# Analysis and Sonification of Gravitational Waves

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Motivation

- The main goal was to better understand gravitational wave events
- We also wanted to learn the process that goes into analyzing them using the data from LIGO Hanford and LIGO Livingston
- It also posed an interesting way in observing the universe in more than one way, by listening to it through the sonification process

Methods

- After installing the gravitational wave package for Python, we used the GPS time the merger occurred to run our calculations
- By plotting the data from LIGO Hanford and filtering out noise, we were able to produce a graph depicting the amplitude and time of the gravitational wave event
- We repeated this process with the data from LIGO Livingston and shifted it 6.9 milliseconds to account for the configurations and locations on Earth, producing a graph that displays data from both locations
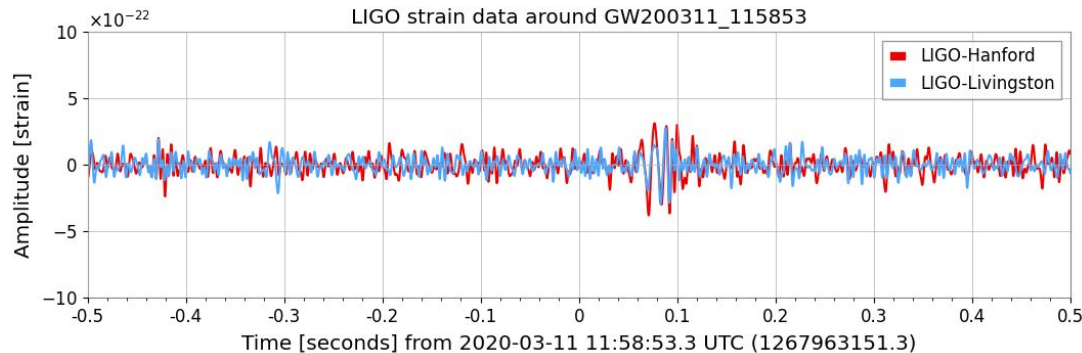
Methods (cont.)

- We then generated a q-transform of the data, turning it into a frequency-time graph with a color scale, making it possible to visualize the "chirp"
- After this we imported SciPy in order to write sound files, and used the data from LIGO Hanford to generate a sound file for the merger event
- Following this we "beautified" the sound by upsampling and using a Fourier transform to try and make the sound more prominent and noticeable
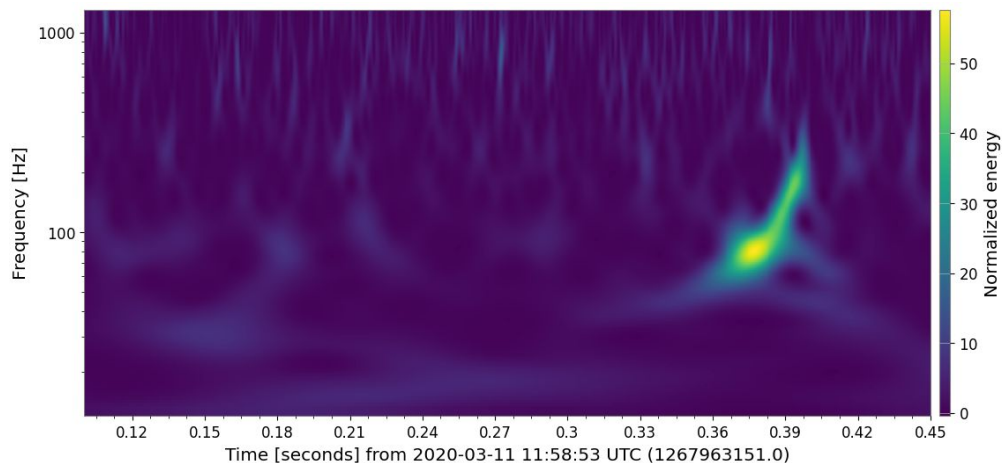
Results

- Ultimately, we were able to produce great looking visual graphs in analyzing gravitational wave merger events
- These have a characteristic shape that is distinct from the noise
- The sonification process did not go as well, and the merger is still somewhat hidden within the noise

Conclusion

- Whilst sonification is a different way to look at data and the universe, more work needs to be done to translate data this into a way easily understood to our ears
- Visual plotting and graphing continues to be the more orthodox way of observing data
- Moving forwards, we may need to look more into the sonification process to produce better sounds with value to them