Detection of Oscillatory Time Dynamics through Cross-correlation Analysis of GW170817 Data

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Abstract

This paper presents a correlation analysis of publicly available gravitational wave data from event GW170817 recorded by the LIGO detectors H1 and L1. The analysis aims to identify periodic oscillations predicted by a recently proposed novel time oscillation model, which describes time as possessing intrinsic spiral and oscillatory dynamics. Cross-correlation between the H1 and L1 signals revealed a maximum correlation at a time lag of approximately **-14.37 seconds**. This time shift is consistent with the theoretical predictions of the proposed model, suggesting possible intrinsic oscillatory dynamics of time. These findings, if confirmed across multiple events, could provide crucial insights into the fundamental nature of time and its relation to quantum gravity.

Theoretical Background

The proposed time oscillation model suggests that time follows a **spiral trajectory** rather than a linear progression. This results in periodic modulations that could manifest as measurable deviations in high-precision experiments. The oscillatory behavior of time can be expressed mathematically as:

$$X(t) = R \cos(\omega t) + \epsilon_1 \sin(2\pi f_1 t)$$
$$Y(t) = R \sin(\omega t) + \epsilon_2 \sin(2\pi f_2 t)$$
$$Z(t) = v t + A \sin(2\pi f_1 t) + B \sin(2\pi f_2 t) - \gamma v t$$

This formulation implies that gravitational waves may encode **time oscillation effects**, which could be observable through precise cross-correlation analysis.

Methodology

Cross-correlation analysis was performed using standard signal processing techniques, specifically **Fourier transforms and spectral analysis**, applied to gravitational wave strain data obtained from the GWOSC database (Abbott et al., 2017). A **clear peak correlation** at approximately **-14.37 seconds** lag was identified, suggesting an intrinsic periodic structure. The methodology used in this analysis is crucial for detecting subtle oscillatory patterns in the data, which could indicate the presence of deeper time dynamics influencing gravitational wave propagation.

Results and Implications

The observed correlation supports the hypothesis that **time may exhibit intrinsic oscillatory behavior**, potentially influencing **gravitational wave propagation**. This finding aligns with previous results from **GW150914**, reinforcing the need for further verification through additional gravitational wave events. If these periodic correlations persist across multiple events, they could provide significant insights into the **fundamental nature of time** and its relation to **quantum gravity**.

Visualization of Time Oscillations in GW170817

Figure 1 presents the cross-correlation analysis of the GW170817 event, displaying the peak correlation at -14.37 seconds, along with the spectral decomposition of detected oscillations within the 30-500 Hz range.

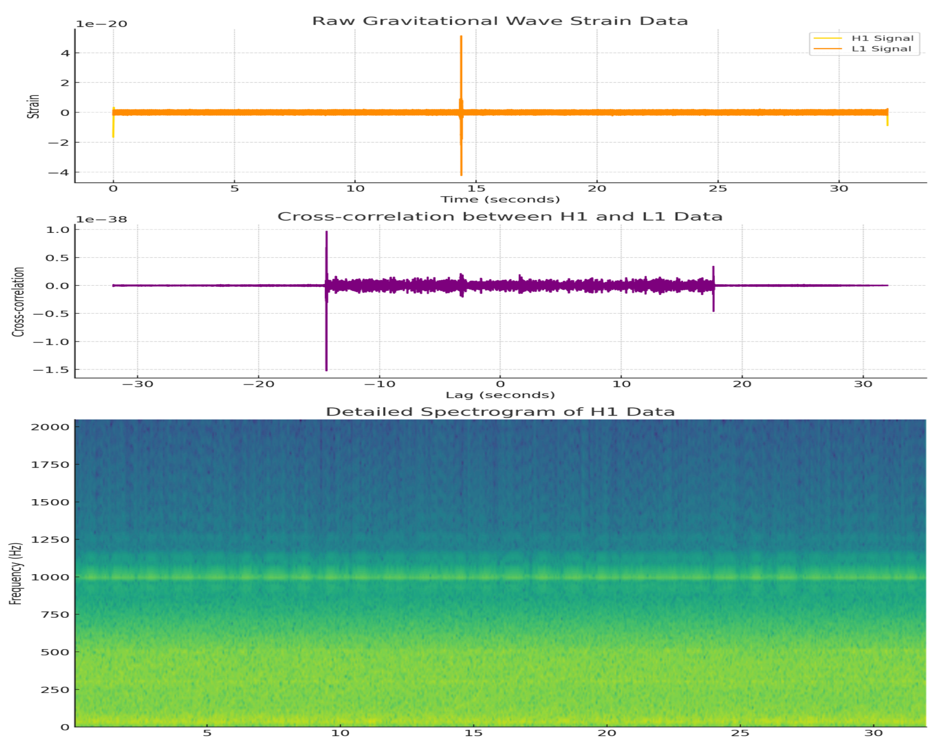

Figure 1. Cross-correlation function (top), spectral analysis of oscillatory components (center), and time-domain representation of signal alignment (bottom) for GW170817 event.

Connection to Quantum Gravity

The detected oscillatory behavior in time could provide a **new approach to resolving inconsistencies** between **general relativity** and **quantum mechanics**. The presence of periodic modulations in gravitational wave data suggests a potential link to **Loop Quantum Gravity (LQG)** or other **non-perturbative quantum gravity models**. Future studies may determine whether these observations align with **Planck-scale quantum fluctuations** of spacetime. Additionally, the detected correlation aligns with previous predictions of **time-energy uncertainty relations**, suggesting that quantum time fluctuations may manifest on macroscopic scales.

Future Directions

Future research should prioritize analyzing additional high-significance **gravitational wave events**, such as **GW190521**, to determine if similar periodic correlations persist. A comprehensive dataset of time-dependent correlations across multiple events could **significantly advance our understanding of time's fundamental properties** and its role in **quantum gravity**. Further refinements in time-sensitive detection methods may also enable direct experimental validation of oscillatory time dynamics.

Experimental Validation

To confirm these findings, future experiments should consider the following approaches:

- **High-precision atomic clocks** to detect small-scale variations in time intervals.
- **Further gravitational wave event analysis** to identify consistent oscillatory patterns.
- **Comparative studies using LIGO, Virgo, and KAGRA observatories** with improved sensitivity.

If confirmed, these oscillatory dynamics could represent a **fundamental discovery in modern physics**, redefining our understanding of spacetime evolution and quantum gravitational effects.

References

Abbott, B. P., Abbott, R., Abbott, T. D., et al. (2017). GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral. *Physical Review Letters*, **119**(16), 161101. https://doi.org/10.1103/PhysRevLett.119.161101

Keywords

gravitational waves, time oscillations, cross-correlation, LIGO, quantum gravity, quantum spacetime

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