StochCharMon

Investigating data quality metrics for stochastic GW detection

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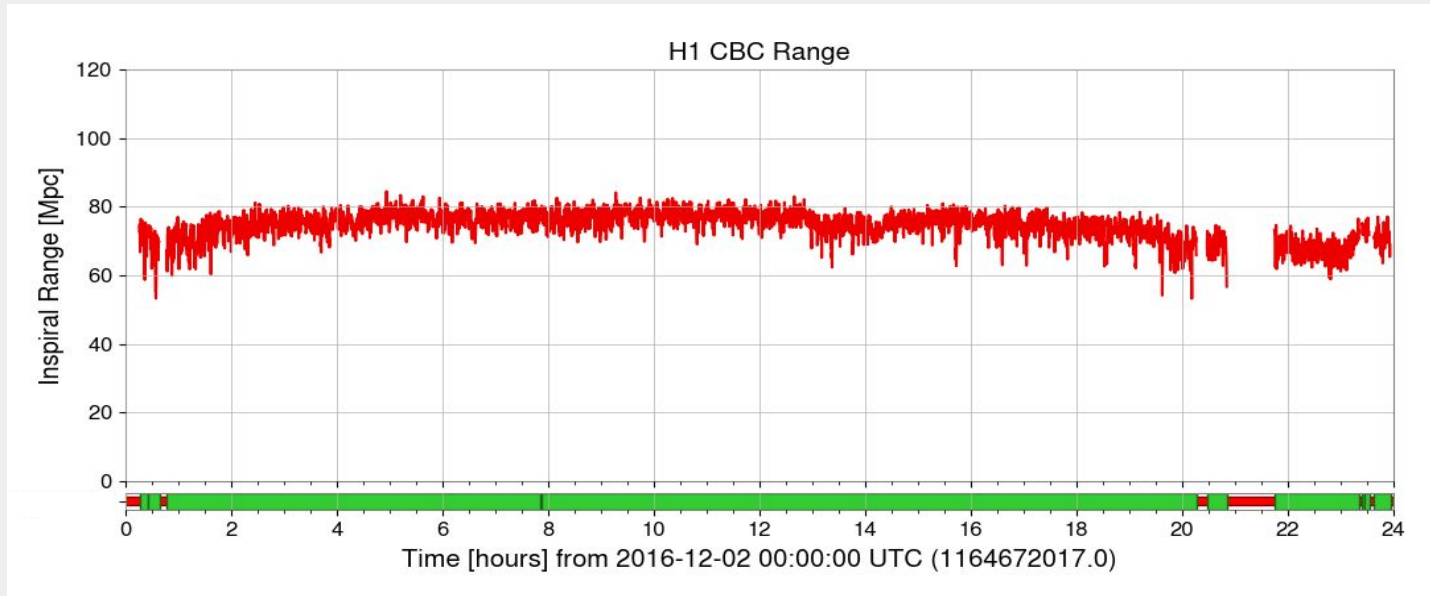August 19th 2021

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Outline

1. Background

2. StochCharMon

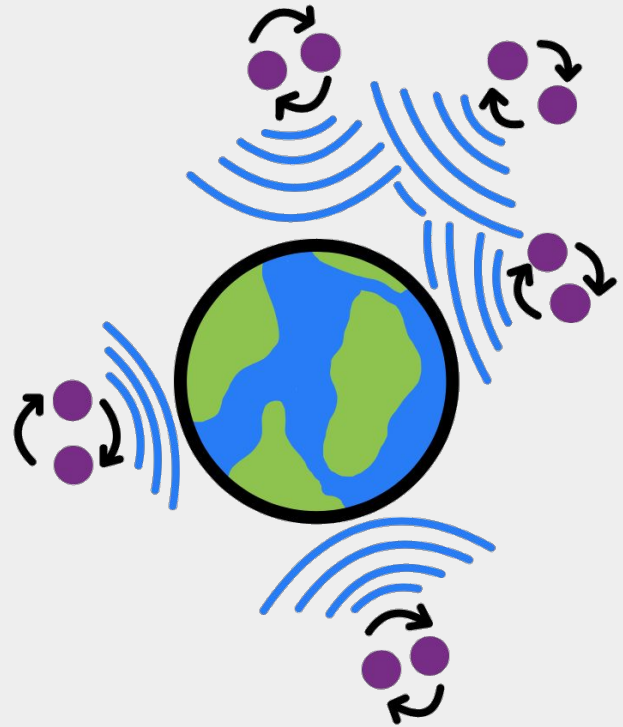3. Stochastic Detector Sensitivity

4. Final Deliverable

CBC Range

- Compact Binary Coalescence Inspiral Range
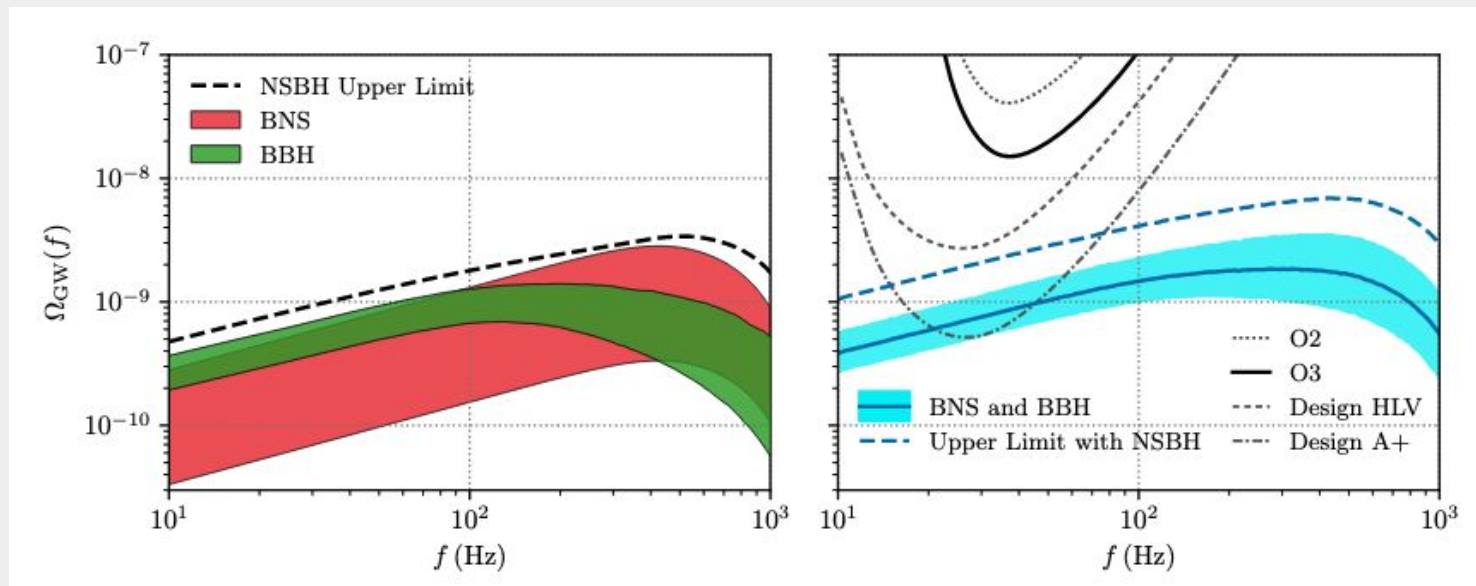
- Detector sensitivity

Higher CBC range
=
Better

Stochastic Gravitational Wave Background

- Weak signals from a collection of sources
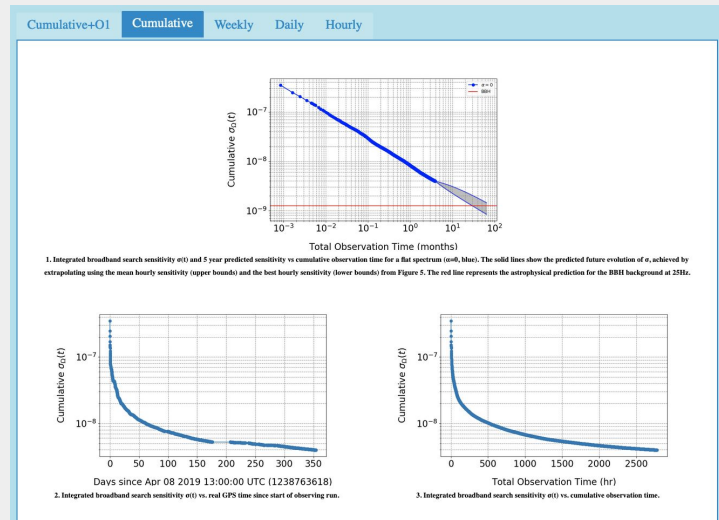
- Informative

- SGWB = not close

- Not yet detected

- GWB energy density predictions

- SGWB upper limit (O3) $\rightarrow$ ~$7*10^{-6}$
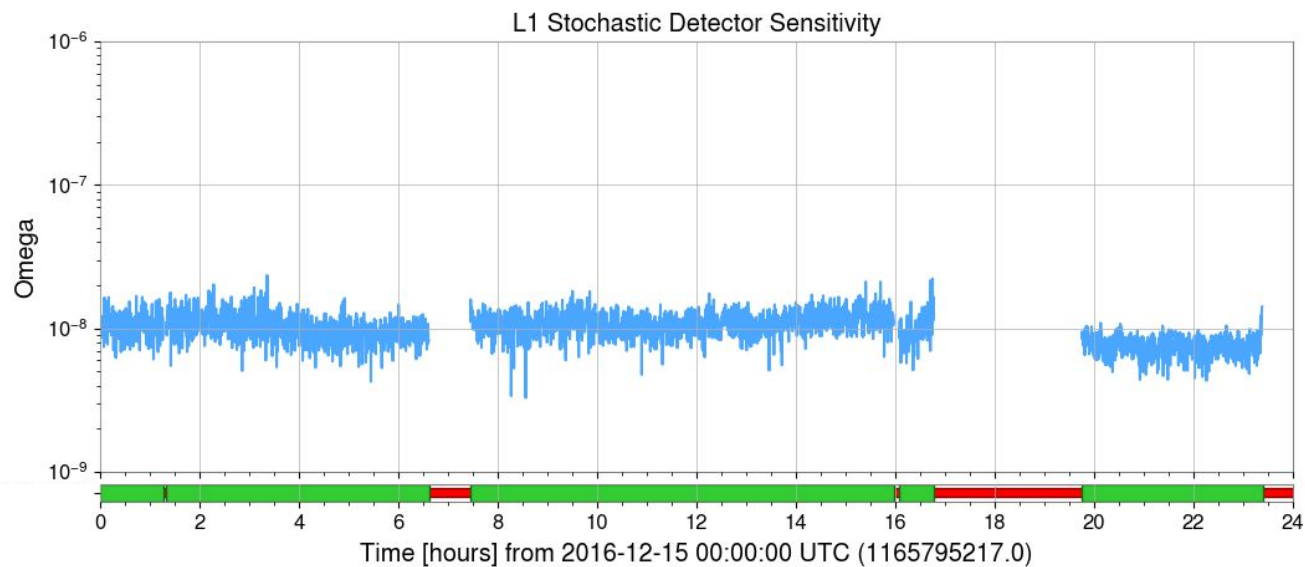

R. Abbott et al. 2021

Stochmon ⟶ StochCharMon

- Low latency stochastic data monitoring pipeline

- Update and integrate

- SGWB detection

- Current Summary Page
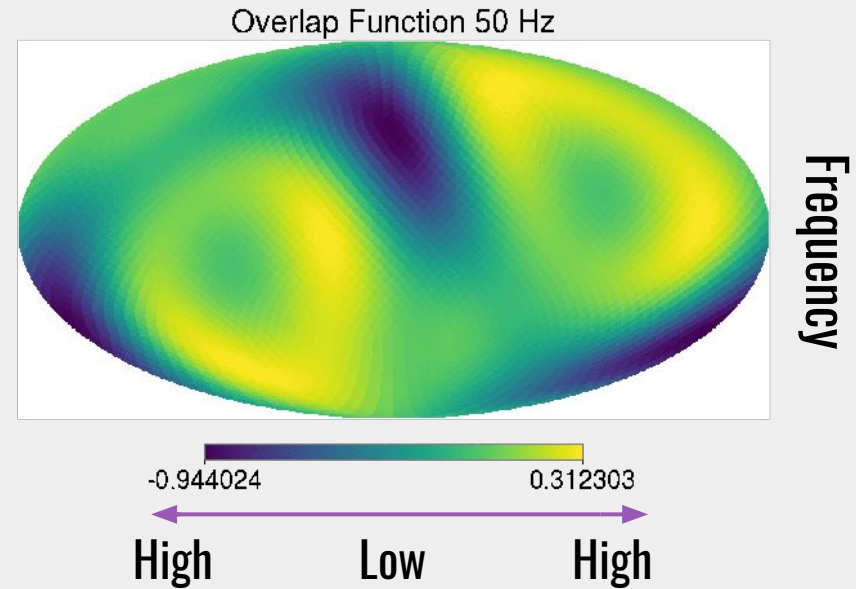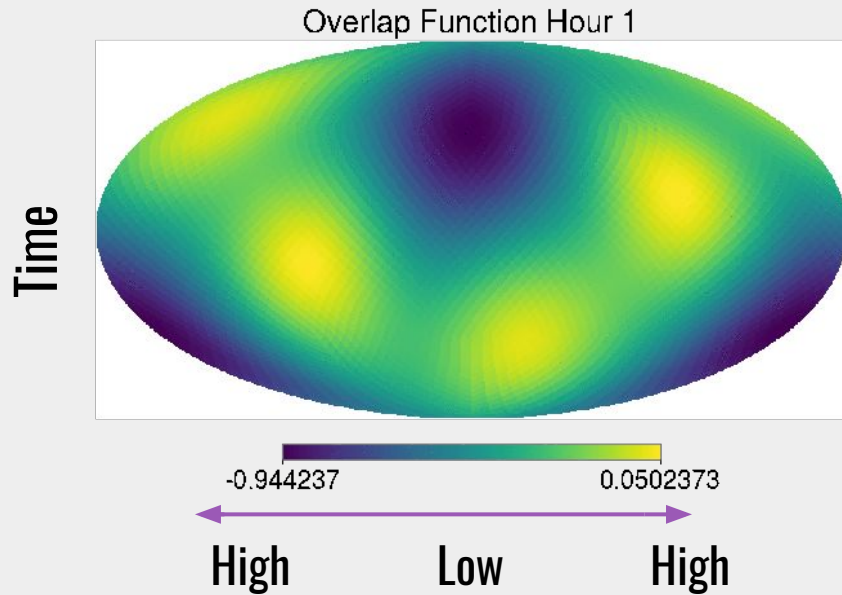
Stochastic Detector Sensitivity

- SDS

- Sensitivity of a singular detector


Lower SDS
=
Better

Stochastic Overlap Function

- Detector polarization response function (+ and x)

- Sensitivity of a pair of detectors

Overlap Function Hour 1

Overlap Function 50 Hz

Time

Frequency

-0.944237   0.0502373

High   Low   High

-0.944024   0.312303

High   Low   High

Overlap Reduction Function

- Frequency dependent correlation between a pair of detectors

H1 and L1 Overlap Reduction Function
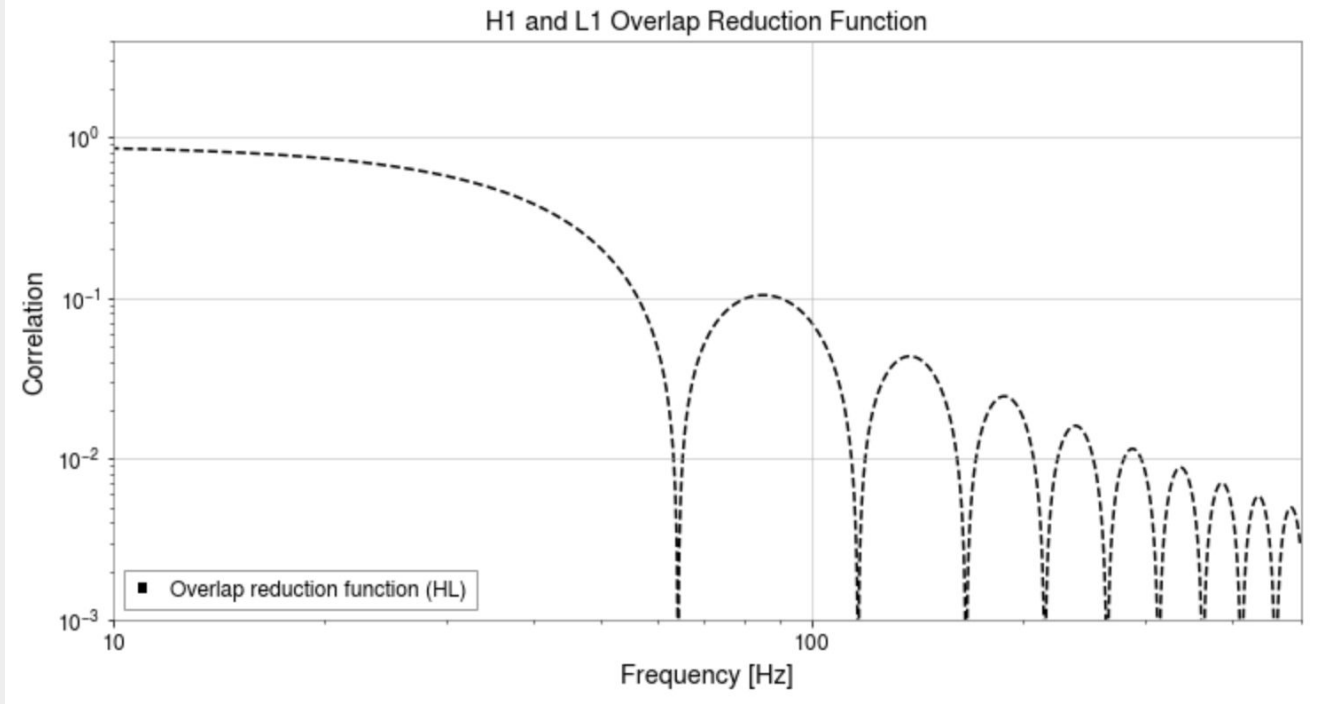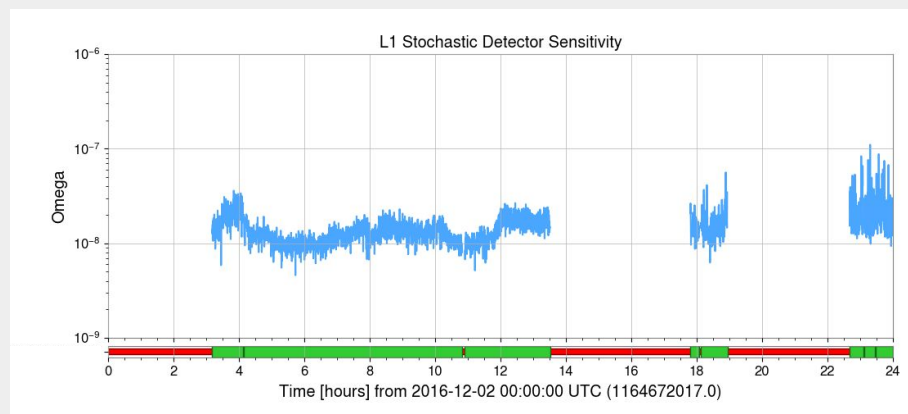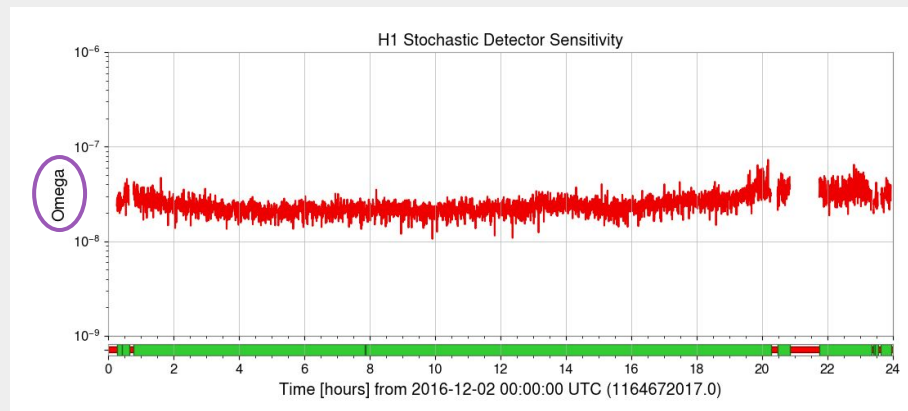
Stochastic Detector Sensitivity

- Similar to CBC range calculation

- ORF → pair of detectors

- PSD → single detector

- Same α as CBC range

$$\propto \int \frac{(ORF)(f^{\alpha-3})}{(PSD)} \, df$$
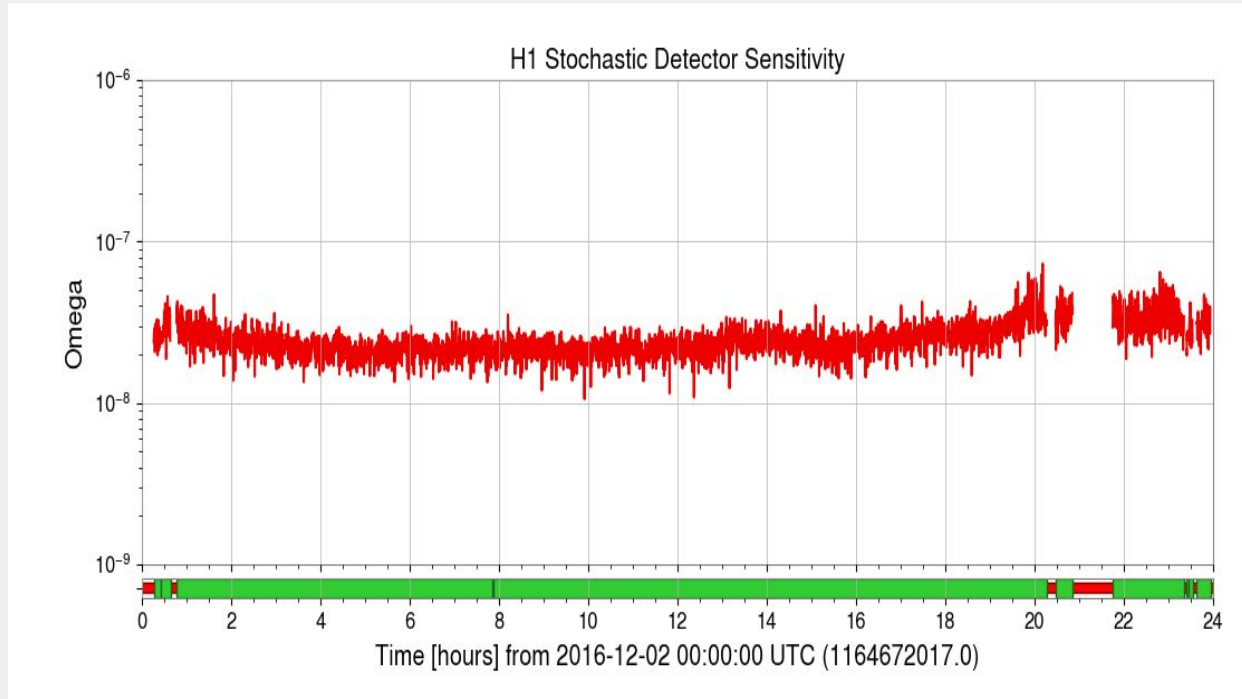
For CBC: $\alpha = \frac{2}{3}$

The Constant

- Re-normalize the fractional energy density
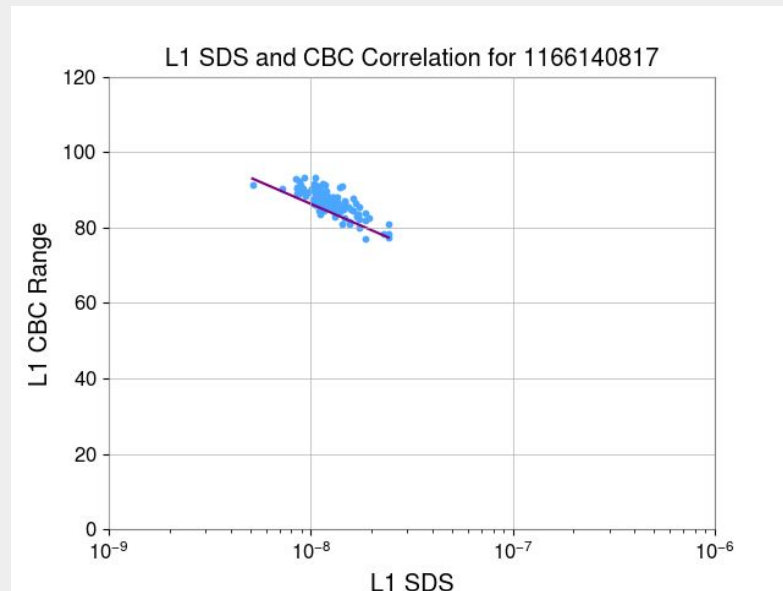
- Obtain the constant from energy density equation
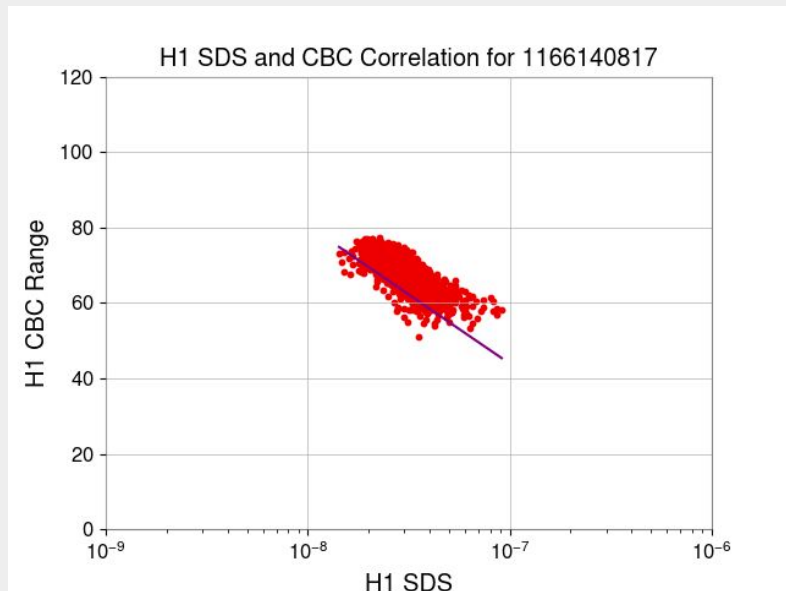
$$\Omega_0 = \boxed{\frac{\rho}{T^{1/2}} f_0^{2/3} \left(\frac{2\pi^2}{3H_0}\right)} \left(\int \left(\frac{(ORF)(f^{\alpha-3})}{PSD}\right)^2 df\right)^{-1/2}$$
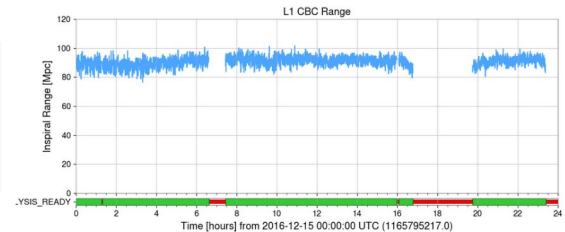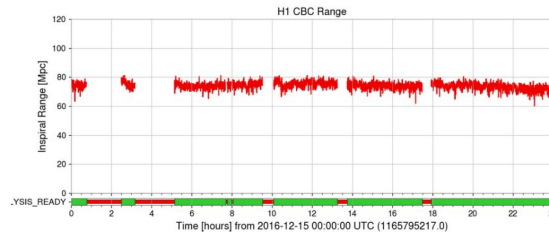
The Constant

Correlation

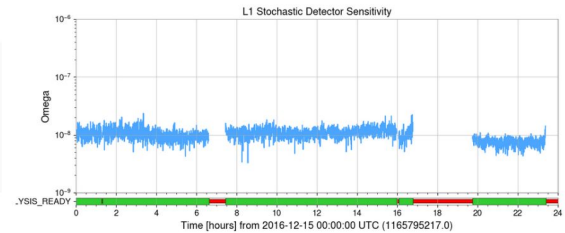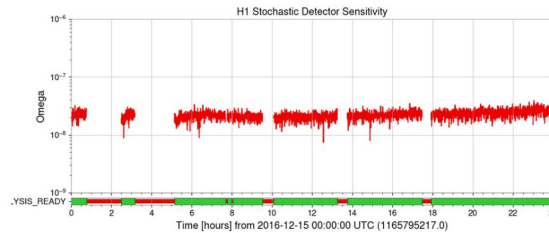- Strong correlation (expected)
- CBC range is a fairly accurate measure of stochastic sensitivity but SDS is still valuable

Summary Page

- Summary page

Future of StochCharMon

- Continue updating and integrating

- O4

- Detect the SGWB

Acknowledgments

Special thanks to my mentors Derek Davis and Arianna Renzini.

Thank you to Alan Weinstein and the NSF.

Thank you to all of the other mentors and all of my fellow LIGO SURFers.

Thank you.