Quantum computing represents a new paradigm that utilizes the fundamental principles of quantum mechanics to perform calculations.

* **Qubit** – basic unit of information in quantum computing;
* **Entanglement** – the ability of quantum particles to correlate their measurements results with each other;
* **Superposition** – the ability of a quantum system to be in multiple states at the same time (until it is measured).

Experiment: Schrodinger’s cat

Let’s say we have a steel box. We put there a cat and we close the box. Next we fill the box with a radioactive gas that has 50% probability to kill the cat in the upcoming hour. We will wait for one hour and then we will open the box.  
**The main question is: at the end of the experiment, will the cat be alive or dead?**

As long as the cat stays in the box, we can say that it is in a **superposition** of states.

If we open the box and try to observe the cat’s state (we **measure** it), then the state of superposition will collapse. Therefore, we will have only one of the states (it is alive or it is dead).

Principles of quantum mechanics:

1. A quantum system can have multiple states at the same time (superposition)
2. A quantum state is continuously evolving
3. If we measure a quantum superposition state, it can change and become a classical state
4. Neither the position nor the impulse can be known precisely (Heisenberg’s uncertainty principle)

While classic computers operate only with bits that have values of 0 and 1’s, quantum computers use qubits. Besides the natural 0 and 1 states, they can be in a superposition of states of 0 and 1. A classic computer processor with n bits can only perform one calculation, a processor of n-qubits can perform up to 2^n calculations.

QC applications:

1. Cryptography – new cryptographic methods can be created that will be a lot safer than from classical computers
2. Big Data – faster search in big sets of data
3. Machine Learning – the increase in the processing power would allow deep learning and machine learning systems to become faster
4. Medicine – Due to the fact that quantum computers rely on quantum mechanics they can successfully simulate the behaviour of small particles. This could lead to the discovery of new materials