Gravitational Wave Data Analysis

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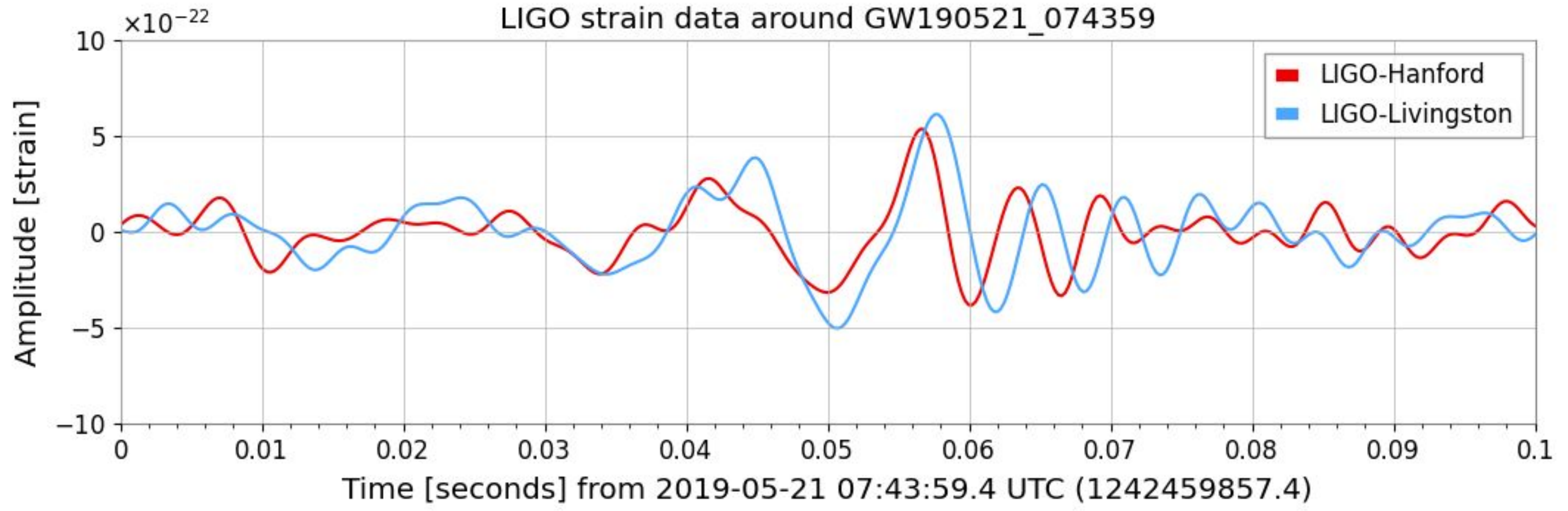
Motivation

- Understanding gravitational waves
- Binary black hole mergers give off energy as gravitational waves
- We can analyze these waves (using LIGO) to find properties of these objects

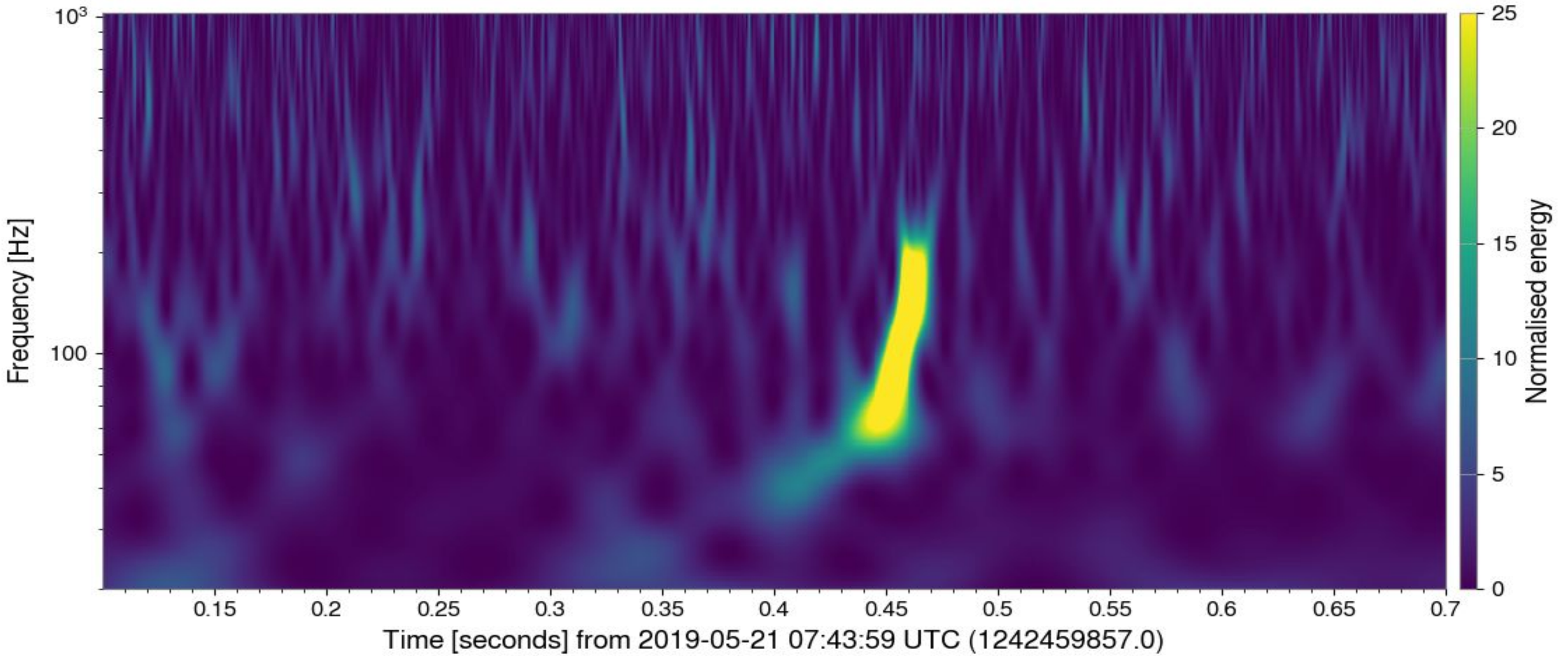
Methods

- Data source: LIGO, GW190521_074359
- High and low frequencies filtered out

Methods - Data



Methods - Data



Estimating Masses and Distance

We use the equation

$$M \approx \frac{\delta_t c^3}{16G\pi}$$

From this we can derive

$$D \approx \frac{\delta_t c}{16\pi h}$$

Here delta_t is the period of the wave and h is the amp

Results

With delta = 1.4e-2 s and h = 5.4e-22 m, approximated from the data, we get the estimates

M approx 59 solar masses

D approx 1.6e10 lightyears

Conclusion

This study analyzed gravitational wave data from the GW190521_074359 event detected by LIGO to explore the energy and properties of binary black hole mergers. By filtering noise, we estimated a mass of approximately 59 solar masses and a distance of around 1.6×10^{10} light-years. Our findings confirm the effectiveness of gravitational wave data in studying distant astrophysical phenomena and highlight its potential to reveal insights into the universe's structure and black hole formation.

AI Statement

AI tools were not used in the creation of this presentation

Contribution Statement

Individual Contributions:

- Zachary Cohen wrote the “Motivation” and “Contribution Statement” slides
- John Wright created the “Methods”, “Estimating Masses and Distance”, and “Results” slides
- Dechong Wang wrote the “Conclusion” and “AI Statement” slides