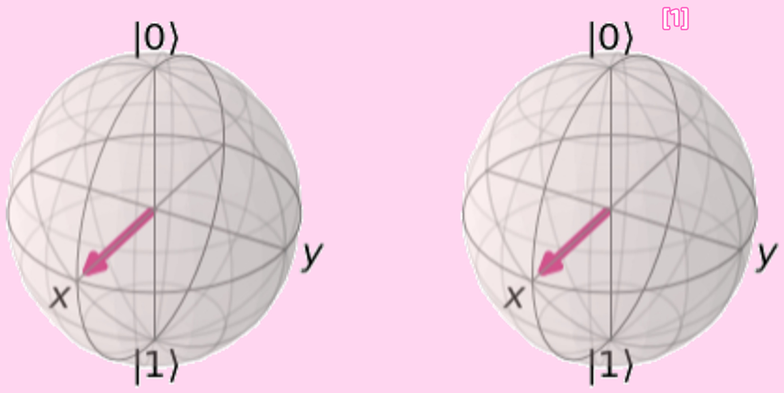
Roselyn Nmaju
Supervisors: Sarah Croke, Fiona Speirits
Thesis: Quantum Algorithms for Gravitational -wave Data Analysis

[1] Qiskit: Deep Learning University
[2] IMB Quantum: Grovers Algorithm
[3] lscsoft.docs.ligo.org
[4] nasa.gov

James McCune Smith Scholarships

QUANTUM COMPUTING



[1]

QUANTUM COMPUTERS:

Quantum computers can provide a speed-up over classical computers

Quantum Computing is a relatively new area in physics that explores using properties of quantum physics to improve on classical computers. By using the principles of quantum mechanics, a quantum computer may be able to solve a problem exponentially faster than a classical computer.

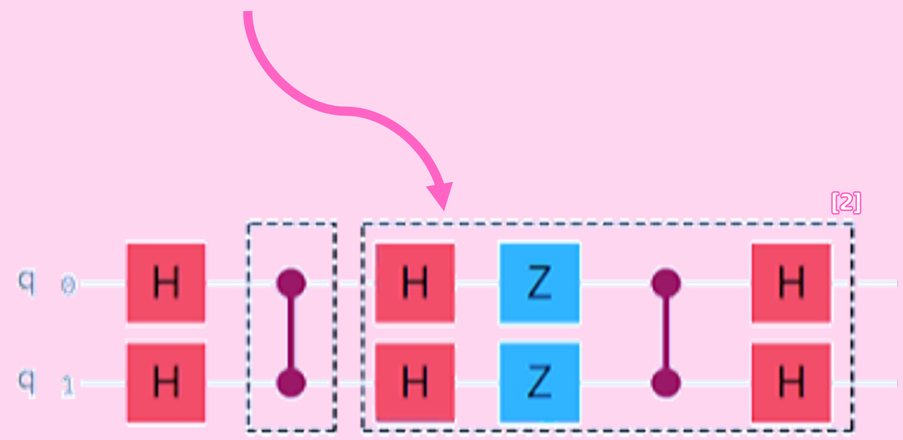
Plenty of computable problems take exponential time or resources to solve, so even with the most powerful and largest classical computers, it can still be extremely taxing.

Therefore, quantum computing is suited to computationally intensive problems that classically require a lot of time or resources.

ALGORITHMS:

Quantum mechanics-based algorithm are needed

Quantum algorithms are designed to utilize quantum mechanics to provide the desired output with an exponential speed-up. A quantum input does not make classical algorithms faster; it is clever uses of quantum mechanical proprieties that provide speed up to these algorithms.



[2]

DATA LOADING:

I am working on loading data into a quantum computer

Data must be loaded into a quantum computer before use, so the challenge is how. It would be a waste to encode data the same as it is classically. My current project is looking at the start of the process in quantum computing and how to efficiently load an arbitrary input when the possibilities for such are almost endless.

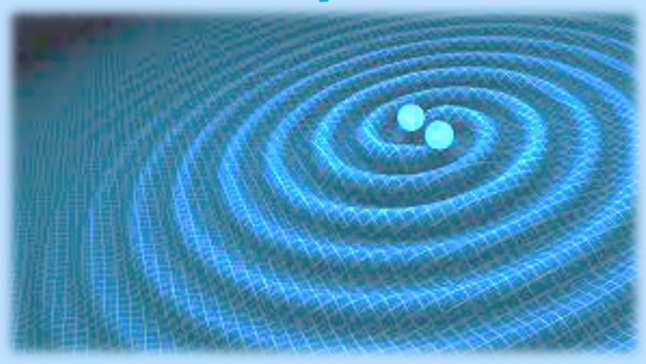
WHAT'S QUANTUM GOT TO DO WITH IT?

GRAVITATIONAL WAVES

ANALYSING THE DATA:

Analysing large amounts of data is time and space intensive

The analysis of the signals that are detected from gravitational waves is very computationally intensive. The signal received can be tough to analyse due to how small it is and how much noise in the signal there is. To efficiently analyse large amounts of detected data would take up large amounts of time and computational resources.


[4]

DETECTIONS:

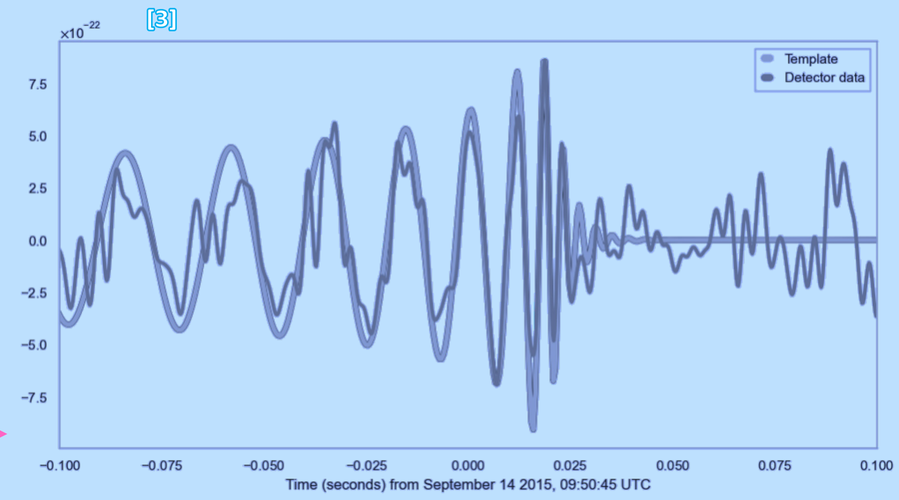
Detectors need to be sensitive

There are large, very sensitive detectors worldwide to detect gravitational events that take place in the universe. The effects of these violent collisions may be measured with the detectors. Despite the size of the objects involved in creating these waves, when these waves propagate through space to Earth, they are only detected as small ripples.

GRAVITATIONAL WAVES:

Massive objects colliding cause ripples in space

Gravitational waves are a relatively new area of physics. Gravitational waves provide a new way to observe and study the universe. They were first directly detected in 2015 when LIGO observed the merger of two black holes. Since then, whole groups have been dedicated to detecting these events.



[3]

COMPUTING

QUANTUM

GRAVITATIONAL WAVES