StochCharMon

Investigating data quality metrics for stochastic GW detection

Makenzi Fischbach[1]
Mentors: Derek Davis[2] & Arianna Renzini[2]

[1] Wellesley College
[2] California Institute of Technology

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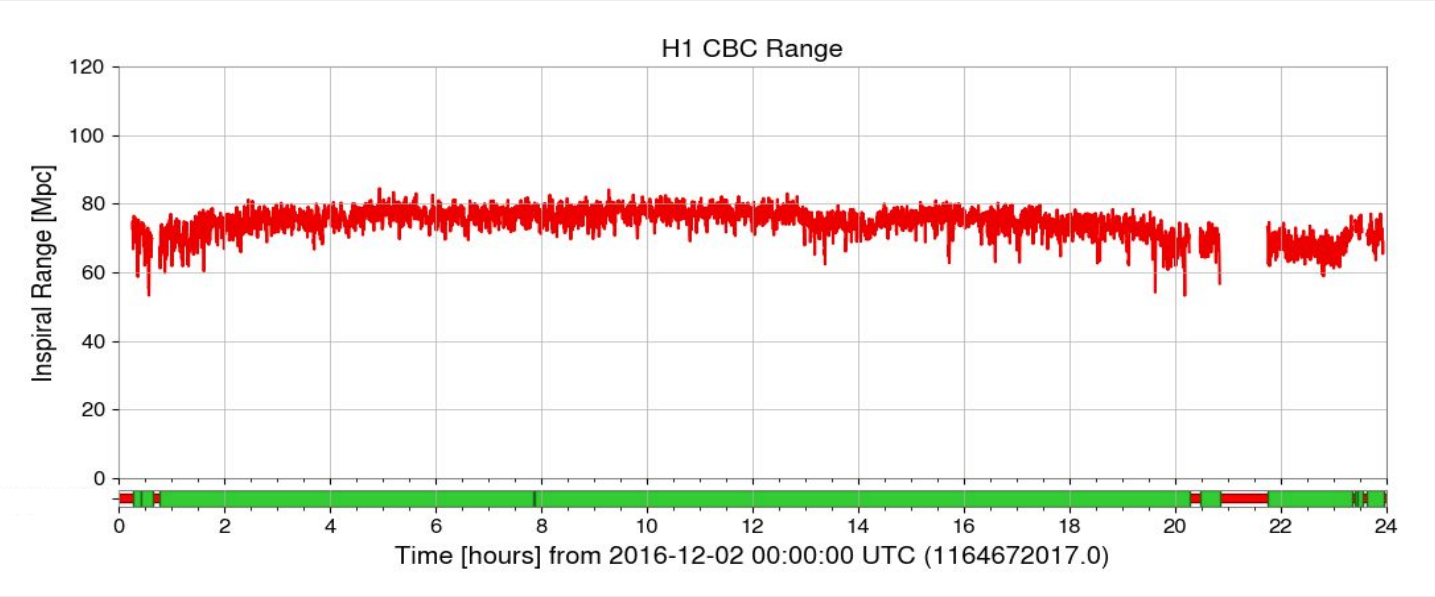
Outline

1. Background
2. StochCharMon
3. Stochastic Detector Sensitivity
4. Final Deliverable

CBC Range

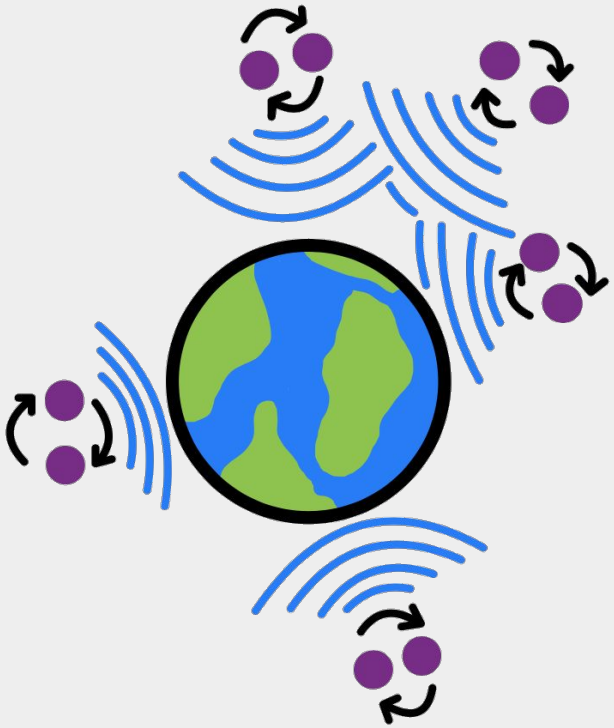
- Compact Binary Coalescence Inspiral Range
- Detector sensitivity



Higher CBC range
=
Better

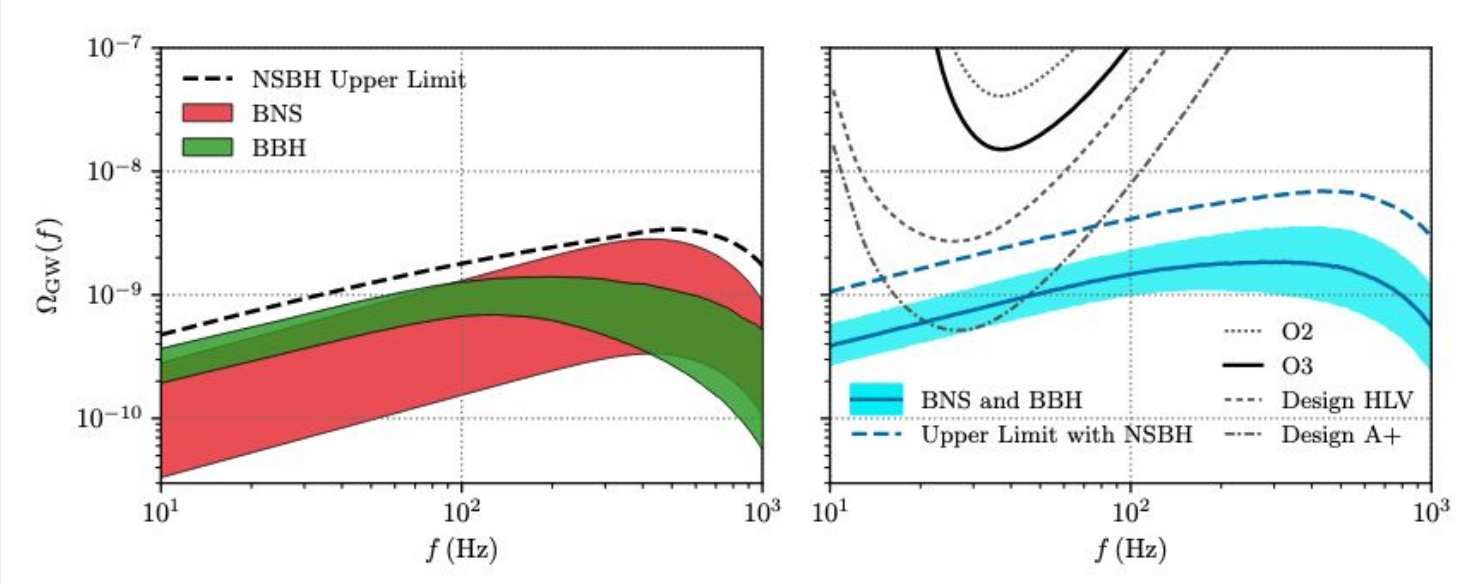
Stochastic Gravitational Wave Background

- Weak signals from a collection of sources
- Informative
- SGWB = not close
- Not yet detected



Energy Density (Ω)

- GWB energy density predictions
- SGWB upper limit (O3) → ~$7*10^{-6}$

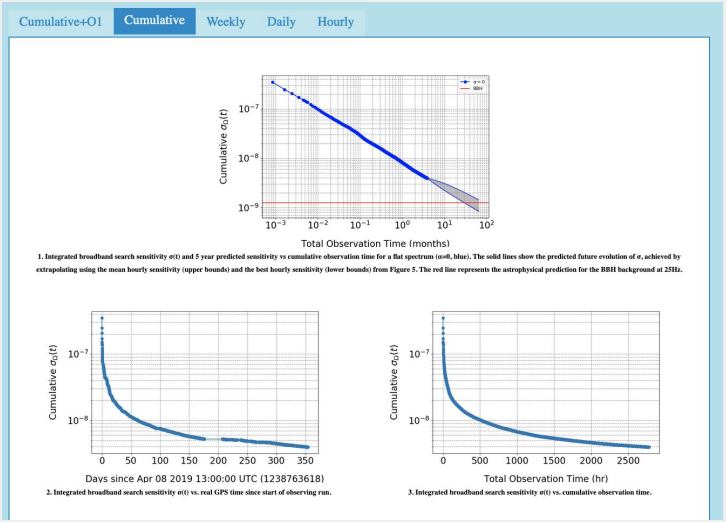


R. Abbott et al. 2021

StochCharMon

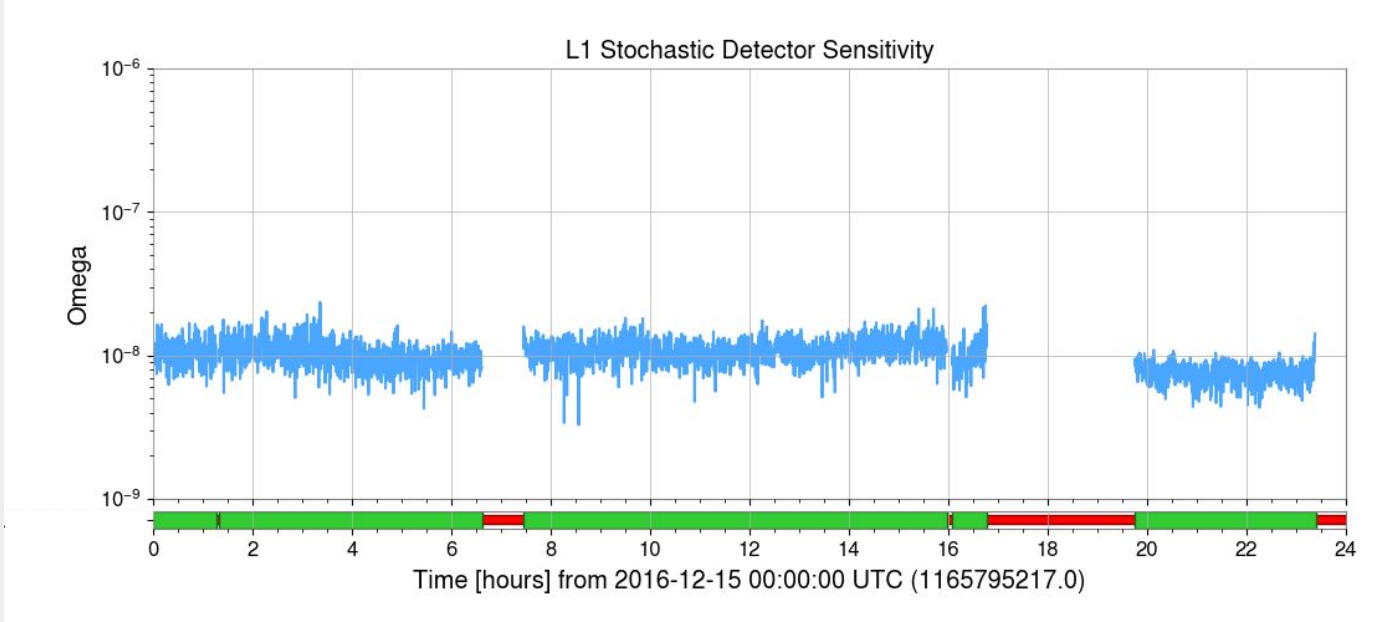
Stochmon → StochCharMon

- Low latency stochastic data monitoring pipeline
- Update and integrate
- SGWB detection
- Current Summary Page



Stochastic Detector Sensitivity

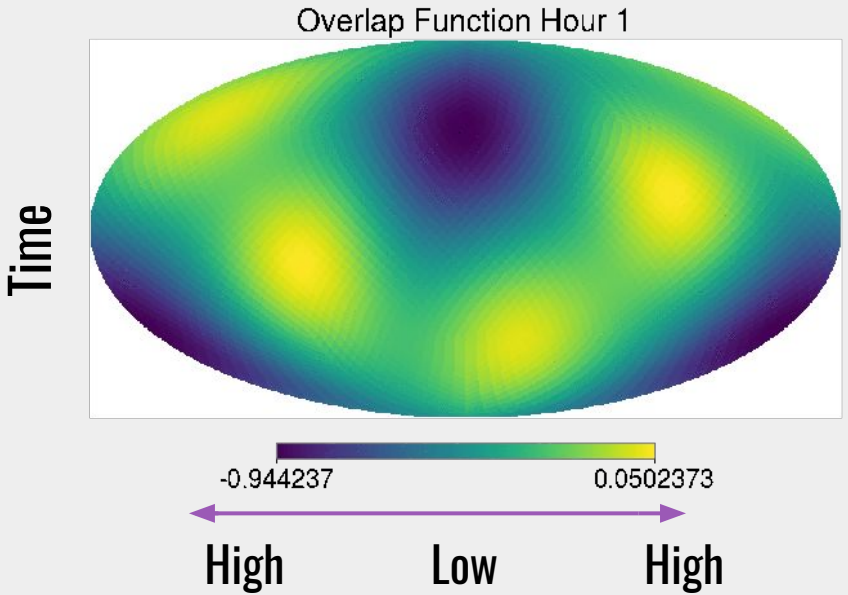
- SDS
- Sensitivity of a singular detector

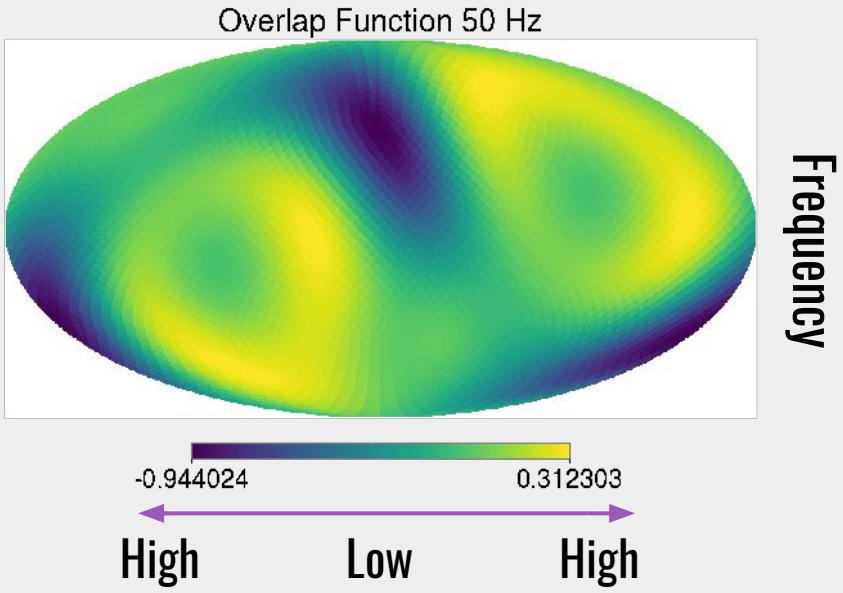


Lower SDS
=
Better

Stochastic Overlap Function

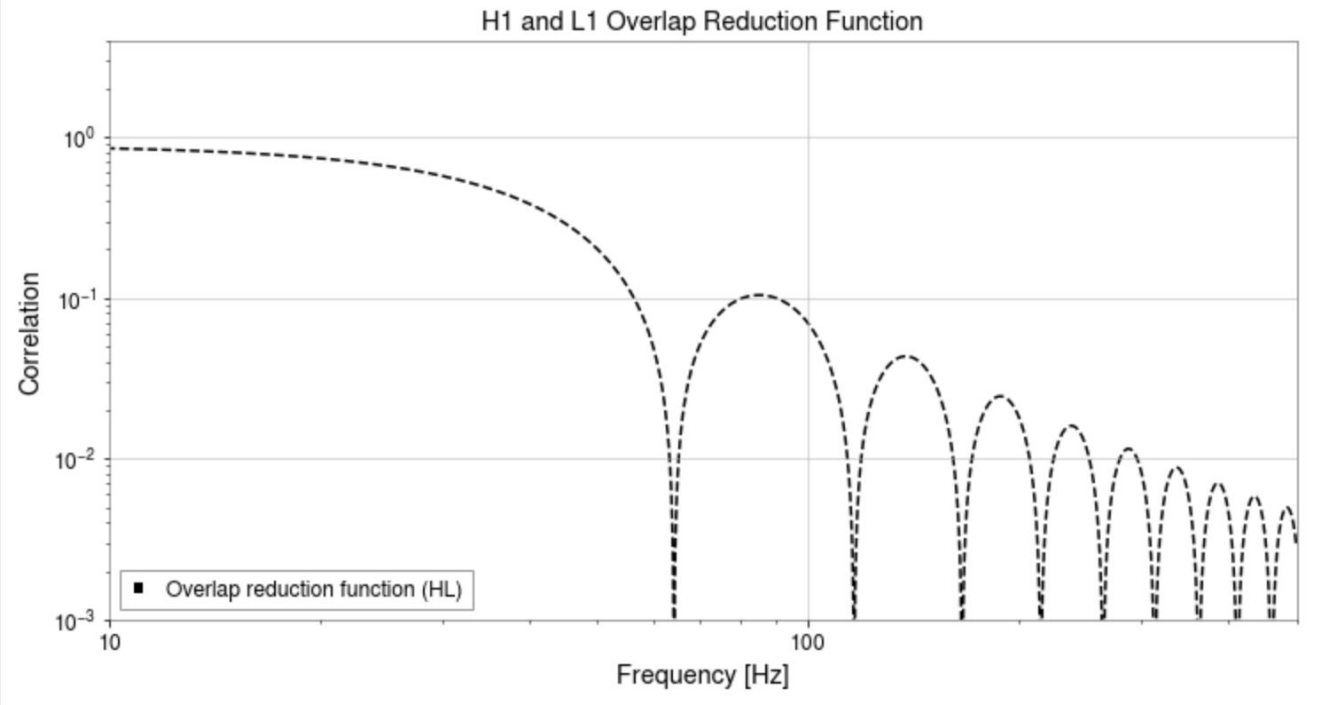
- Detector polarization response function (+ and x)
- Sensitivity of a pair of detectors





Overlap Reduction Function

- Frequency dependent correlation between a pair of detectors

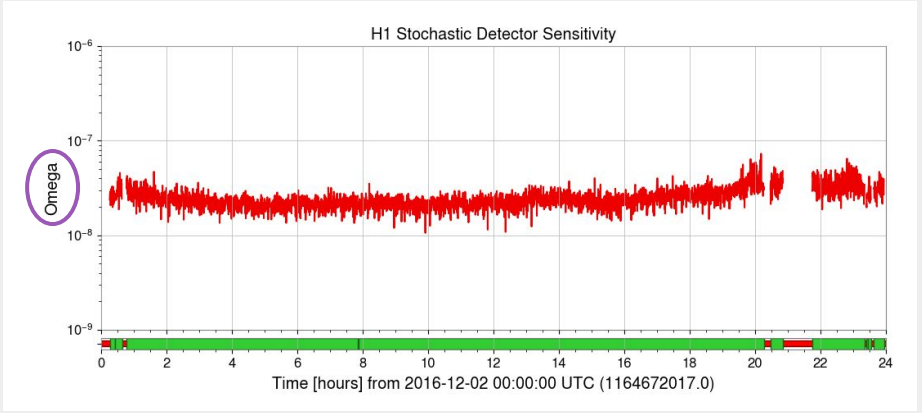


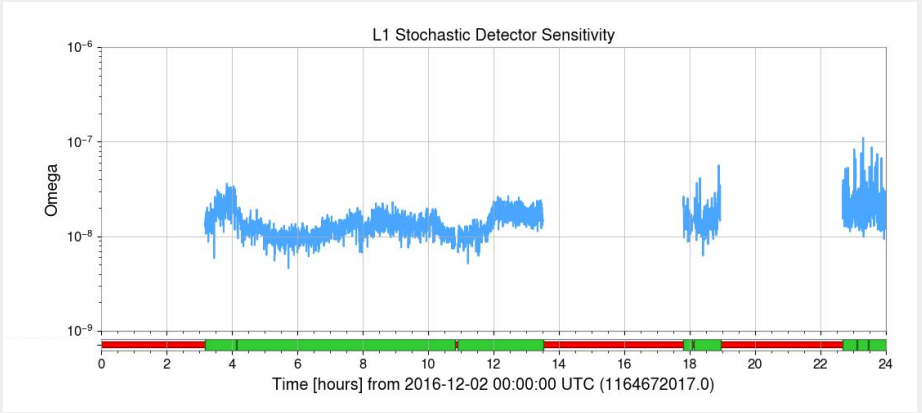
Stochastic Detector Sensitivity

- 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: $\alpha = \frac{2}{3}$



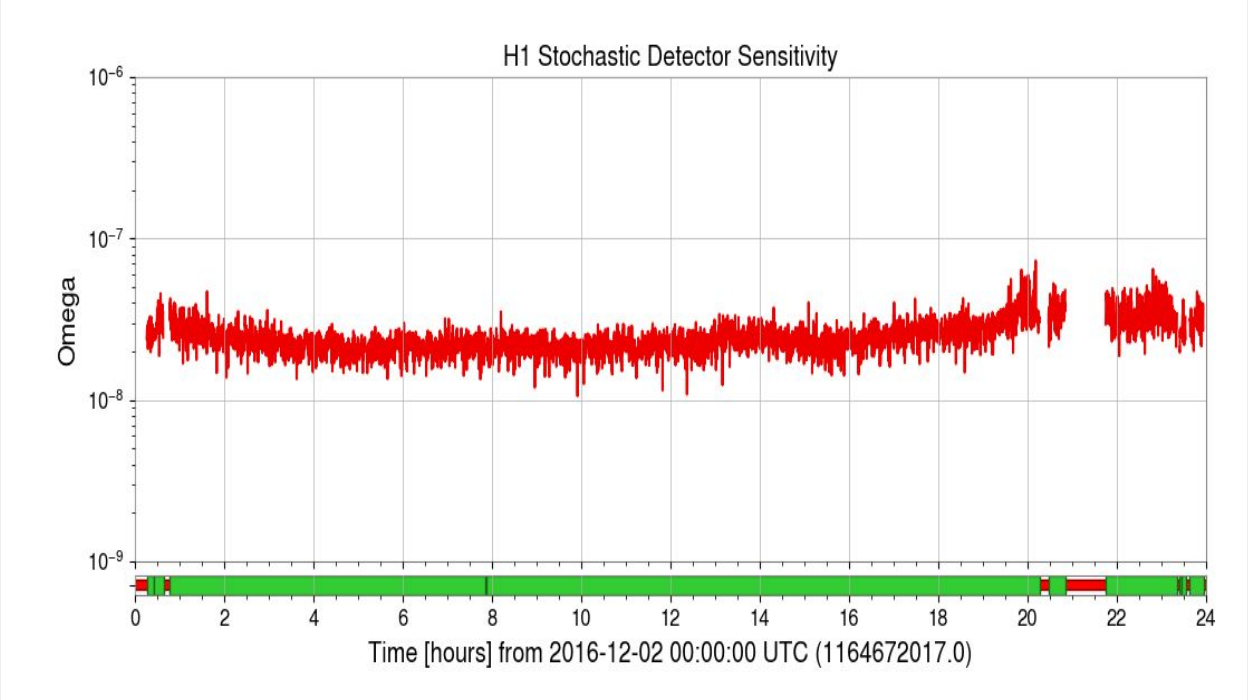


The Constant

- Re-normalize the fractional energy density
- Obtain the constant from energy density equation

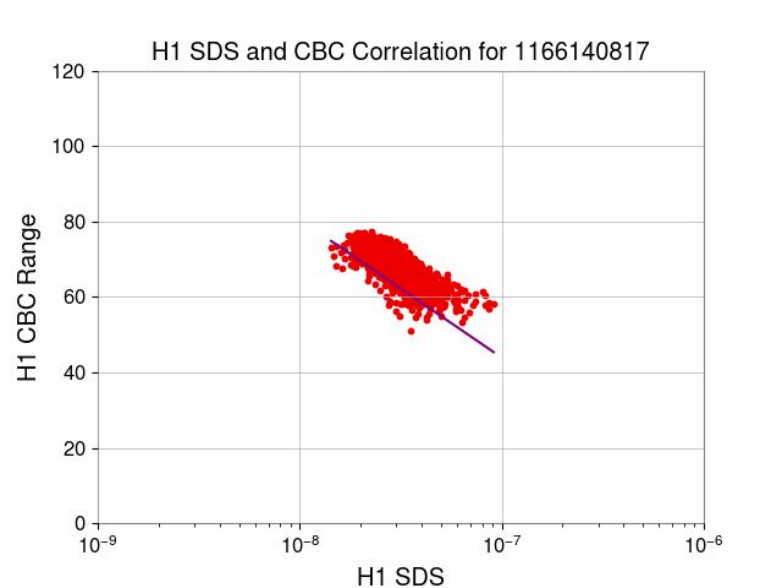
$$\Omega_0 = \frac{\rho}{T^{1/2}} f_0^{2/3} \left(\frac{2\pi^2}{3H_0}\right) \left(\int \left(\frac{(ORF)(f^{\alpha-3})}{PSD} \right)^2 df \right)^{-1/2}$$

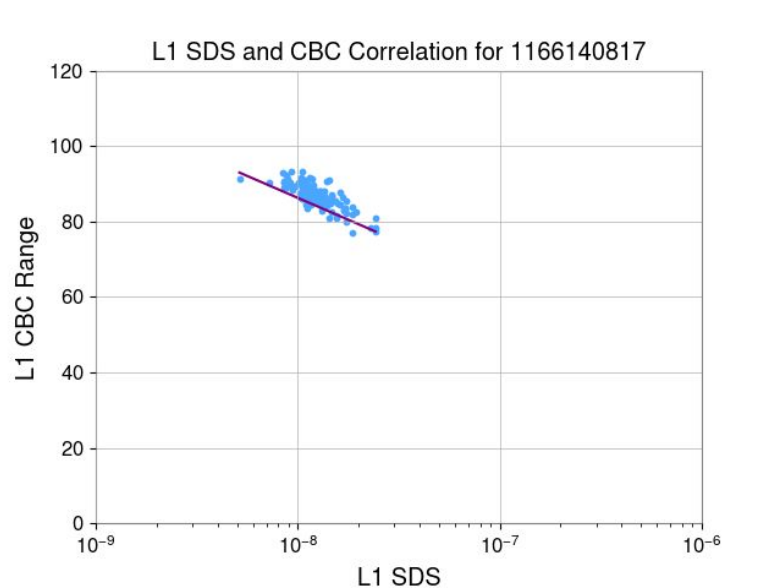
The Constant



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

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Caltech

Thank you.