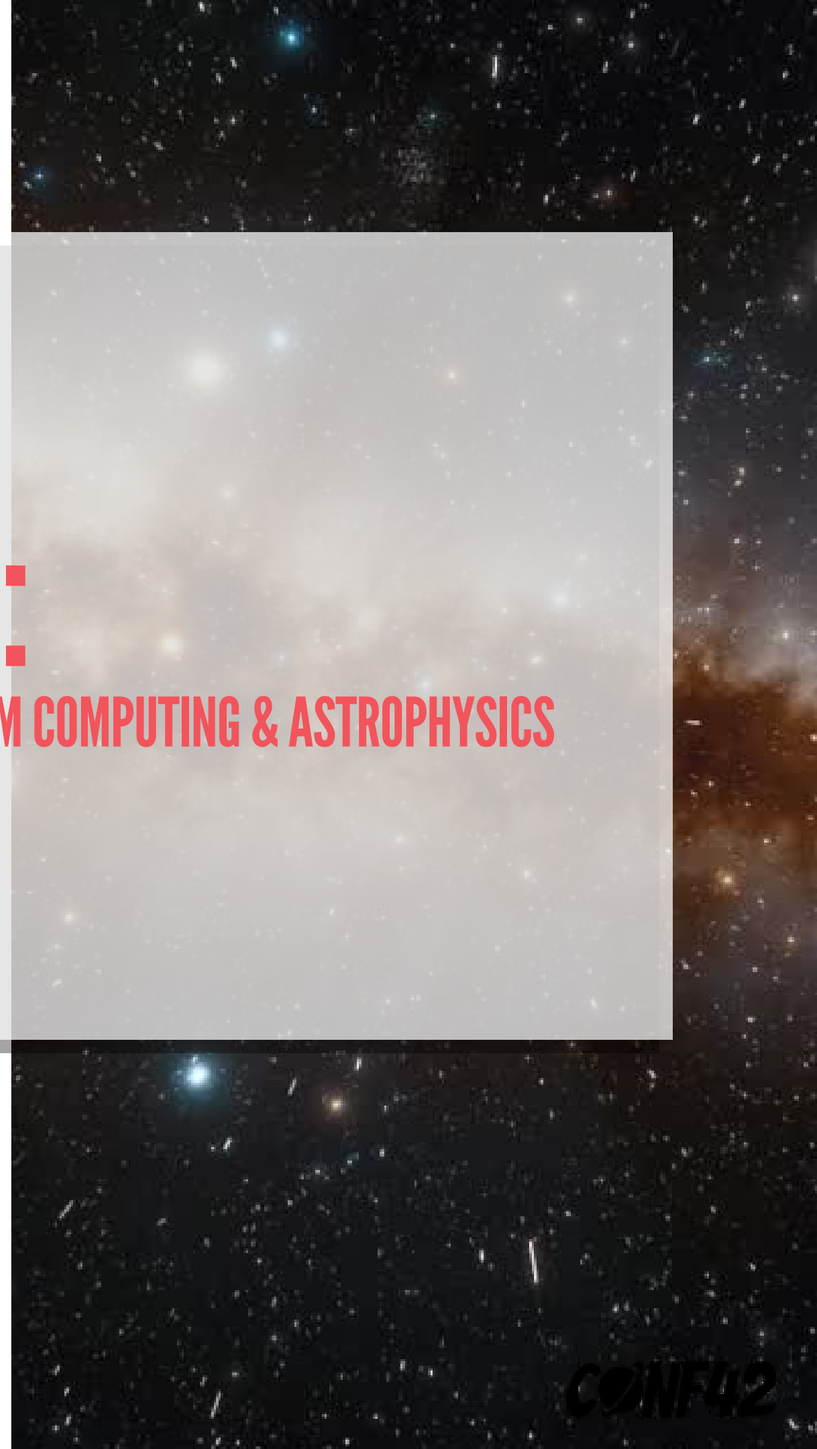
IN IGNOTIS :

AN INTRODUCTION TO QUANTUM COMPUTING & ASTROPHYSICS

Presented By

Archit Srivastava



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ABOUT

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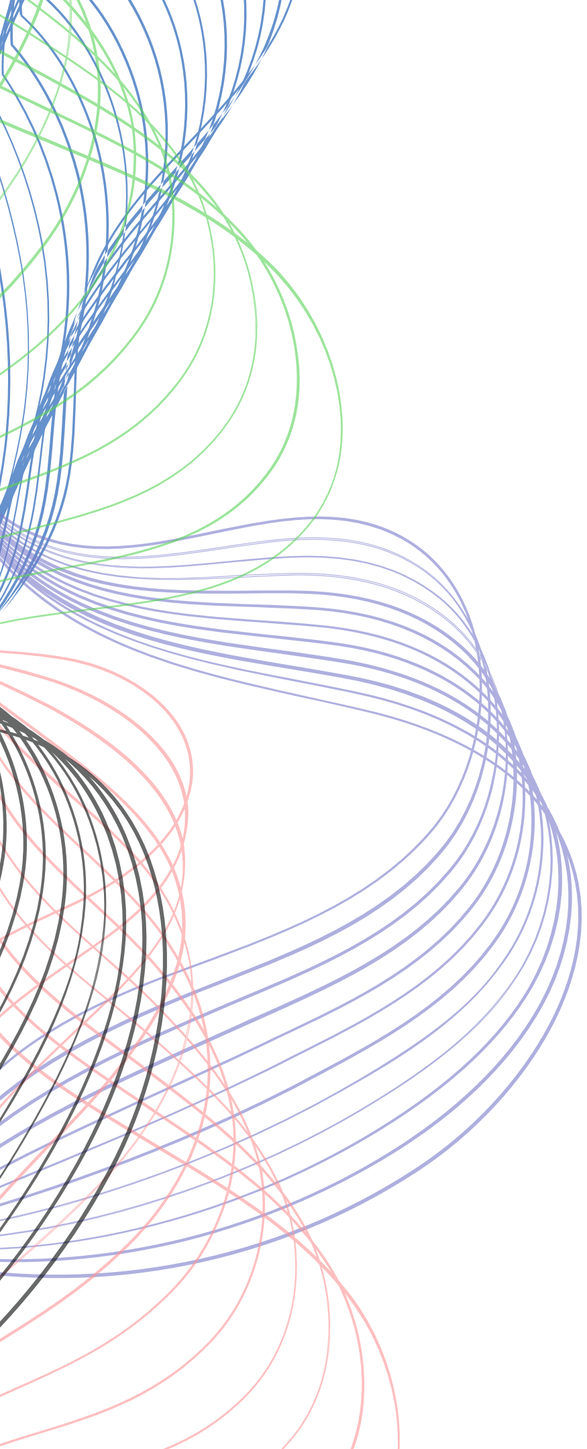
- Founded AiQyaM, a Quantum Hardware Community .
- Founder of CIRQuIT Quantum Research at RVCE & Quantum Hardware Learning Circle in QCI.
- Quantum Computing Intern at BosonQ Psi Pvt. Ltd.
- Full Stack Data Engineer at Hewlett Packard Enterprise, Bengaluru, Karnataka, India.
- Looking for ways to integrate Quantum Computing in the field of Gravitational Wave Astronomy.

AiQyaM

Hewlett Packard Enterprise



MOTIVATION

- There's a lack of knowledge about Quantum Eco-System and the need for growth in the domain.

- Increase in the need to spread awareness about various topics related to Quantum Computing and Astrophysics.

- The need to find people of same mindset to work towards the field of Quantum Gravity.

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CONTENT

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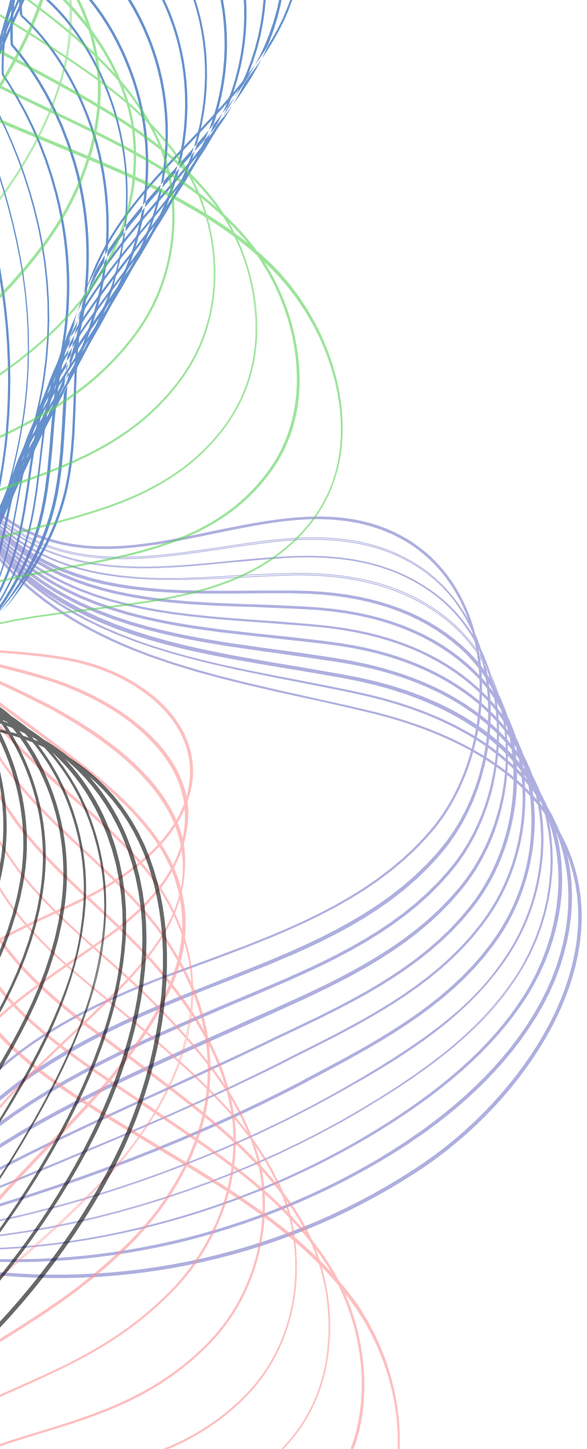

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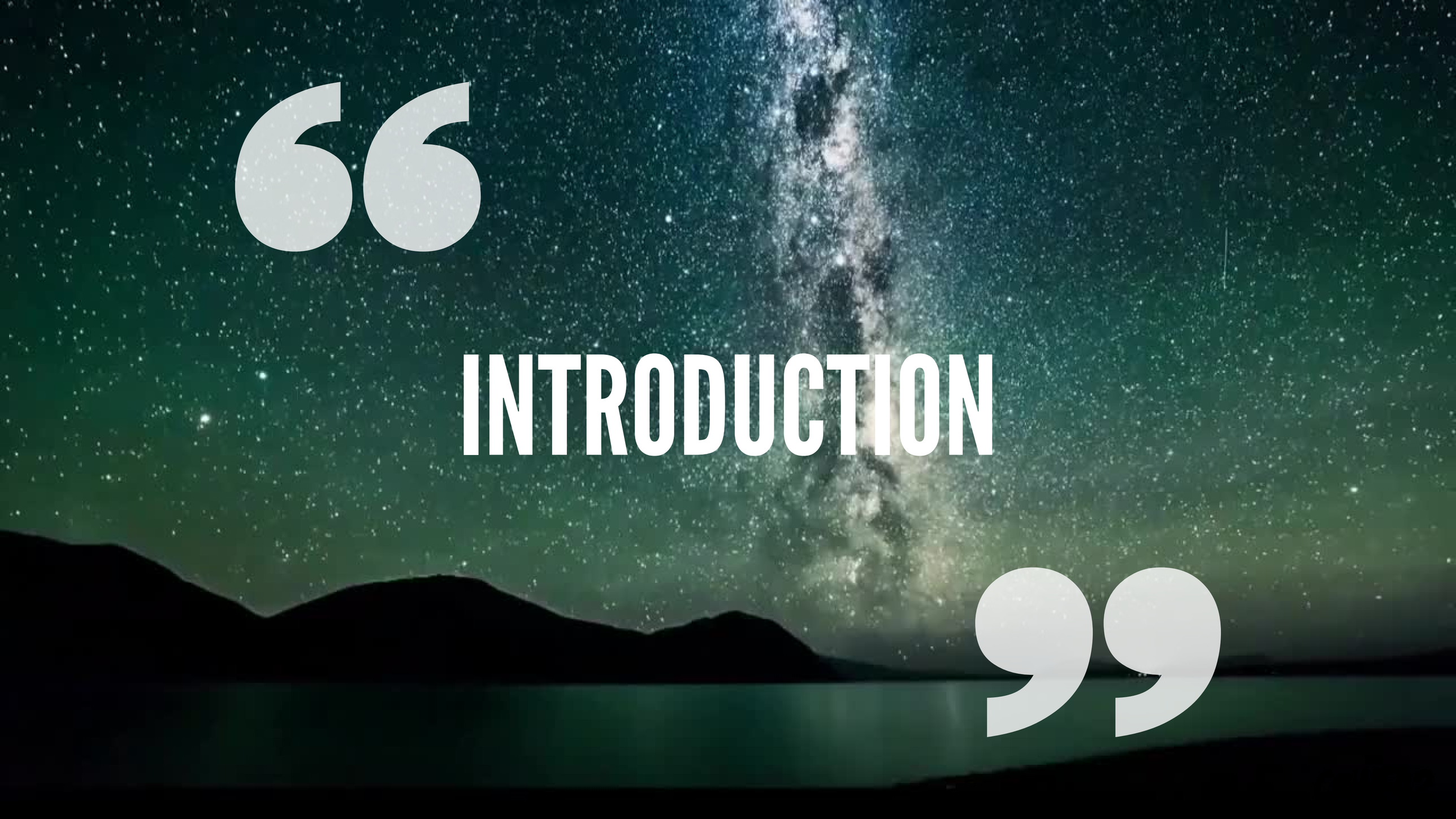
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INTRODUCTION
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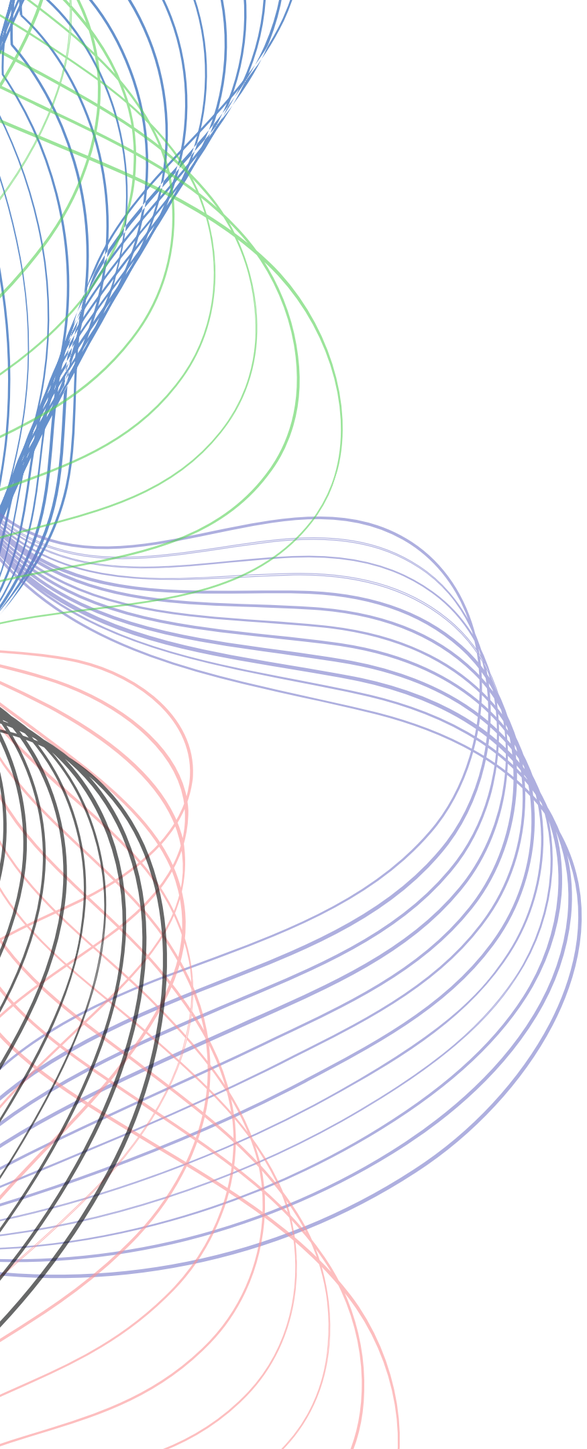
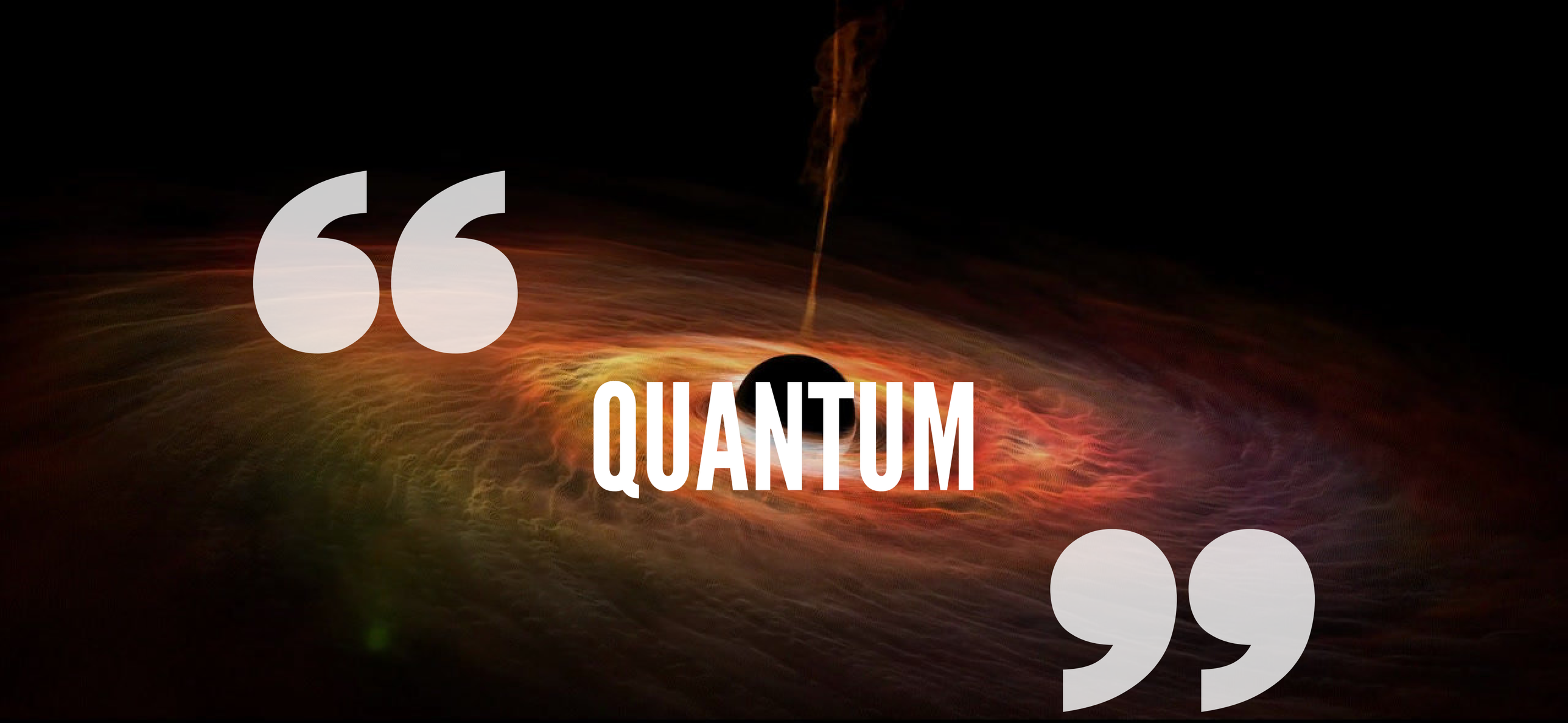


- Quantum Computing and Astrophysics
- LIGO and Gravitational Wave Detectors
- Quantum Computers for the rescue
- Different Architectures of Quantum Computers
- Quantum Gravity?
- Needed to investigate the realm of the unknown
- A niche area of research with infinite possibilities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QUANTUM
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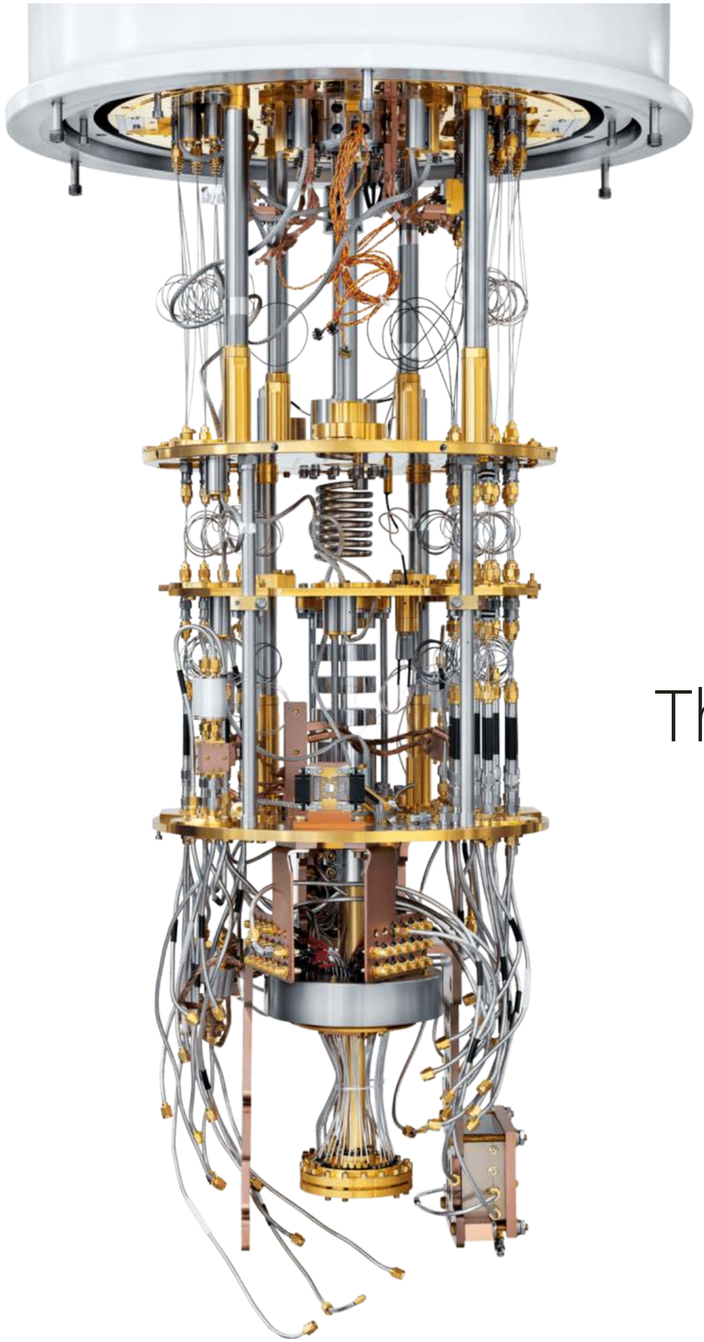
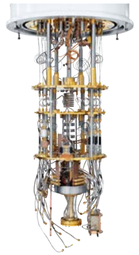


This is a Quantum Computer :-)

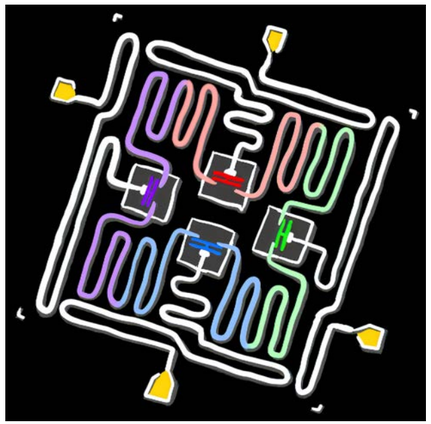
(Well not Actually)

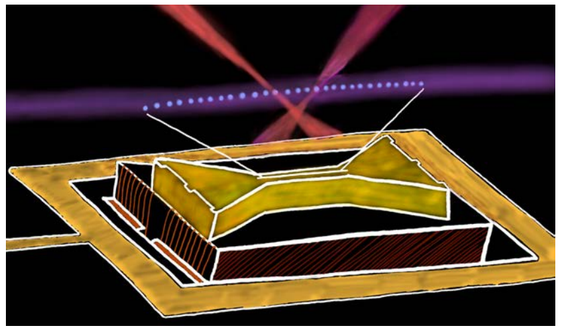


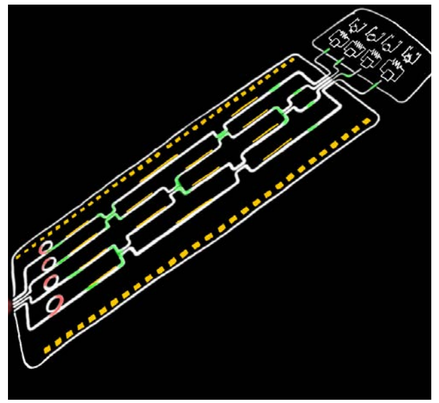
Superconducting

Trapped-Ions

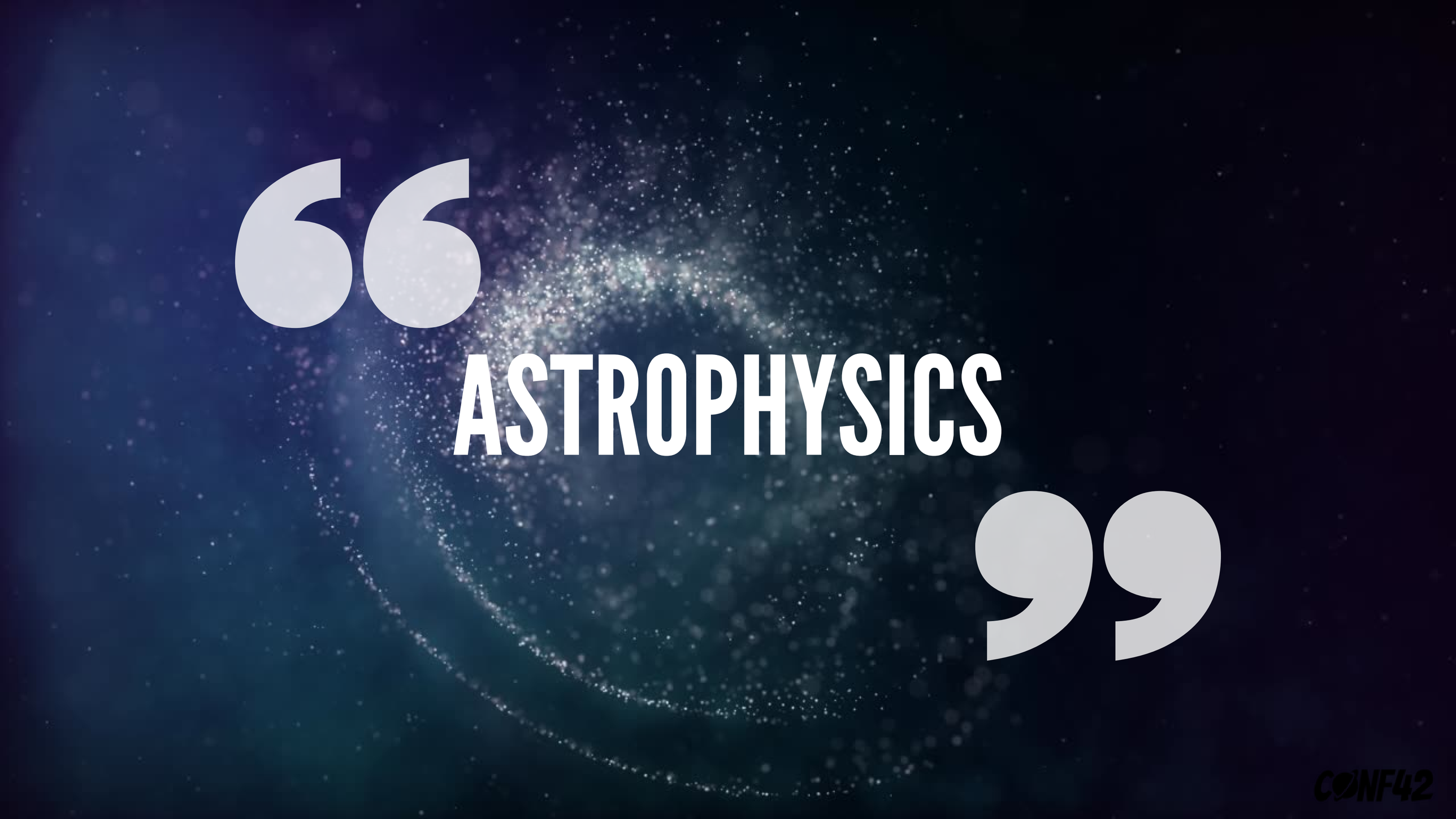
Photonics







and more...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ASTROPHYSICS
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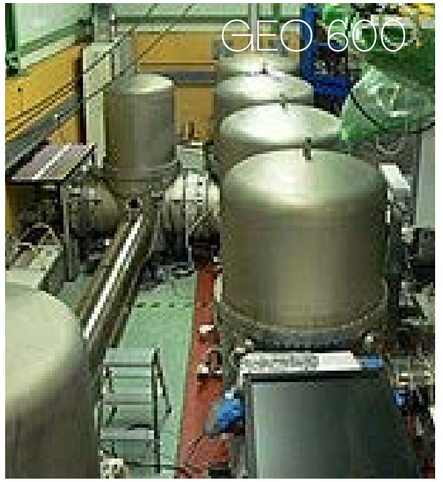

LIGO

Detectors

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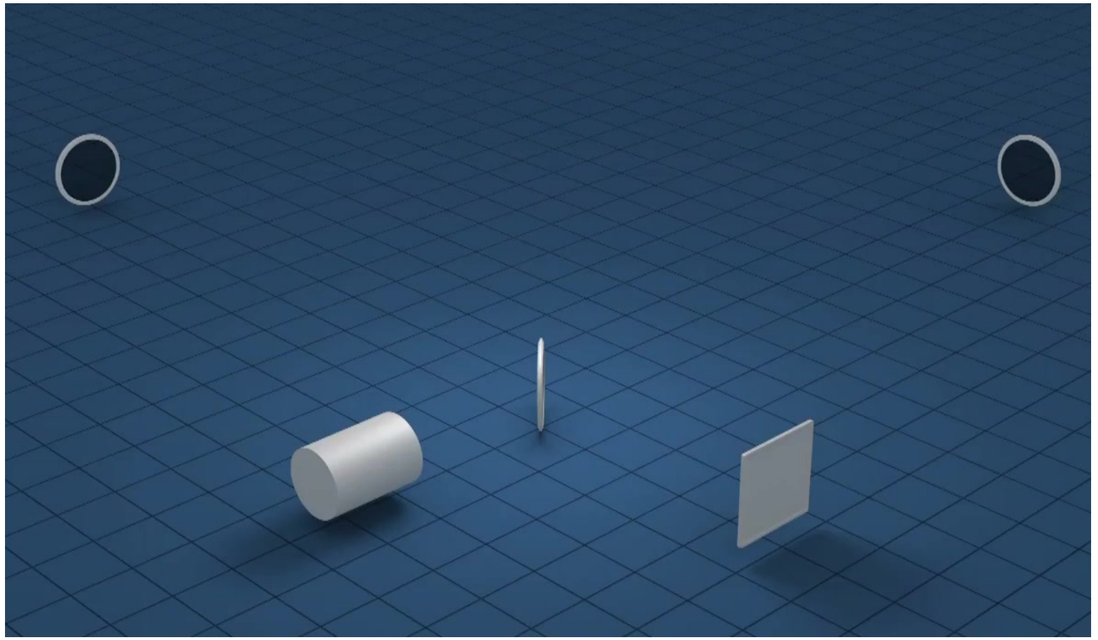
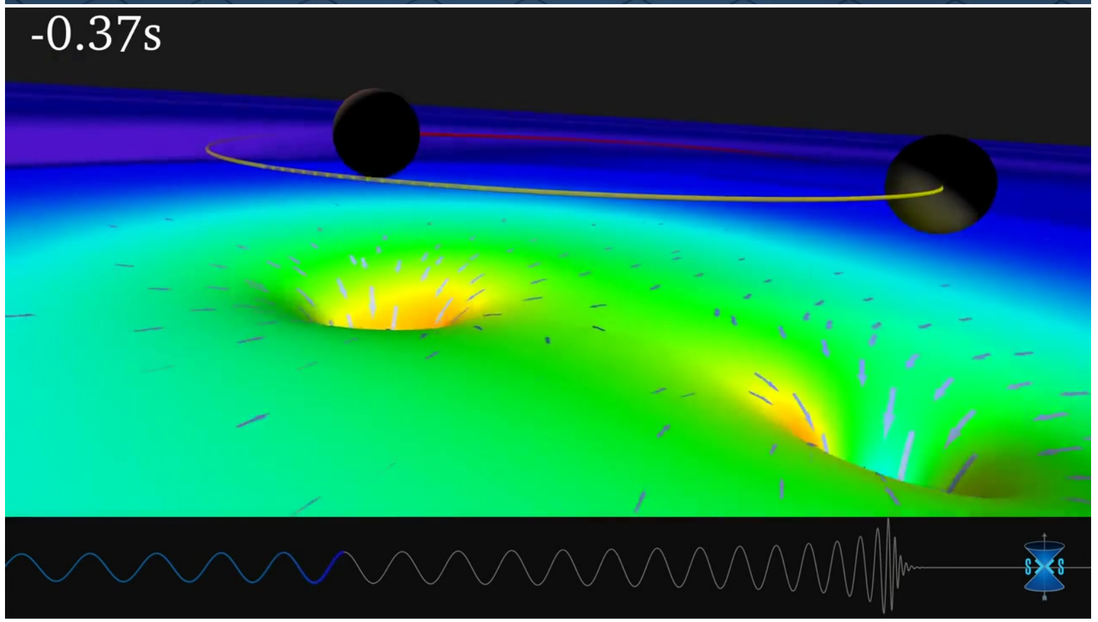
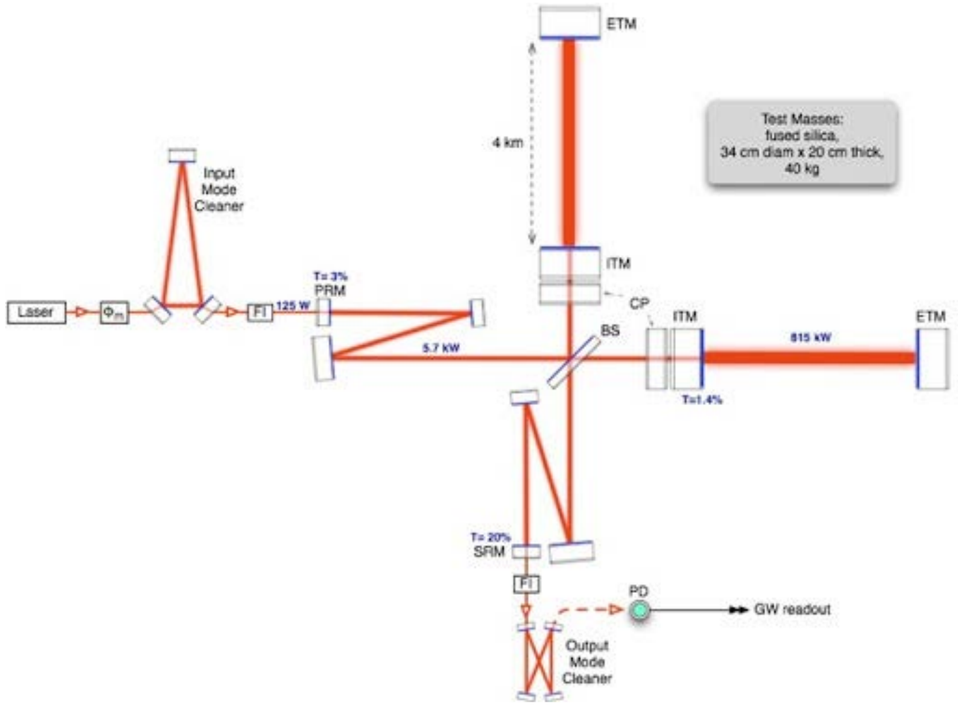


How the detectors behave when a Gravitational Wave crosses the arms

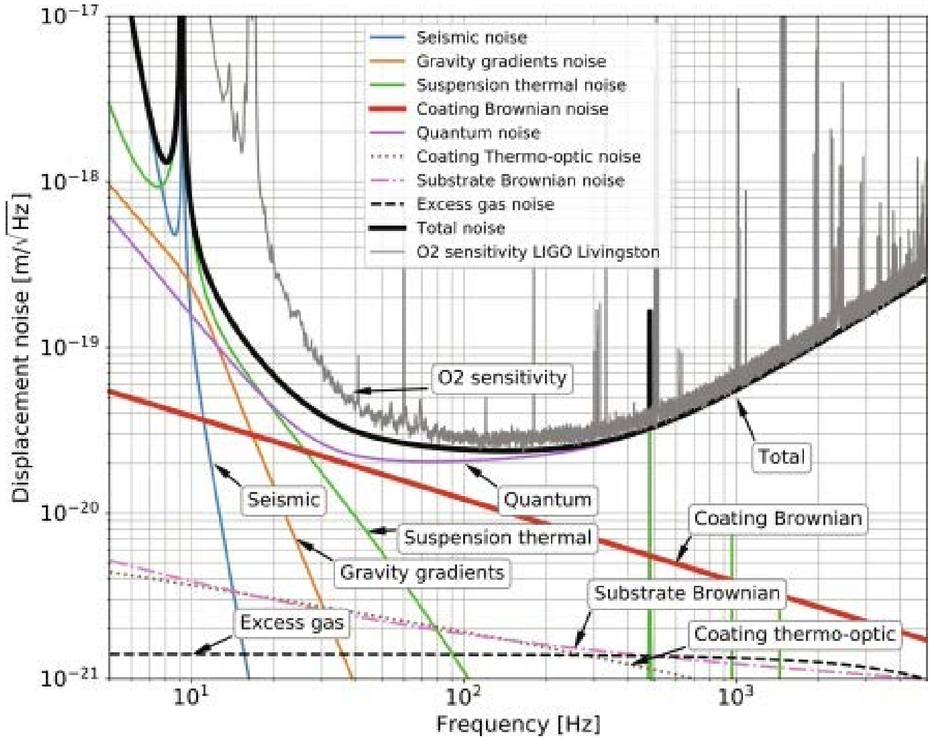
LIGO



Warped Space-Time fabric during a Binary Black Hole merger



Advanced LIGO



Noise in LIGO

Quantum Shot Noise has one of the major contributions to noise...

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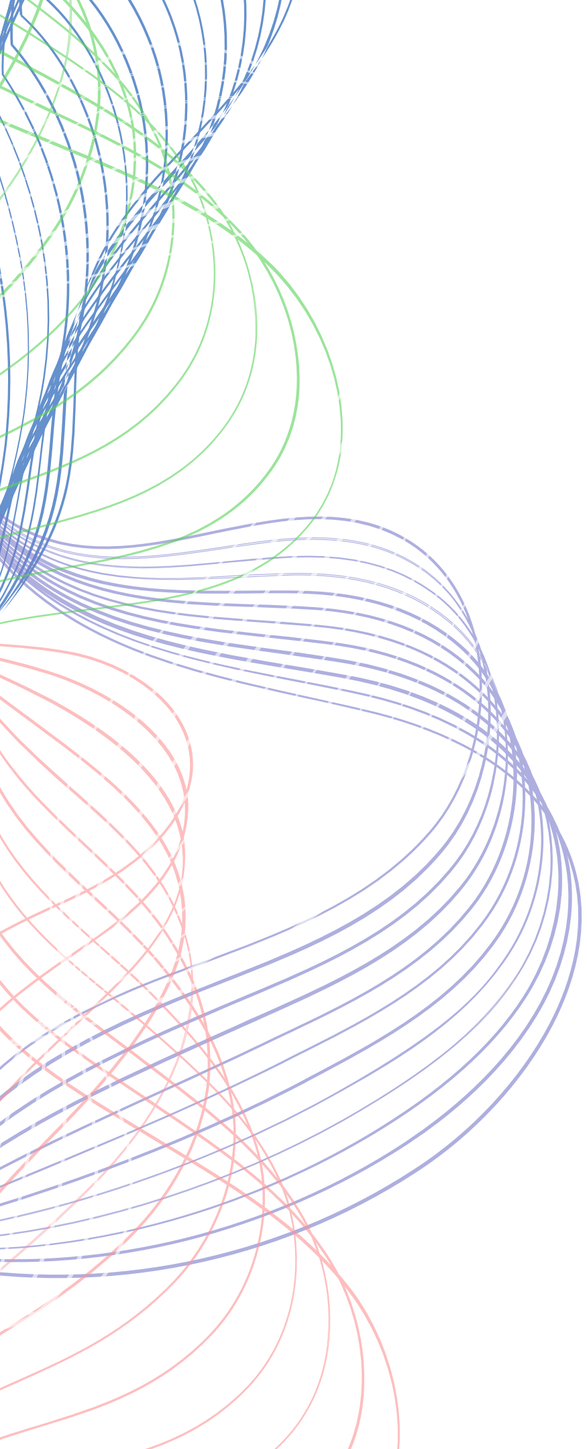
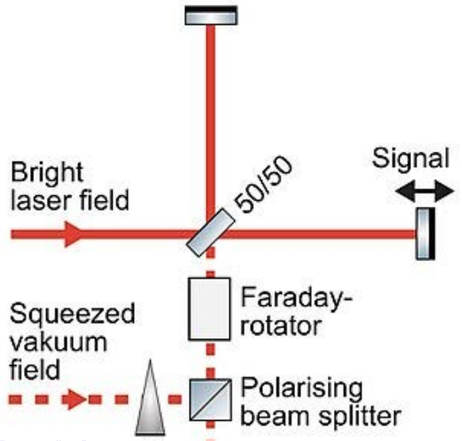


- These noises are significant when the GW detections are being made.
- Occur due to quantum vacuum fluctuations.
- Squeezed states of light are used to reduce the shot noise.
- Increasing the SNR helps in detecting faint gravitational wave signatures.

“METHODS”



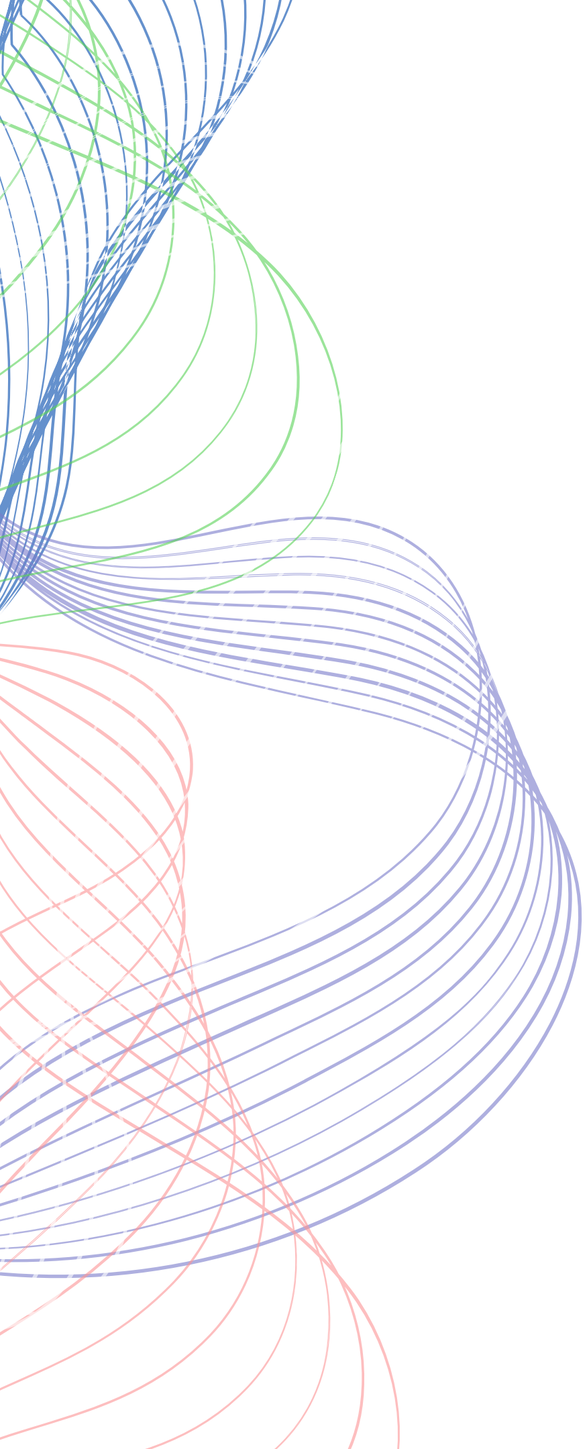
Quantum Signal
Pre-Processing

Measurement
(Photo-Detector)

Quantum Signal
Post-Processing

Quantum Signal Pre-Processing

- Potential quantum information of hidden in gravitational waves.
- This method tries to perform a pre-processing step on the signal before it is measured.
- Might provide a wider spectrum of data collection opportunities by using Hilbert spaces.
- Inspiration: GEO-600



Quantum Signal Post-Processing

- The present signal post-processing steps are classical.
- A quantum equivalent of the Signal processing step could be developed.
- This may increase the processing speed thus increasing the accuracy of signal isolation.
- The error can then be isolated more efficiently,

Quantum Signal Post-Processing

- The 16m experiment of A+ in Advanced LIGO and efforts by GEO-600 team forms the foundation of the idea.
- Modular experimental setup.

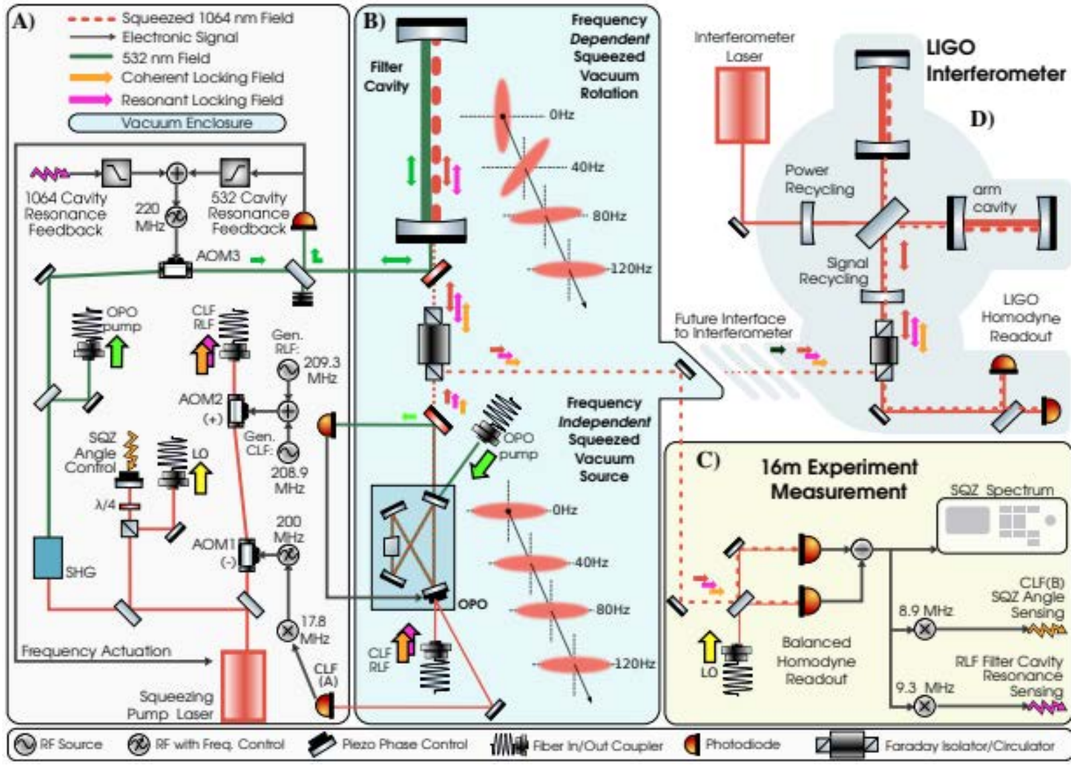


Image credits: Frequency-Dependent Squeezing for Advanced LIGO

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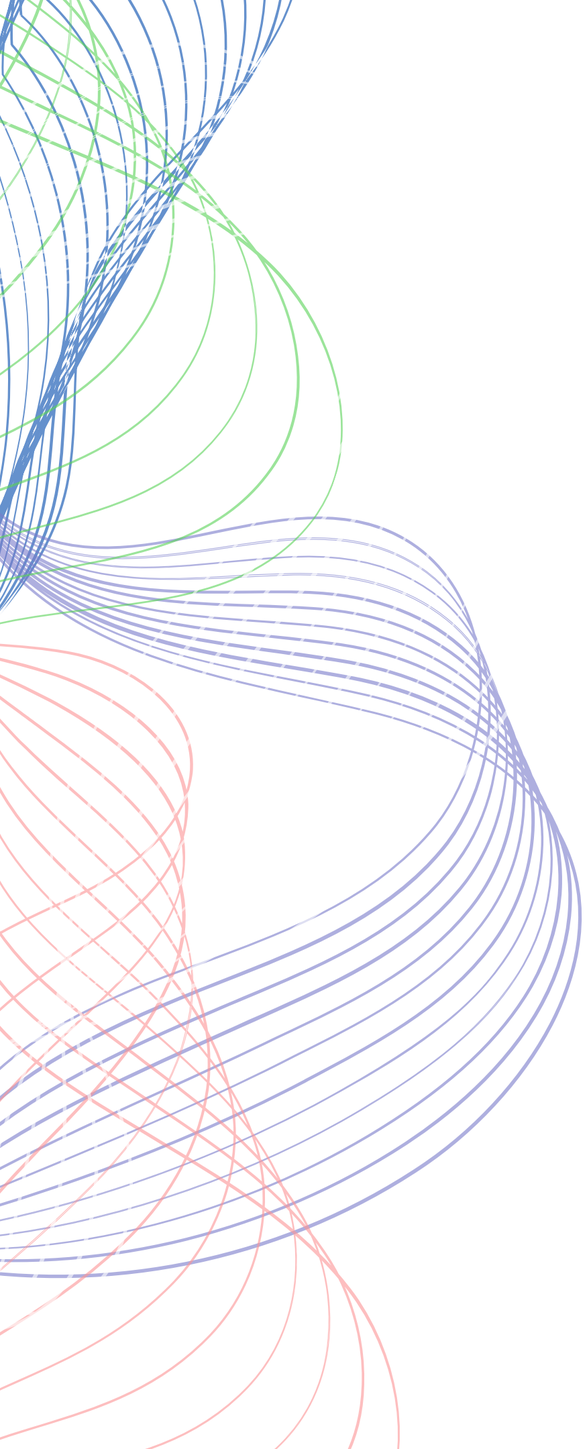
“CONCLUSION”



Quantum Signal Post-Processing

- These methods and researches can help us explore the unknown area of Quantum Gravity.
- Might have the potential to hypothesize a method to experimentally prove the existance of Gravitons.
- Exploration may help in the development in the field of Gravitational Wave Detection.
- Will help the ever growing community of Quantum Computing enthusiasts.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THANK YOU
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