack:



we make the values close to each other

So Eve (and also Bob) has a problem to detect which value.

Bob, however, to set the value and detect Eve's attack. He measure the state and calculate the probability distribution. If this is different from the expected, so Eve may have manipulated the values before.

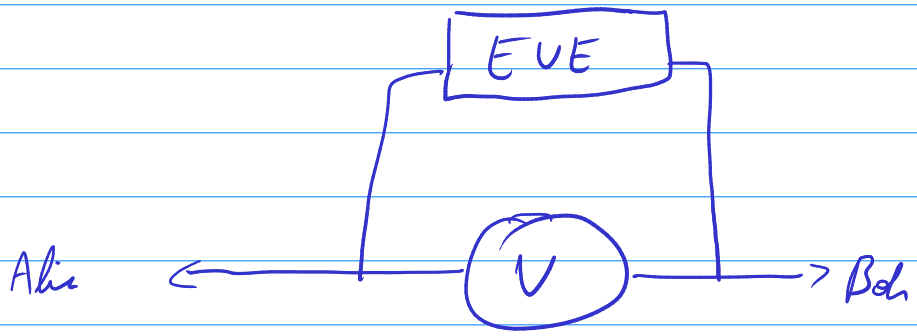


EC and PA can be used here.

Continuous variable entanglement

→ If you measure the momentum or position of one part, you instantaneously know the value of the other one

DI - CV - QKD



This time, we have an entanglement source "V" that creates an EPR state and send it, as a bunch of photons to Alice and Bob.

Eve could get some of the photons and store it in a quantum memory, however, following the protocols, she may not have the final key

The mean. DI QKD, still the same way as before, as well.

Advantages

→ how we use a bunch of photon, the data loss is very small