How does entanglement evolve in quantum gases?

What *is* entanglement?
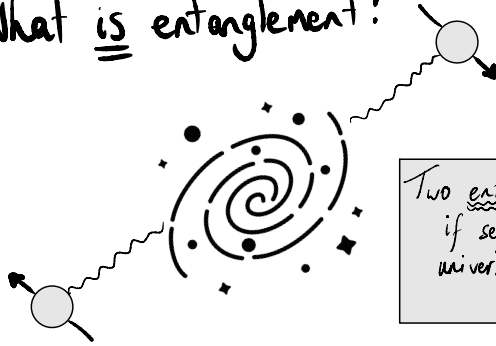
Two entangled particles — even if separated by the entire universe — can "communicate" without time delay
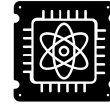
Share a "special handshake" maybe communicate is ok?

Why study entanglement?

Quantum Teleportation
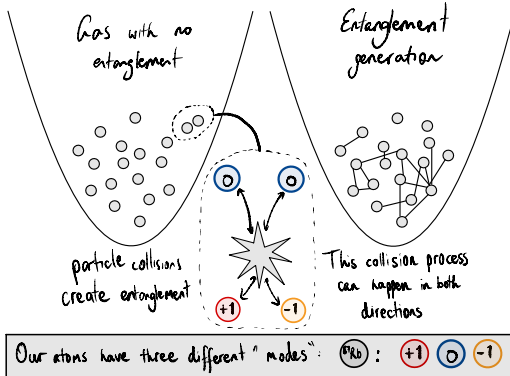
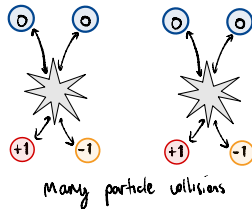**Quantum Encryption**

Quantum Computing

Quantum Metrology

Our Research with Ultracold Quantum Gases

"Ultracold" here means 0.00000001 K (~ −273.15°C)!

Ultracold quantum gases are *ideal* systems to study *complex* quantum phenomena

How to measure entanglement

separate gas

Expand gas ... Expand gas

"Particle" 1   "Particle" 2
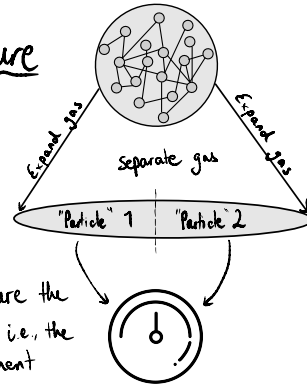
Here, we measure the "communication", i.e. the entanglement

The measurement itself is incredibly hard! The central goal of this project is to improve upon current techniques.

Gas with no entanglement

Entanglement generation

particle collisions create entanglement

This collision process can happen in both directions

Propogate system and ask **HOW DOES ENTANGLEMENT EVOLVE?**

Many particle collisions

Does entanglement continually grow?

OR

Does entanglement disappear?

OR something else?

Our atoms have three different "modes": (Prob): (+1) (o) (−1)

+1   o   −1

→ time