Project 3 - Gravitational Waves

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Abstract

What are gravitational waves and how are they created? In this project, we will be covering how gravitational waves are created and the process of a black hole orbiting another black hole. This will allow us to show how gravitational waves function, how they are created, and what happens when black holes orbit each other. Our team analyzed Gravitational Wave strain data from the LIGO Hanford detector specifically around GW150914. Our team focused on extracting the strain of GW150914 as well as finding an estimate for the masses of merging black holes and their distances.

Motivation

Our team set out to code and interpret the data from the gravitational wave event GW 150914, motivated by a desire to explore the universe through a lens beyond light. Unlike light, gravitational waves can travel through matter without significant interactions, and it gives us the opportunity to collect data from events despite the fact we can't see them. When detected by our LIGO detectors on Earth, we can observe this phenomenon in our universe that can't always be seen. This observation adds to our roadmap of the universe.

Methods

We used the open repository of the LIGO Hanford detector to retrieve the data of our specified strain as it spanned across a specific interval of time. Through this data collection we applied filters (Bandpass and Notch) in our COLAB code in order to ignore background noise and solely capture the gravitational wave. After we acquired the filtered version of our gravitational wave data, we calculated the ASD (amplitude spectral density) to identify important frequency peaks

between 50-250hz, which we can see lines up with the inspiral phase as well as the merger phase of a black hole.

Results/Conclusion

We found out that once black holes merge they stop emitting gravitational waves and emit energy when merging. This energy released can be seen by the amount of weight lost when the merging happens. Furthermore, gravitational waves

Contribution Statement

Motivation - O'Brein Carr

Methods/Abstract - Justin Lewis

Results/Conclusion - Abdullahi Omar

References/Citations

Wang, J. (2023, October 10). *Astron1221/gravitationalwave/gravitationalwave.ipynb at 1C1E08F561072D878A167AF4CC2950851317F18C · WJ198414/ASTRON1221*. GitHub. https://github.com/wj198414/ASTRON1221/blob/1c1e08f561072d878a167af4cc2950851317f18c/GravitationalWave/GravitationalWave.ipynb