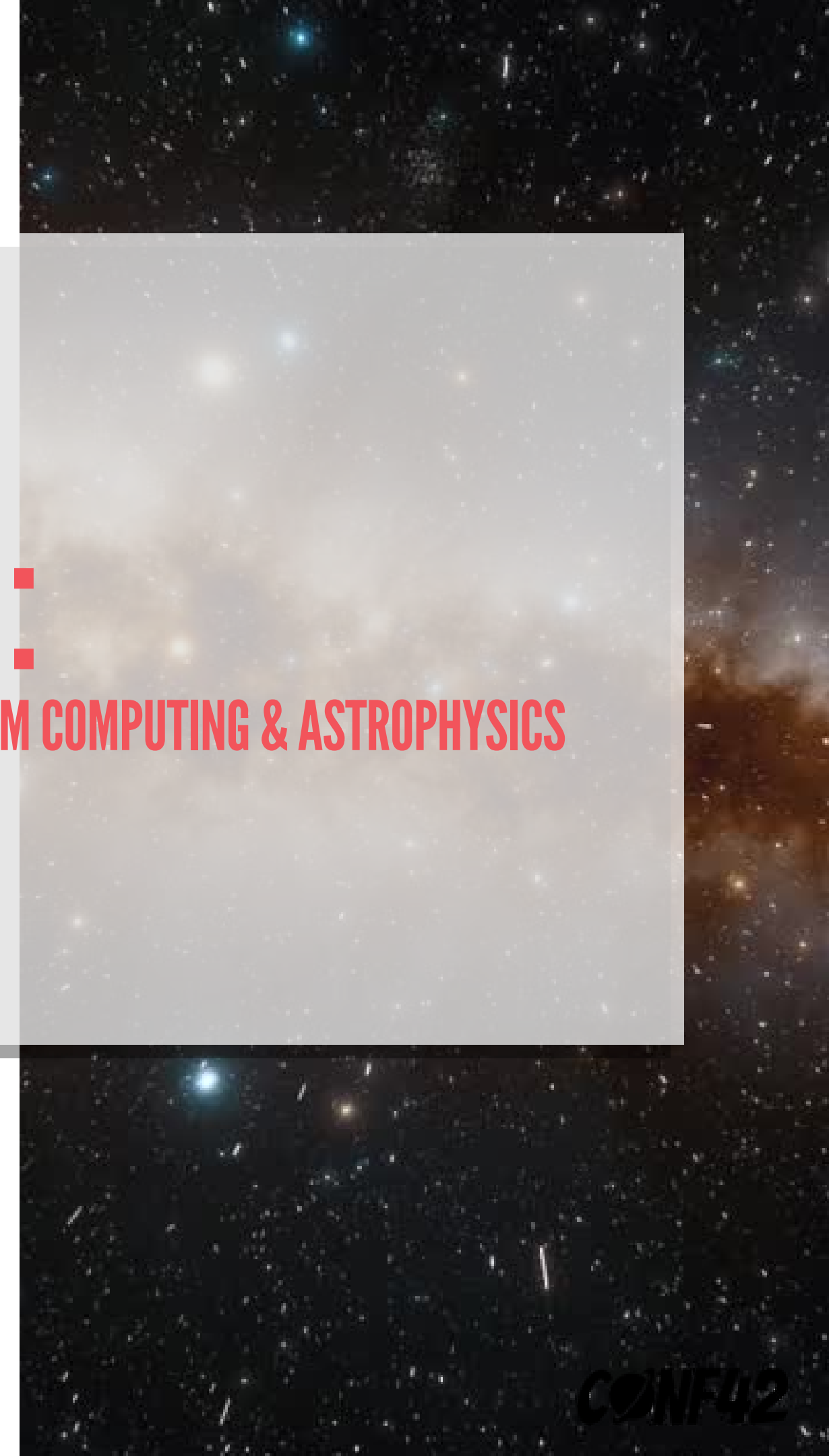


IN IGNOTIS :

AN INTRODUCTION TO QUANTUM COMPUTING & ASTROPHYSICS

Presented By

Archit Srivastava



“

ABOUT

”

- 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.



CONF42



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.

“

CONTENT

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CONTENT

INTRODUCTION

UNVEILING QUANTUM

WHY ASTROPHYSICS? WHAT
IS LIGO?

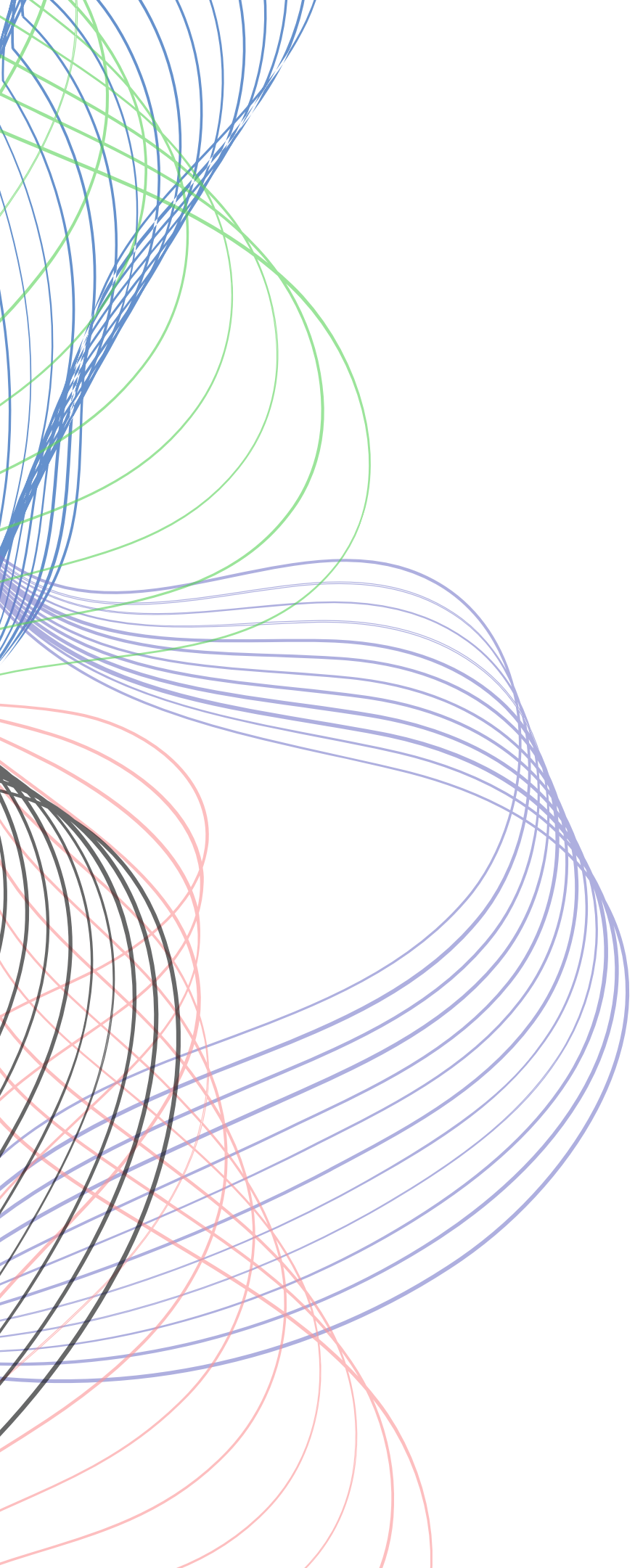
METHODS

CONCLUSIONS

“

INTRODUCTION

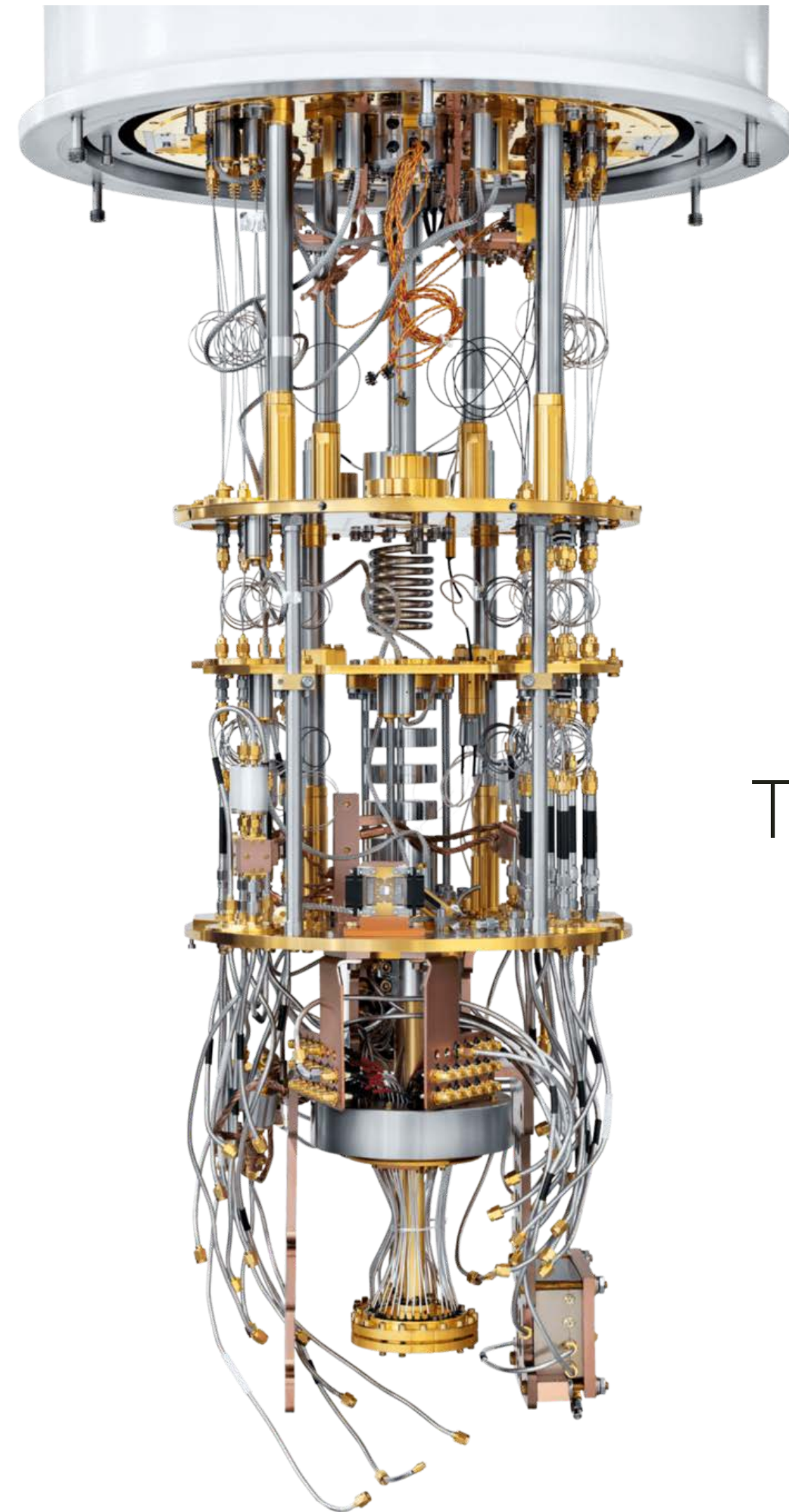
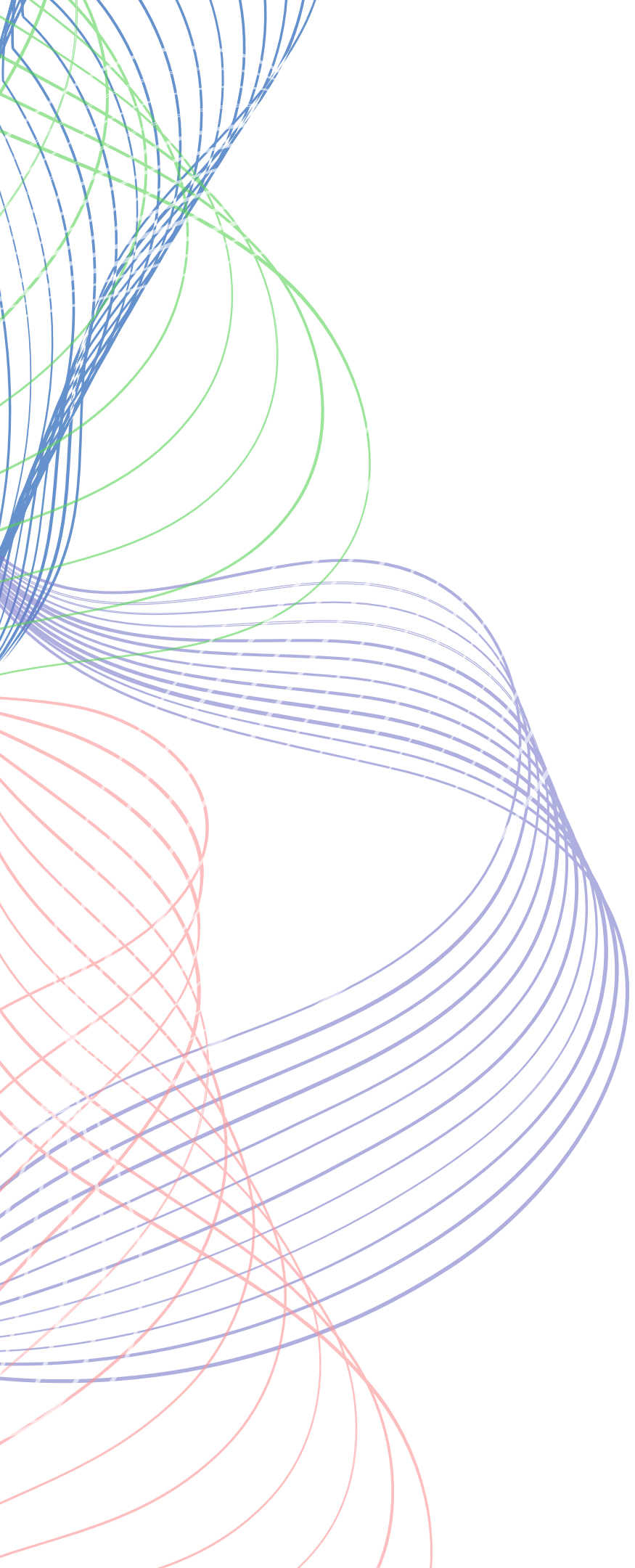
”

- 
- 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

“

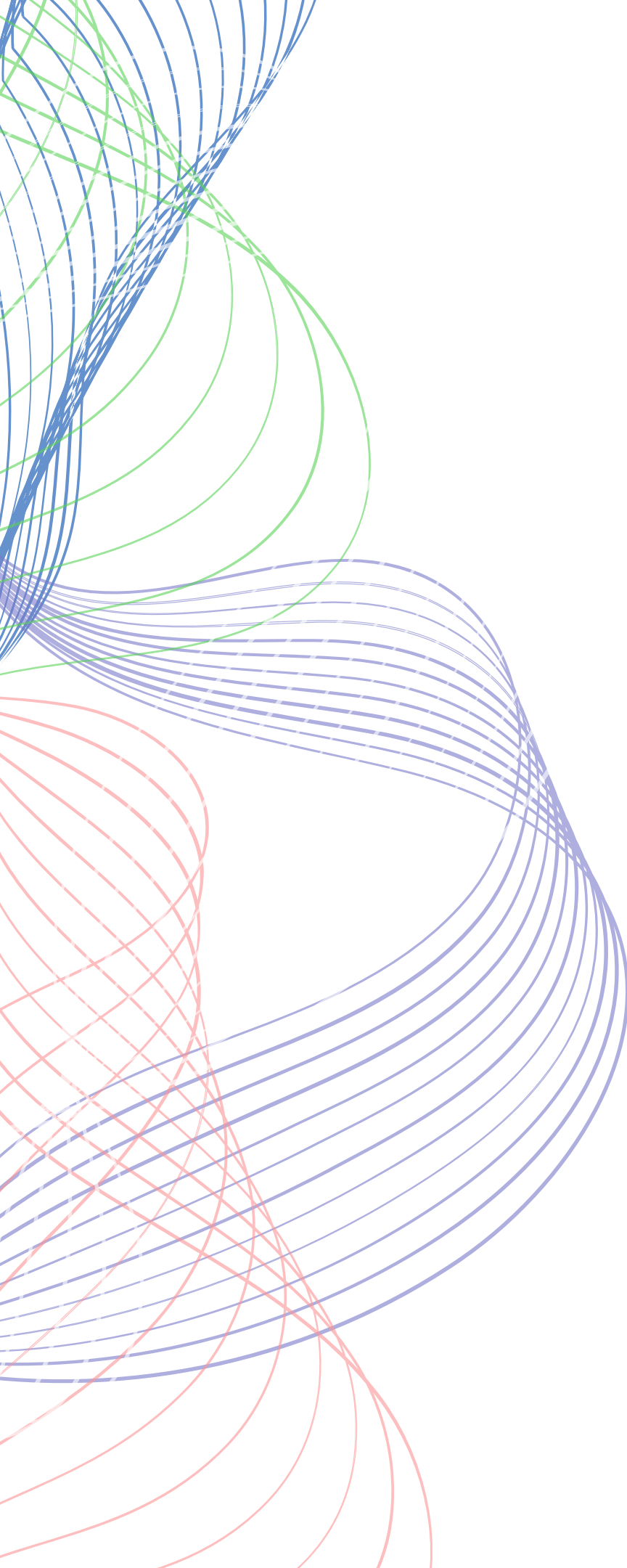
QUANTUM

”

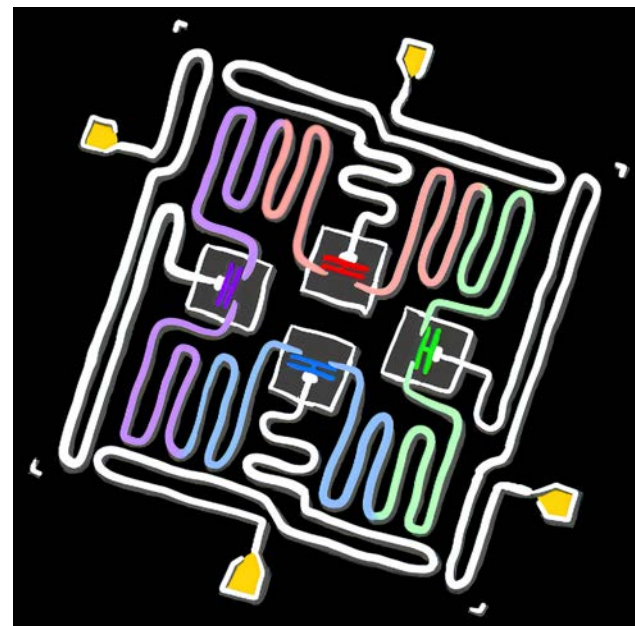


This is a Quantum Computer :-)

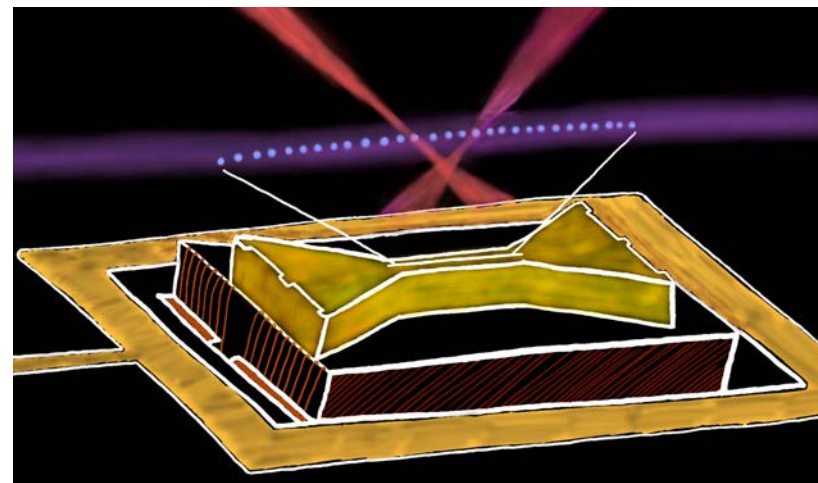
(Well not Actually)



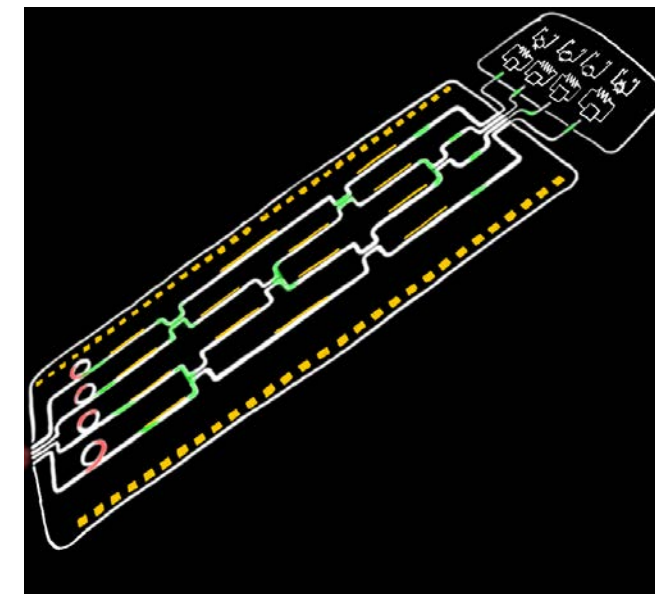
Superconducting



Trapped-Ions



Photonics

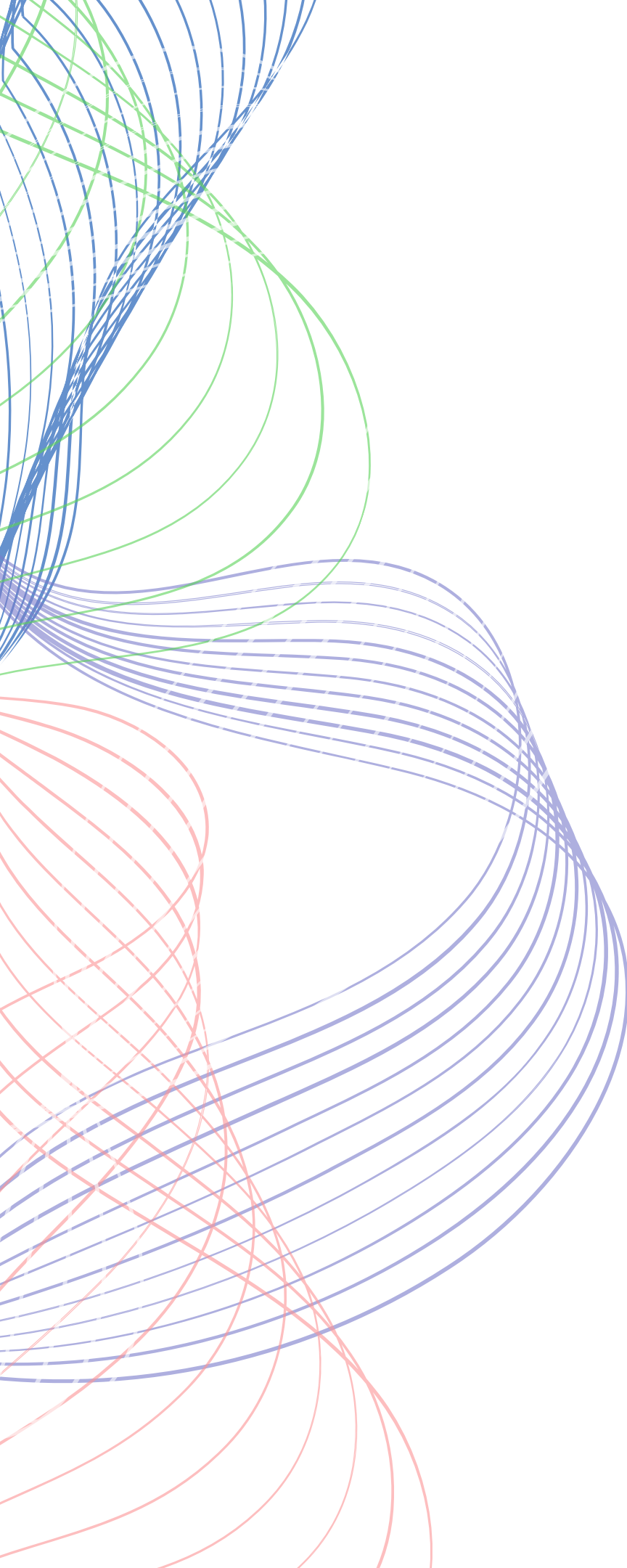


and more...

“

ASTROPHYSICS

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Livingston

Hanford



Kagra

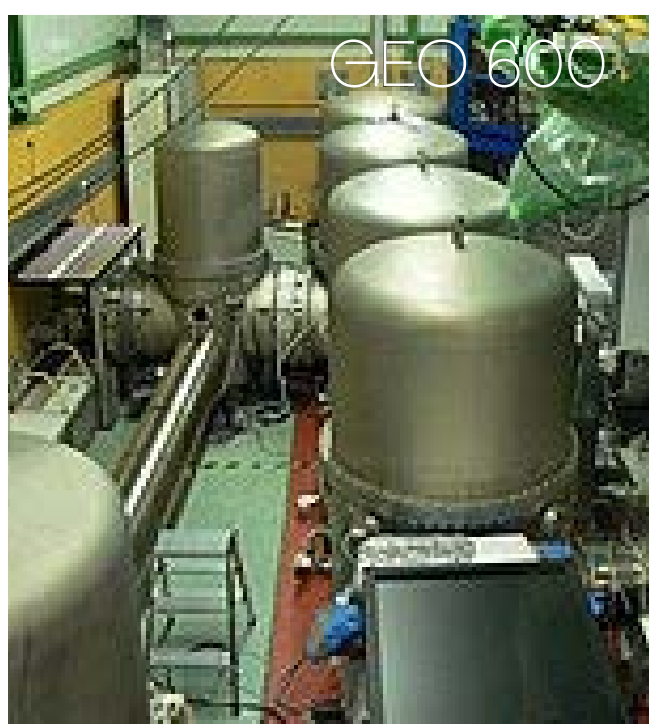


Indigo

CAD drawing of the proposed LIGO India observatory



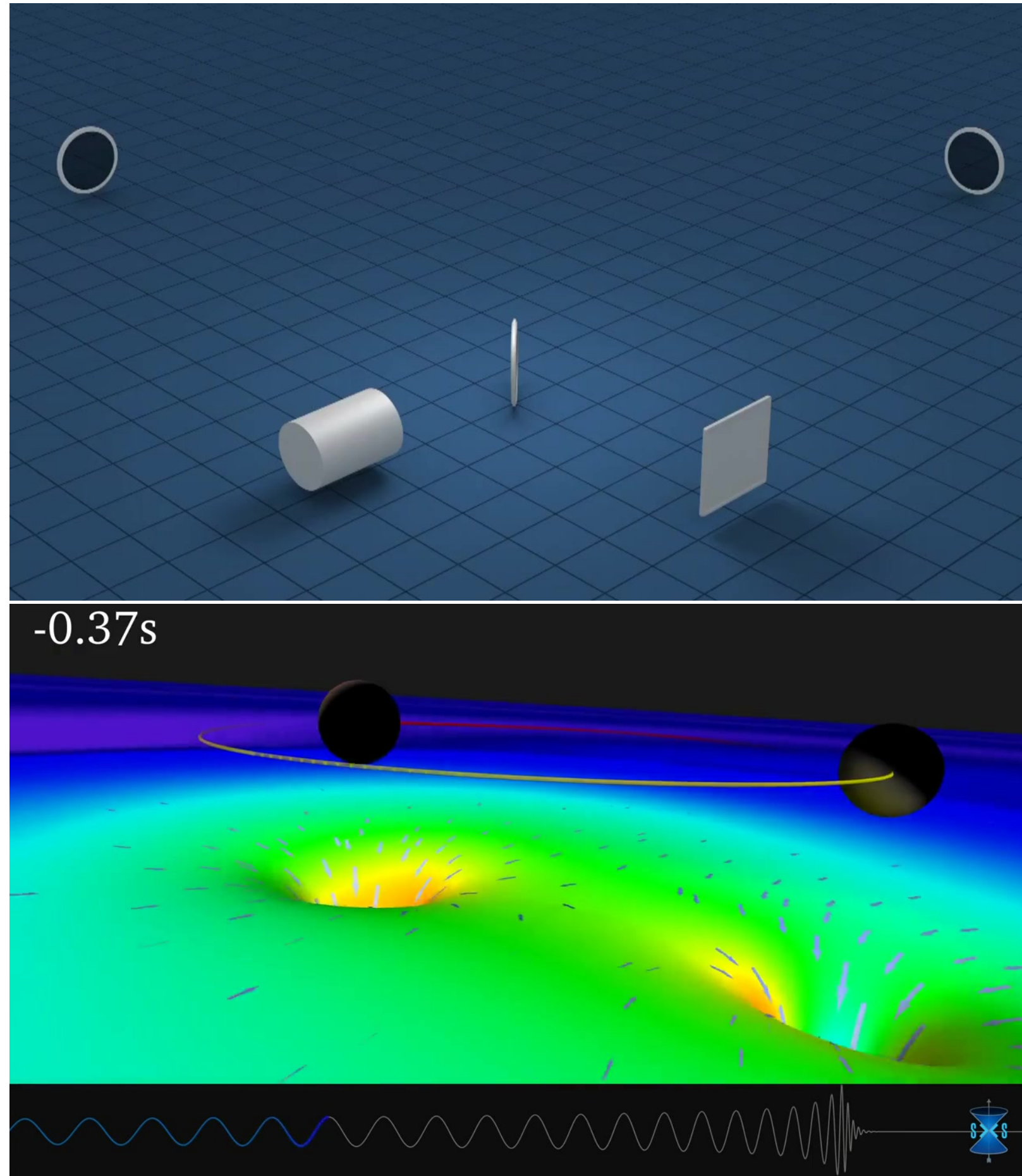
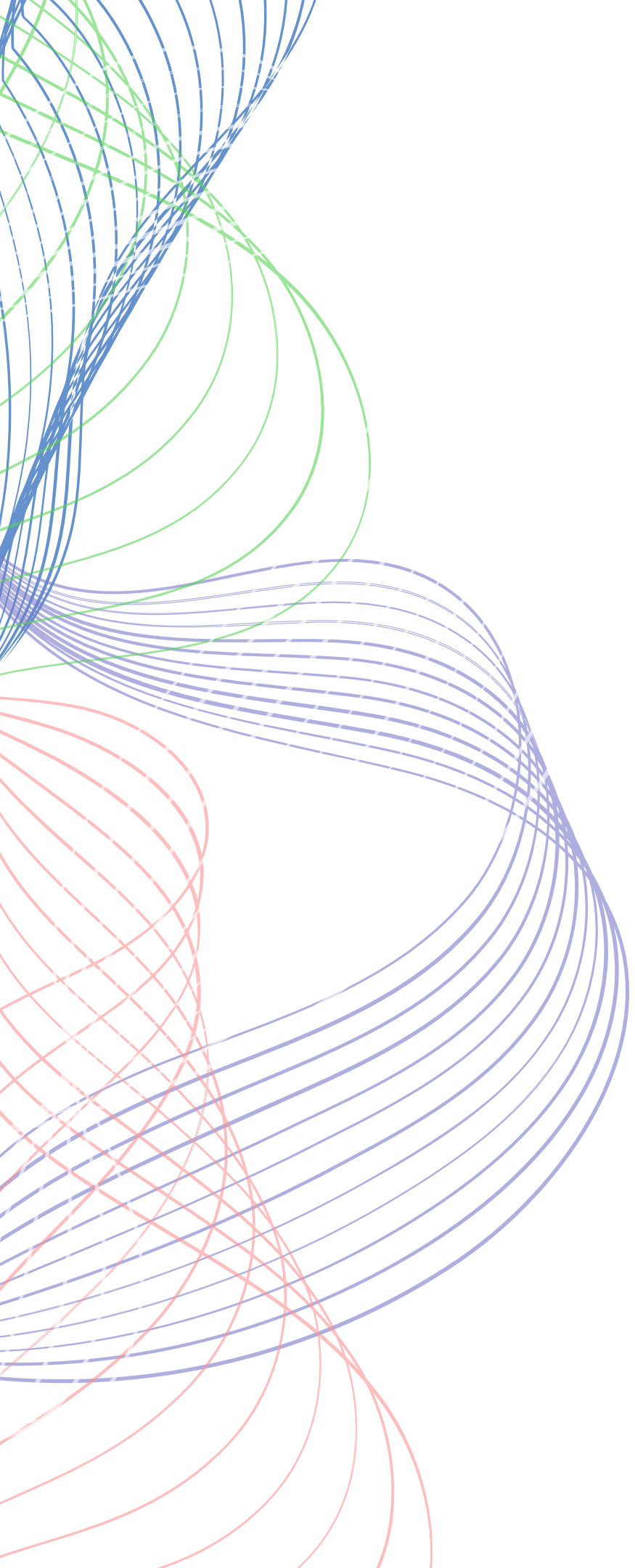
Virgo



GEO 600

LIGO

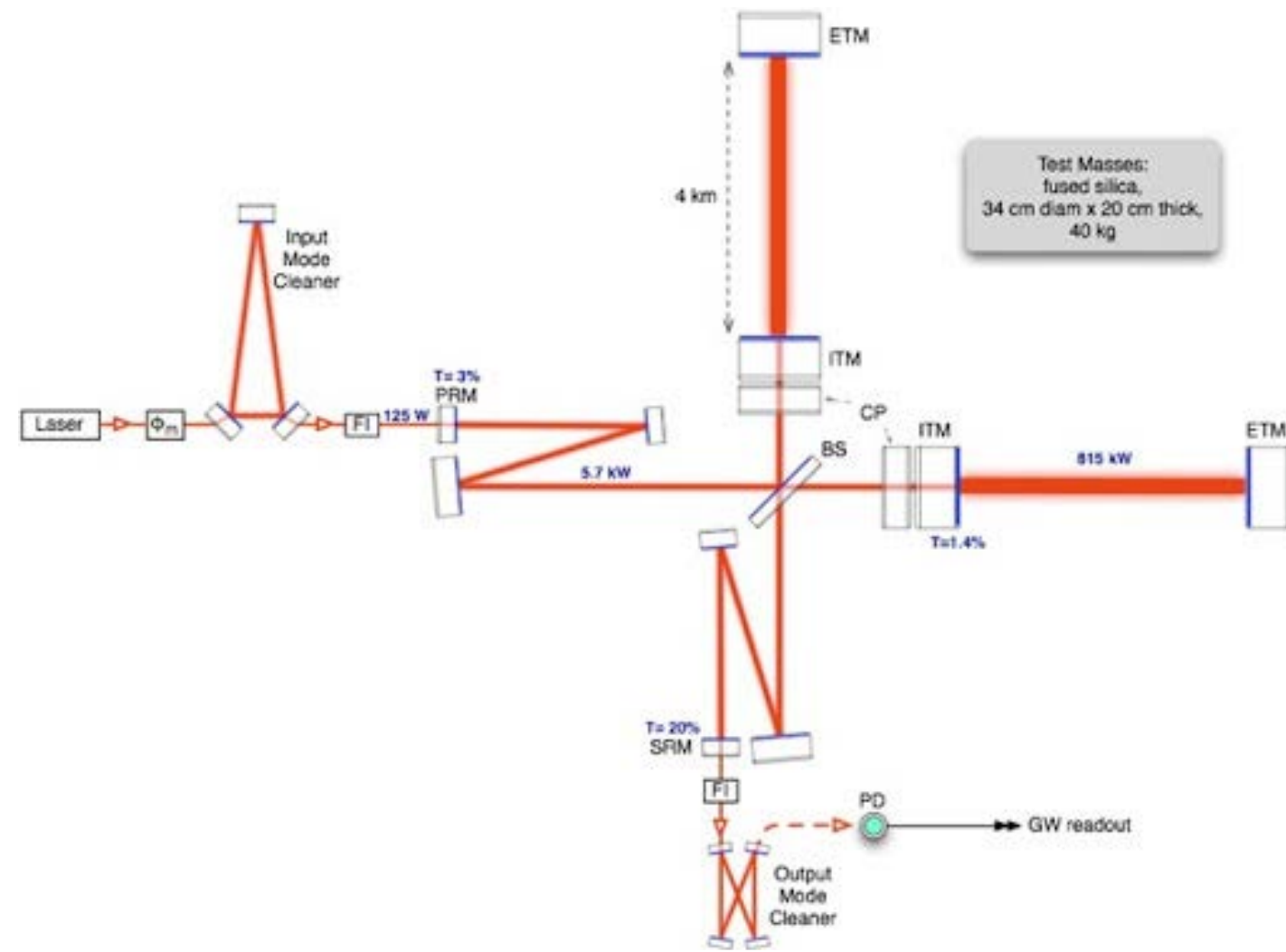
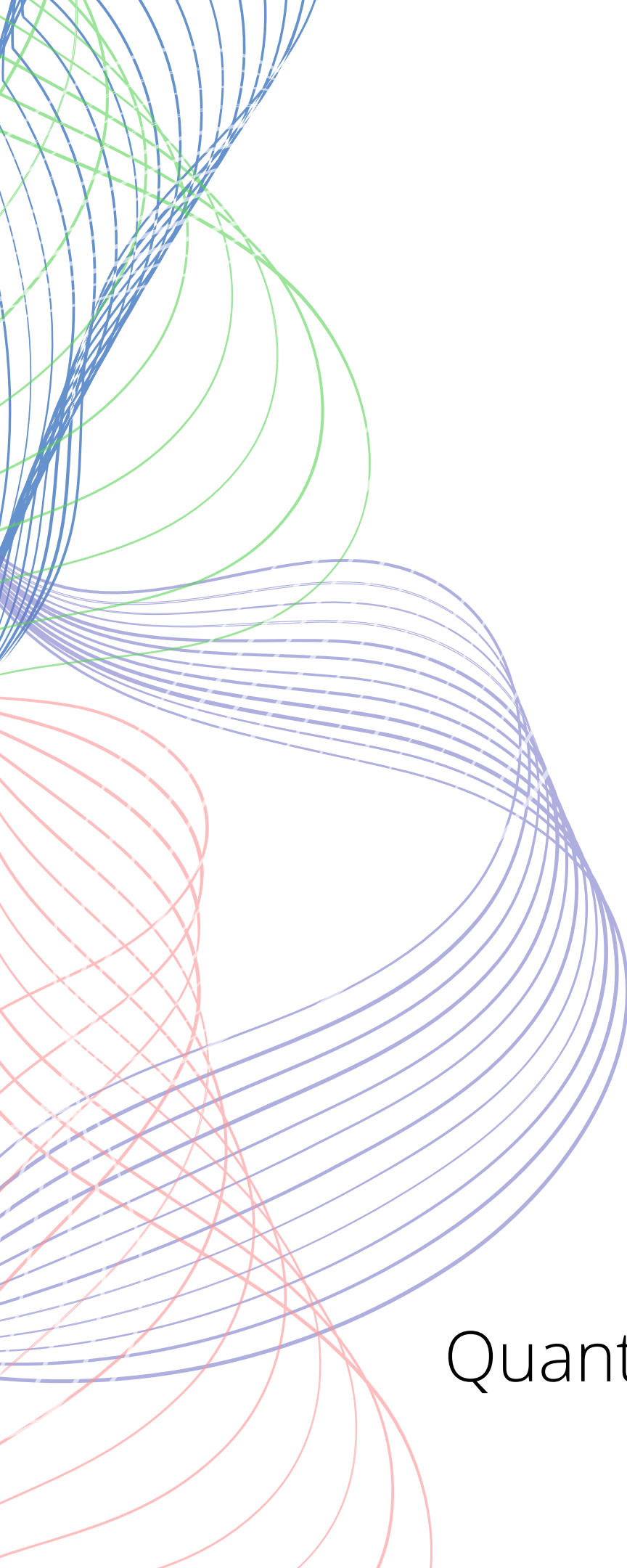
Detectors



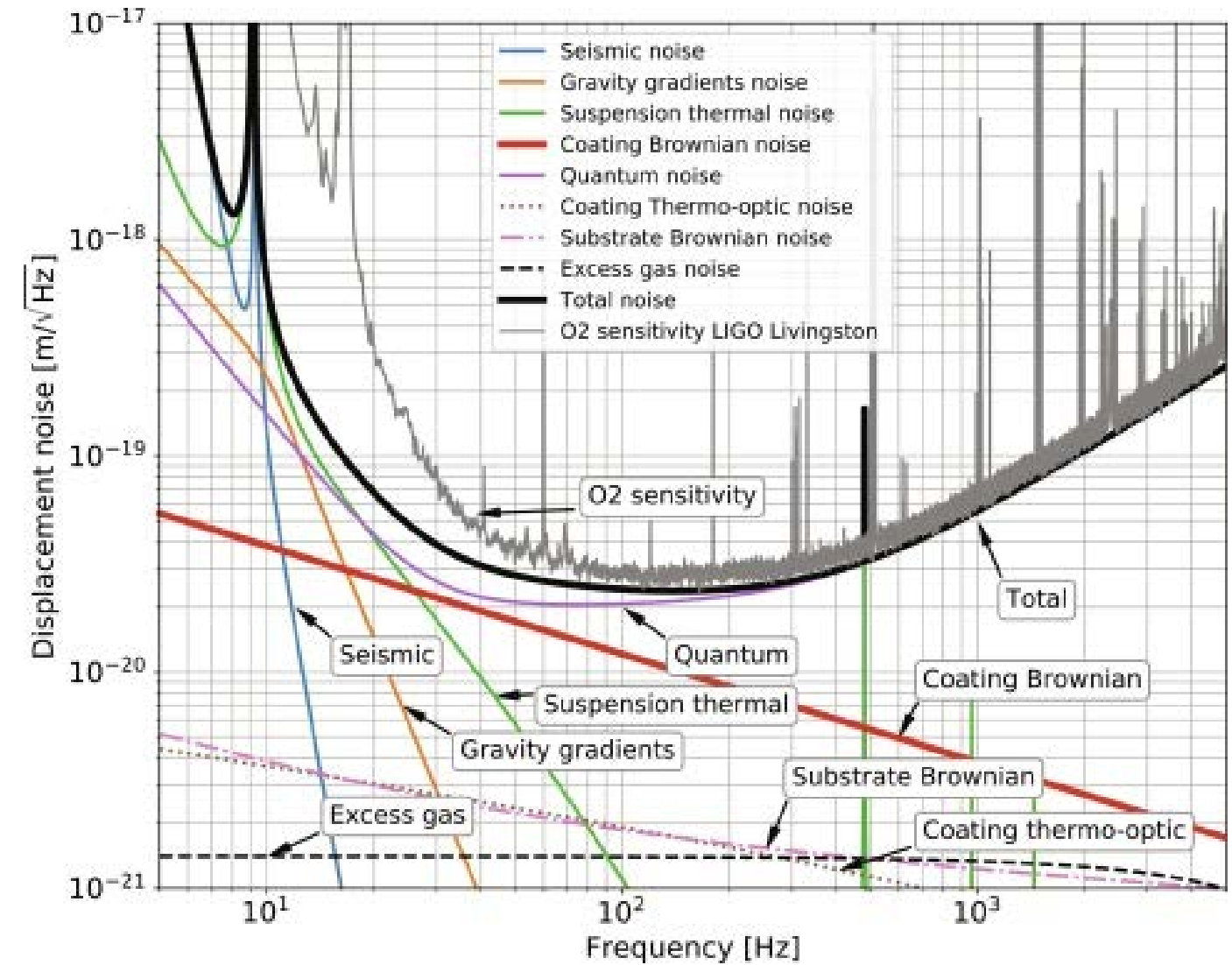
*How the detectors behave when a
Gravitational Wave crosses the
arms*

LIGO

*Warped Space-Time fabric during a
Binary Black Hole merger*

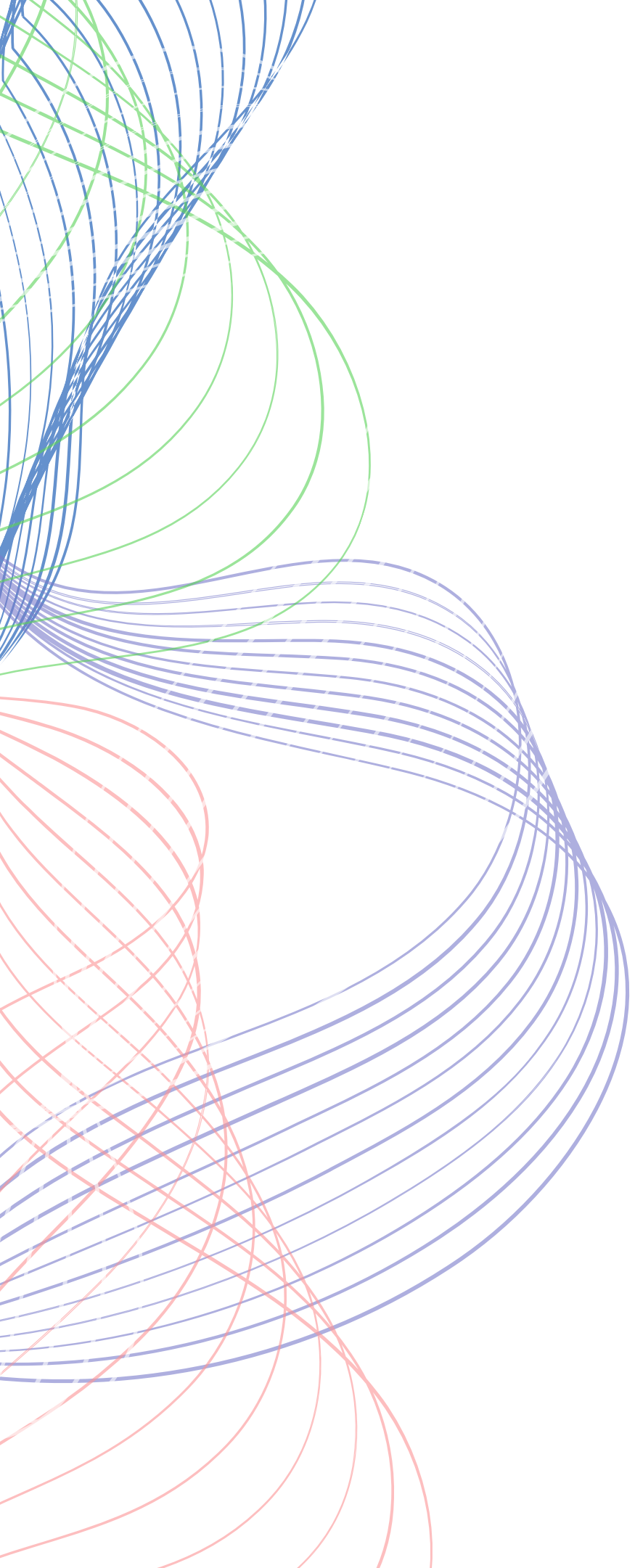


Advanced LIGO



Noise in LIGO

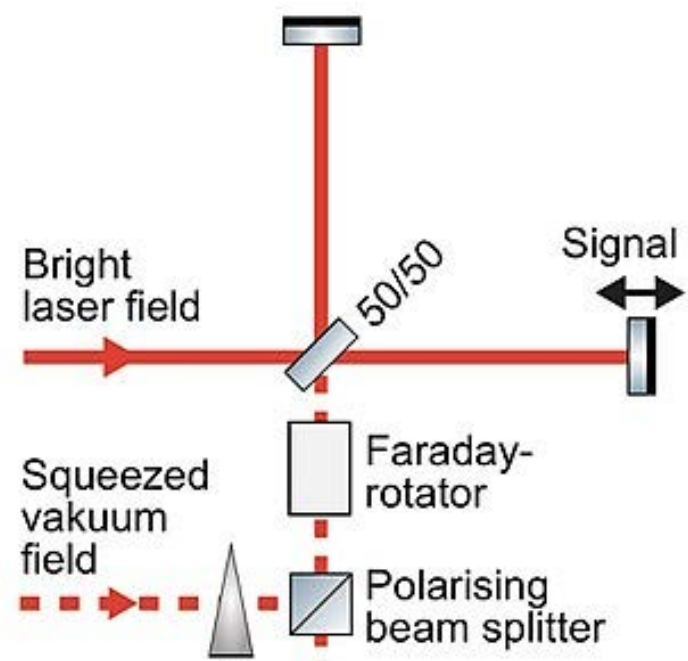
Quantum Shot Noise has one of the major contributions to noise...

- 
- 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

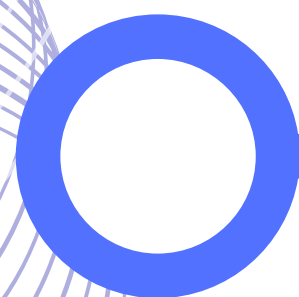
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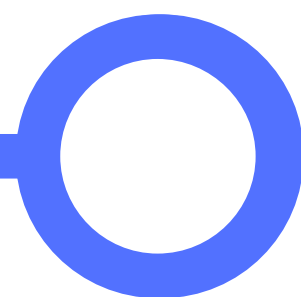
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001111011100101100011100001110
010100110011111011110110101001
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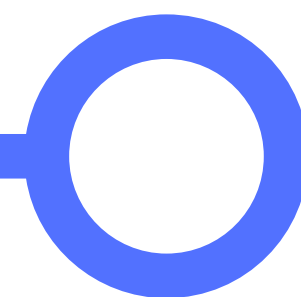
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Quantum Signal
Pre-Processing



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.

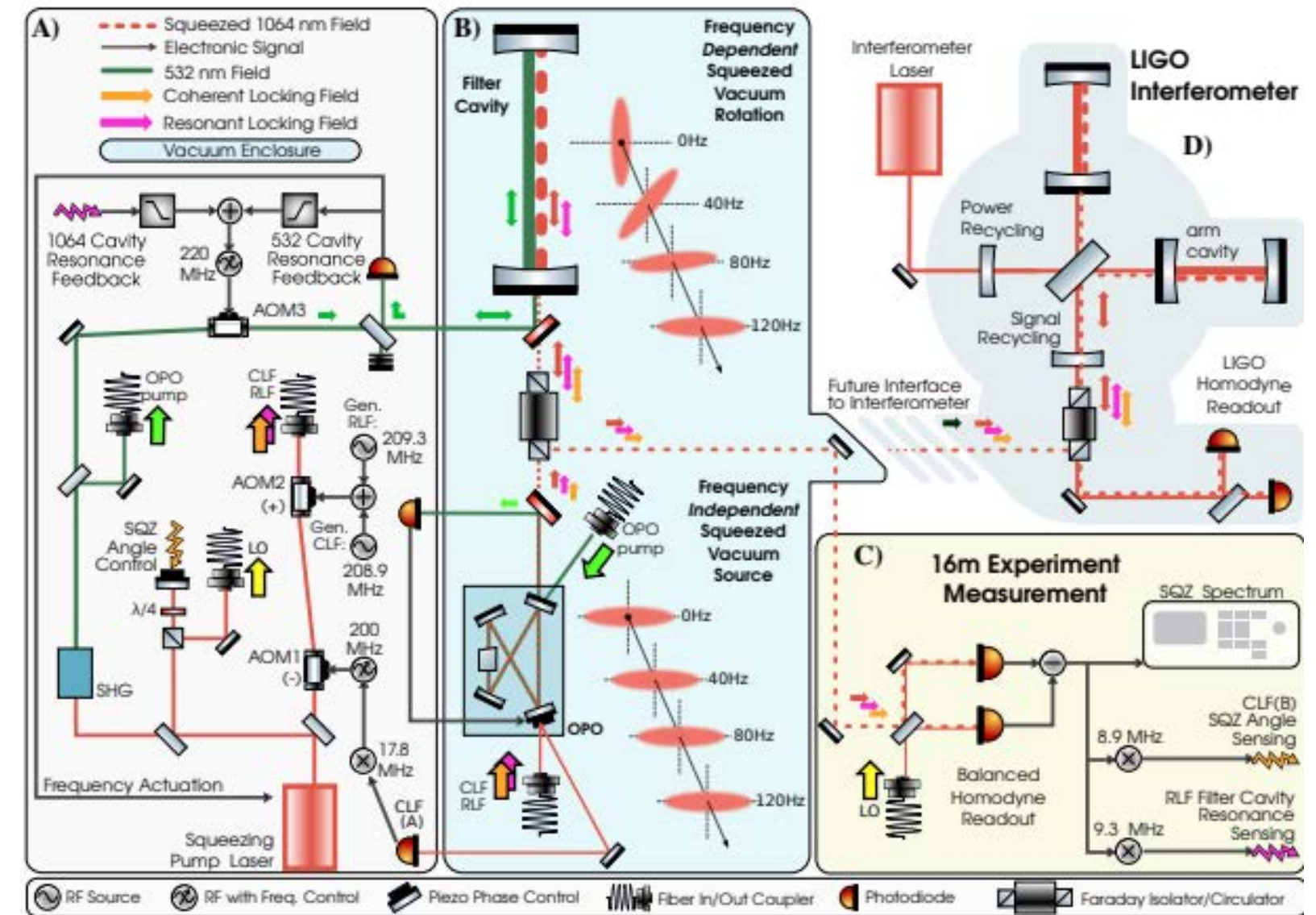


Image credits: Frequency-Dependent Squeezing for Advanced LIGO

“

CONCLUSION

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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 existence 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.

“

THANK YOU

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