# Robust PSD estimation methods for LISA

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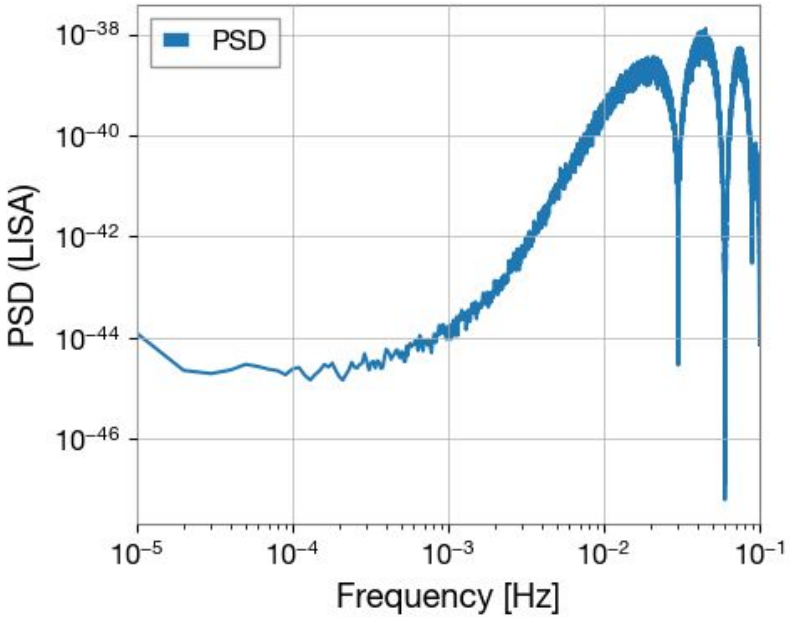
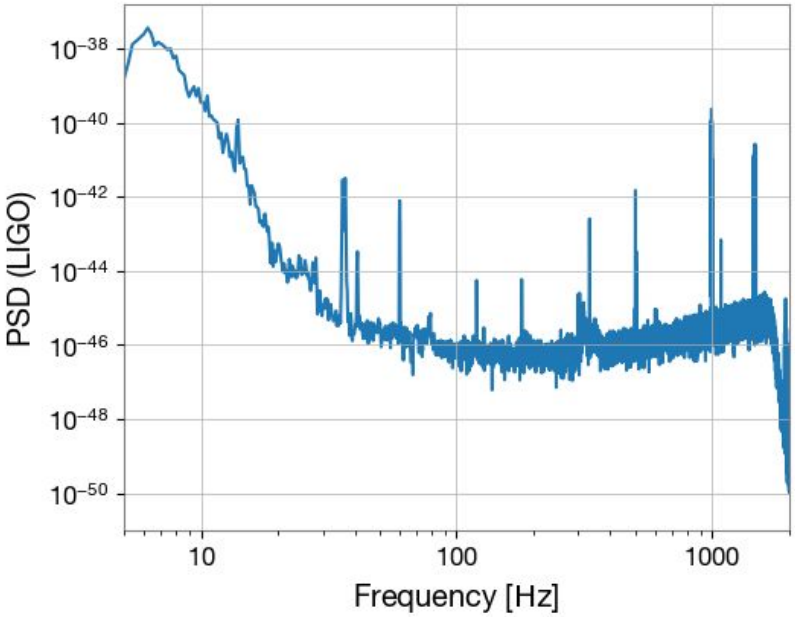
# What is PSD (Power Spectral Density)?

Power distribution across frequency series



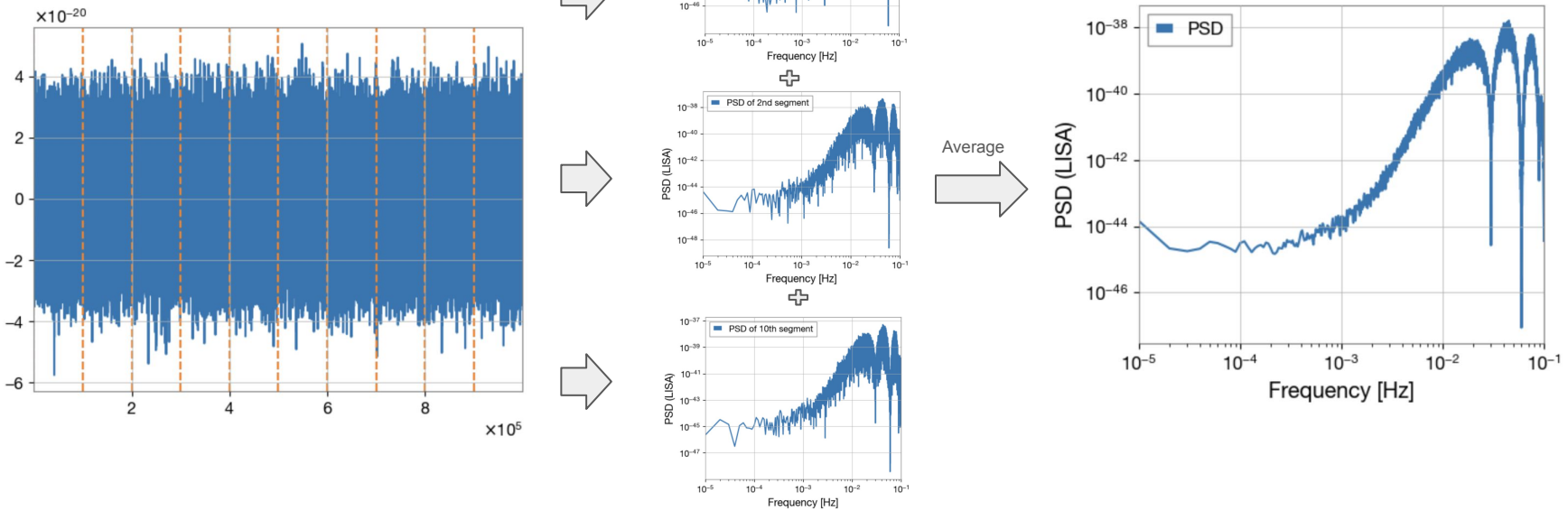



# How is PSD calculated?

Using WOSA (Welch's Overlapped Segment averaging) method:

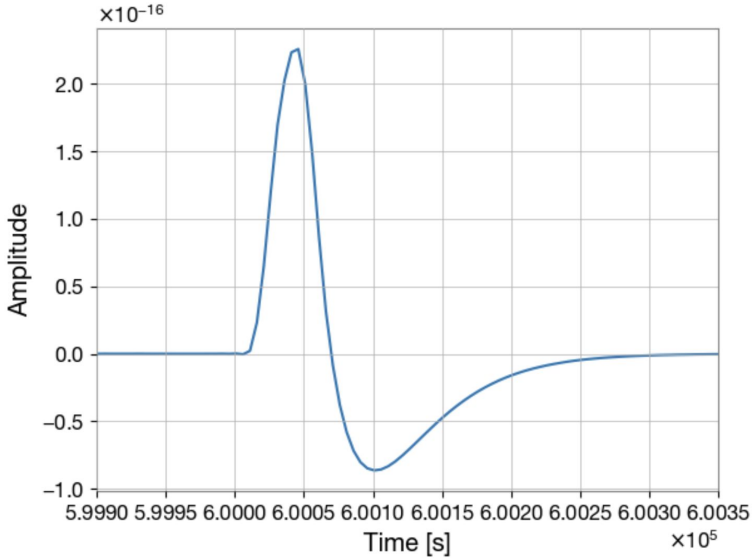
- Divide the time series into (possibly overlapping) segments
- Find the PSD for each of the segments (window -> FFT -> square -> scale)
- Average the PSD to reduce variance

# WOSA method:


×10⁻²⁰
4
2
0
−2
−4
−6
2
4
6
8
×10⁵
PSD of 1st segment
PSD of 2nd segment
PSD of 10th segment
PSD (LISA)
Frequency [Hz]
Average
PSD
PSD (LISA)
Frequency [Hz]

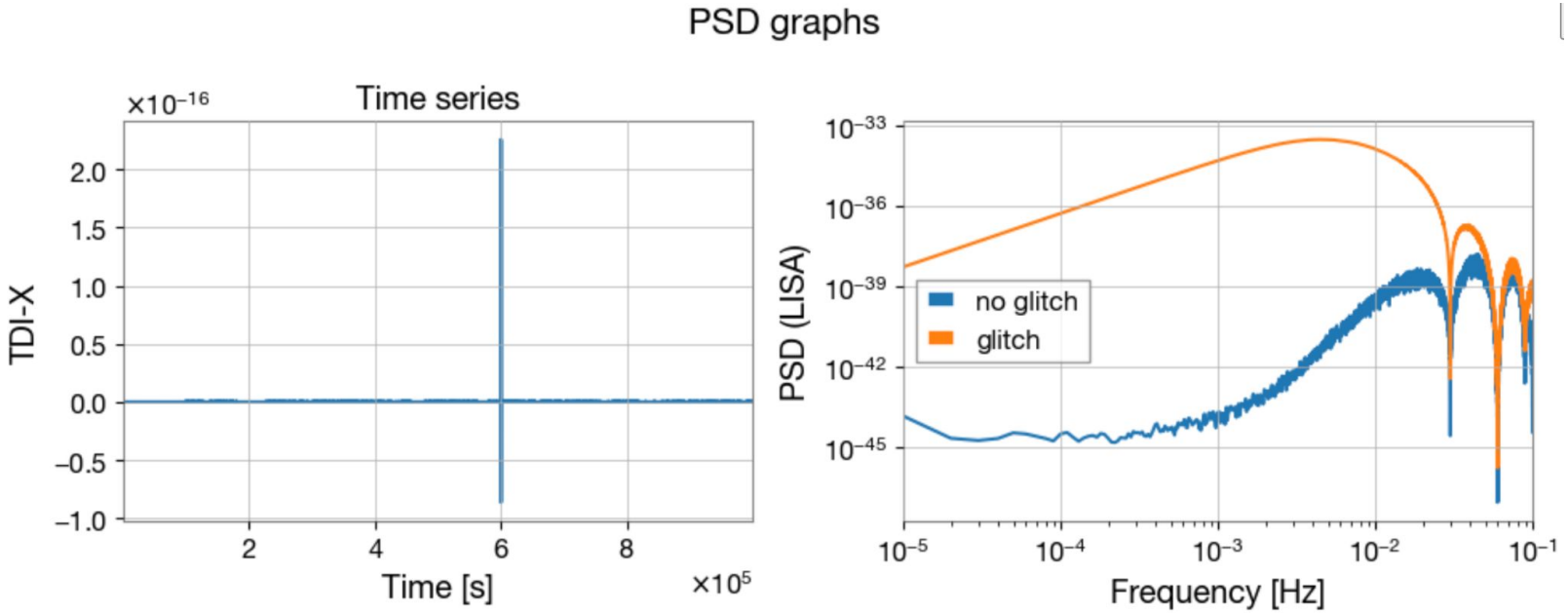
# Glitches

- Transient bursts: They are sudden and short-lived signals in the detector's data stream, can resemble Astrophysical signal
- Non-Gaussian: They don't follow a normal distribution, making them difficult to model and remove



# Glitches mess up the PSD plot:

Glitch with SNR=1000:

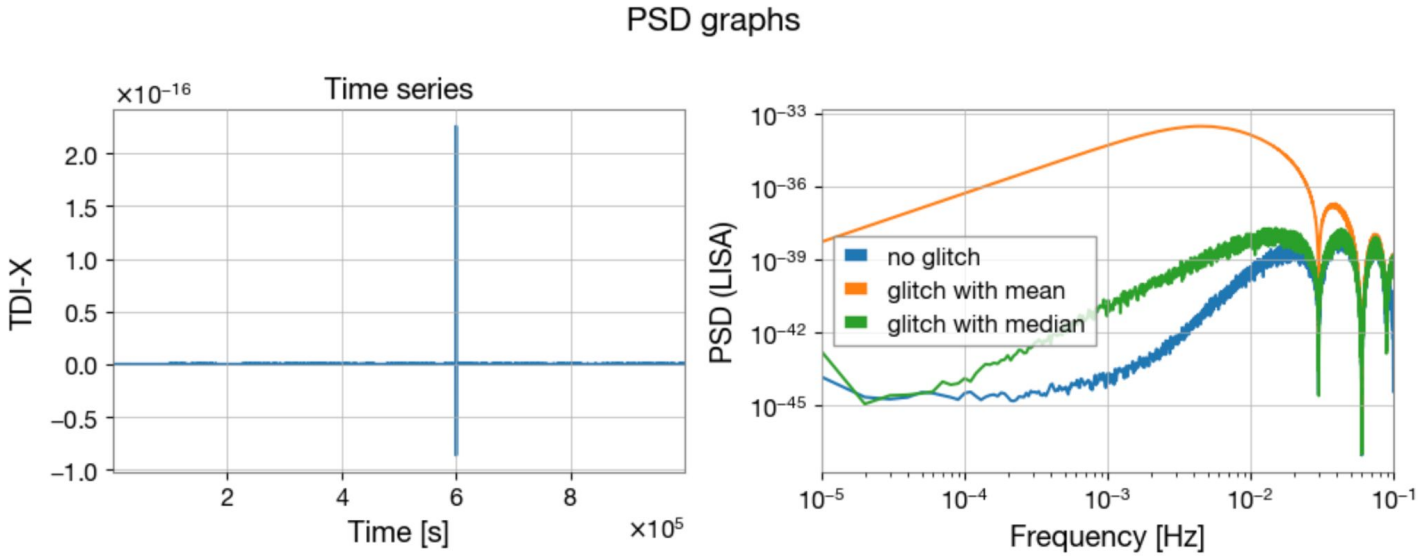


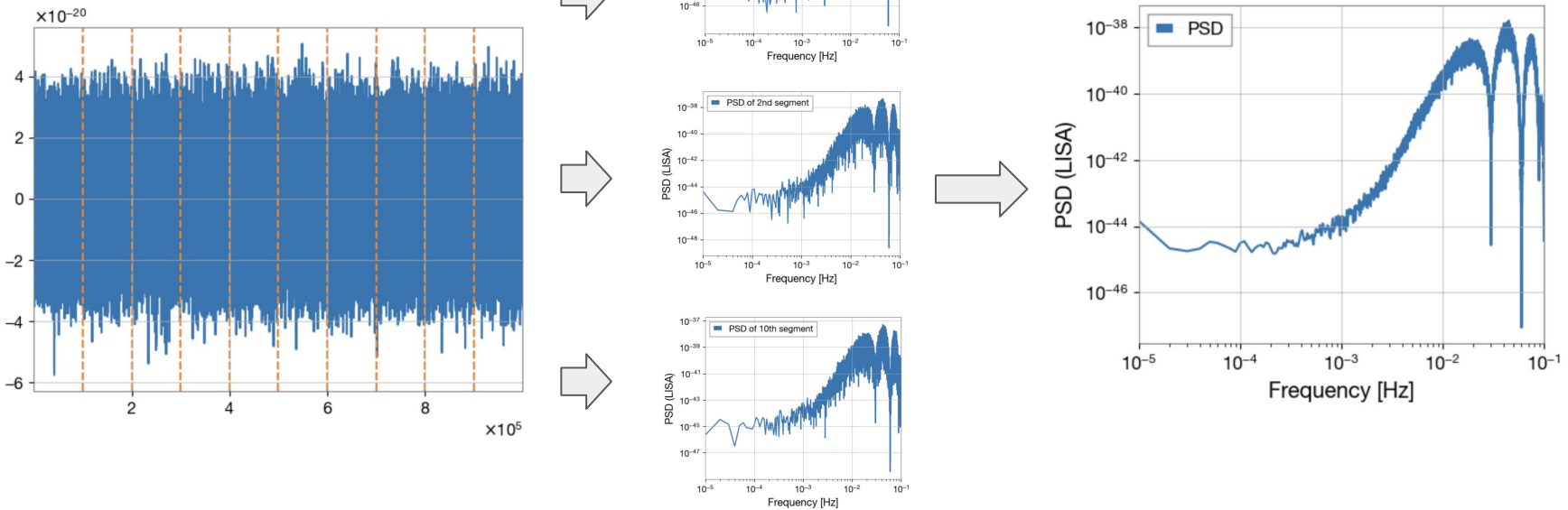
# What am I working on over the summer?

Trying out different methods to calculate PSD, and seeing how it works in the presence of glitches

# Median instead of mean in WOSA method

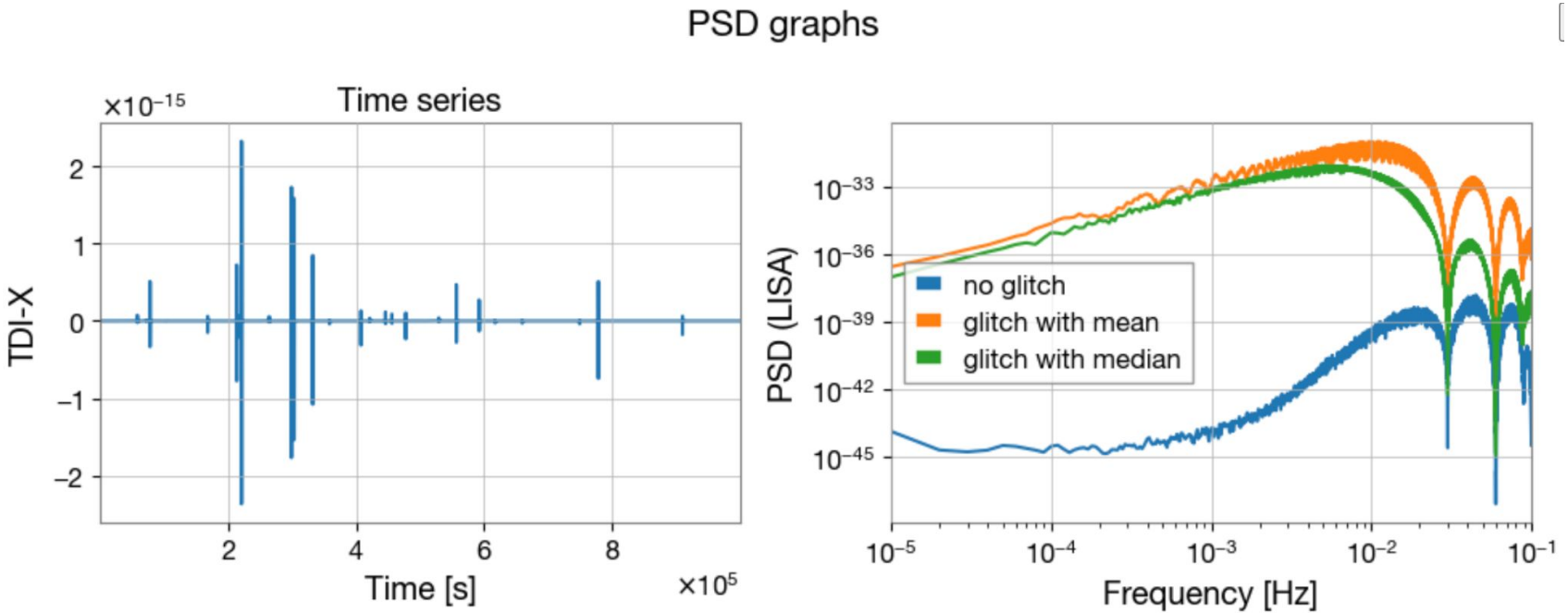
- Divide the time series into segments
- Find the PSD for each of the segments
- Find the ~~mean~~ median PSD in each of the bins




×10^−20
4
2
0
−2
−4
−6
2
4
6
8
×10^5
PSD of 1st segment
PSD of 2nd segment
PSD of 10th segment
PSD (LISA)
Frequency [Hz]
PSD
PSD (LISA)
Frequency [Hz]

# Limits….

If there are too many glitches, we would need to remove them:



# Other things to try:

- Using logPSD and LPSD algorithm instead of WOSA
- Outlier detection
- Finding error-bars in PSD calculation

# Conclusion

- PSD plot shows the power distribution across the frequency spectrum
- Glitches change the PSD plots by a lot
- Try out different methods
- Find the error bars for each of the methods

Thank you!