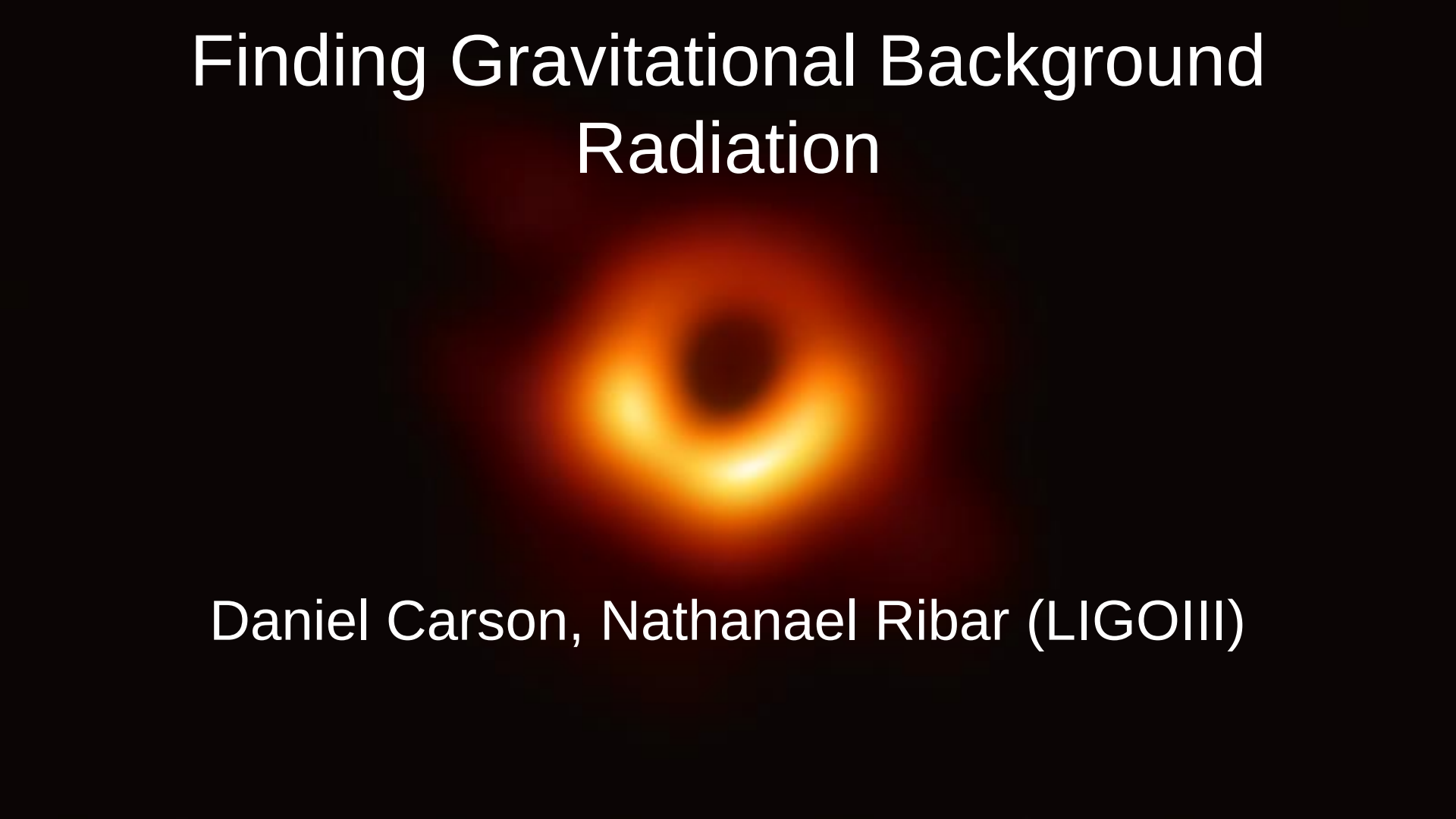
Finding Gravitational Background Radiation



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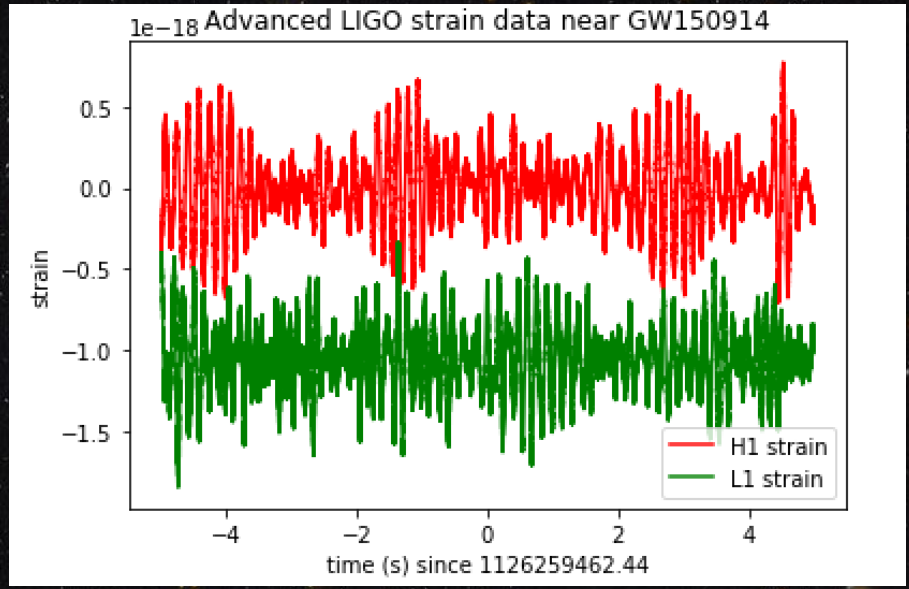
Background for the “Background”

- We have set out to find possible signatures of a “gravitational background radiation” in available LIGO data.
- GBR is predicted to be uniformly distributed and very subtle, gravitational waves left over from the violent and dense state of the very early cosmos
- This is analogous to the Cosmic Microwave Background
- The primary issue in finding GBR is identical to that which faced the discoverers of the CMB: the signal we seek is lost in the noise.

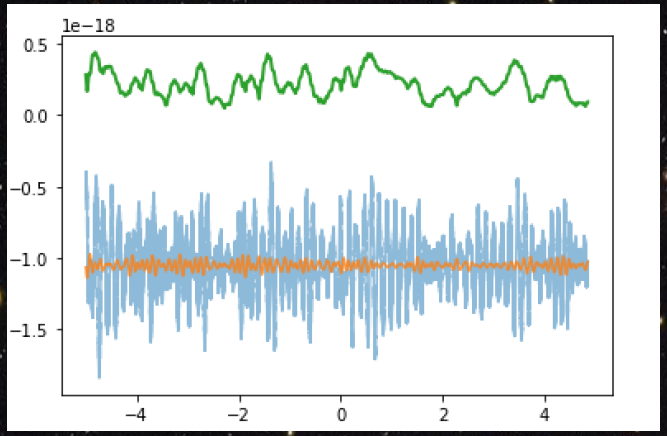
Strain

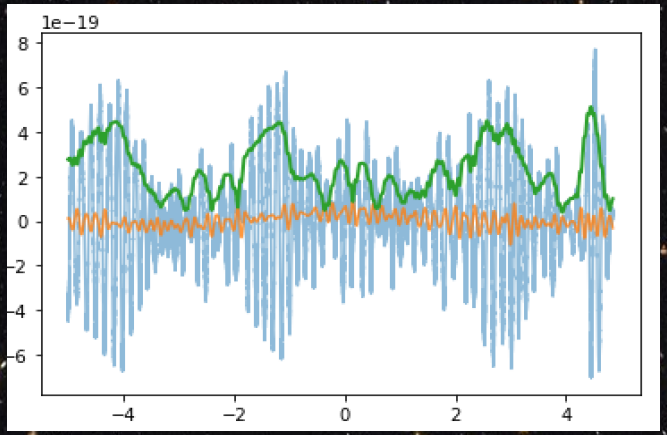
- Following the tutorial available on the LIGO website, we produced a plot for the strains given during an event measured at the Hanford and Livingston sites
- The signal is not visible in this plot; more data analysis is needed



Rolling Standard Deviation

- Our first step in breaking the data down was finding the rolling standard deviation.
- The blue in these plots is the strain, the green is the RSD, and the orange is the mean.
- The RSD has different altitudes for each reading because the Livingston data is deliberately offset, while the RSD is centered at 0



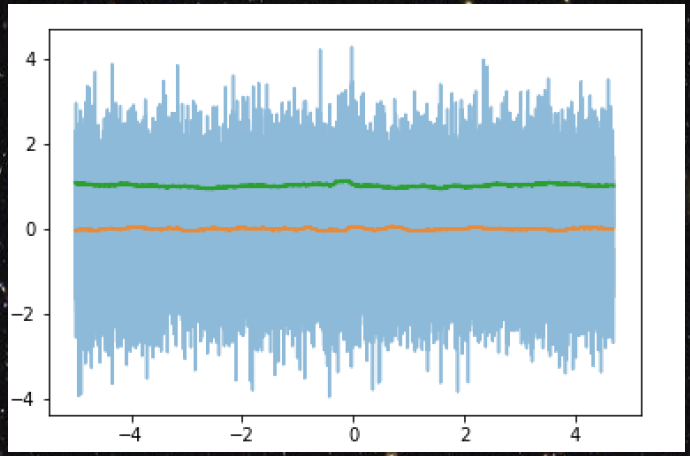


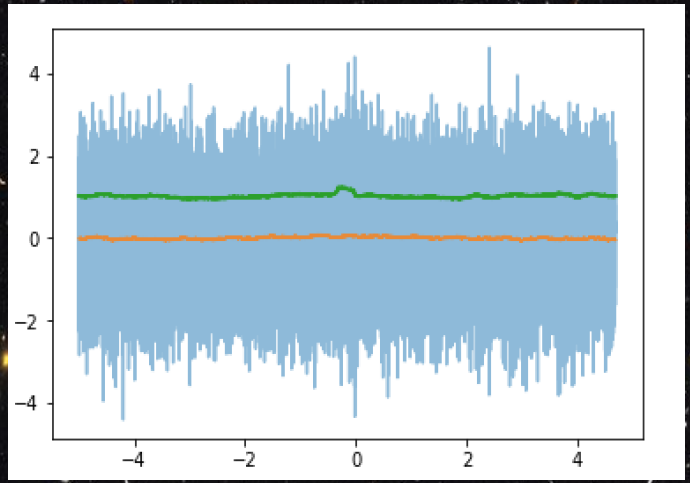
Whitened Data

- The whitening process filters out both instrumental and fine noise, in order to make a gravitational wave event more noticable.
- We originally opted to forego the whitening process, thinking that it might also filter out the subtle GBR signal, if it exists
- However, after finding nothing interesting in the unwhitened data alone, we decided to also measure the whitened data.

Whitened Data

- What would make a signal obvious would be if the standard deviation bottomed out prematurely, indicating a uniform and recognizable noise at some frequency, i.e. GBR.
- In both this whitened data and the unwhitened data shown previously, this is not seen, so there is more work to be done.





Next Steps

- Thus far, we have been working with data collected from a black hole merger. Our next step is to analyze random data, not optimized to read a specific outcome. We would be looking for significant differences between the RST measured.
- We have also thought of using the same technique used by the discoverers of the CMB: taking pot shots with Markov chain Monte Carlo algorithms. However, this is a time consuming process, one which may not be possible to complete within the semester.