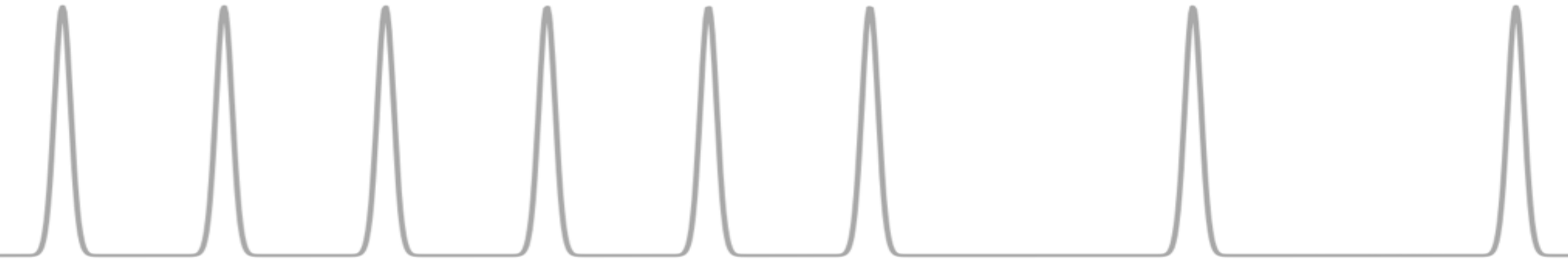
PTAs Beyond the Stochastic Background

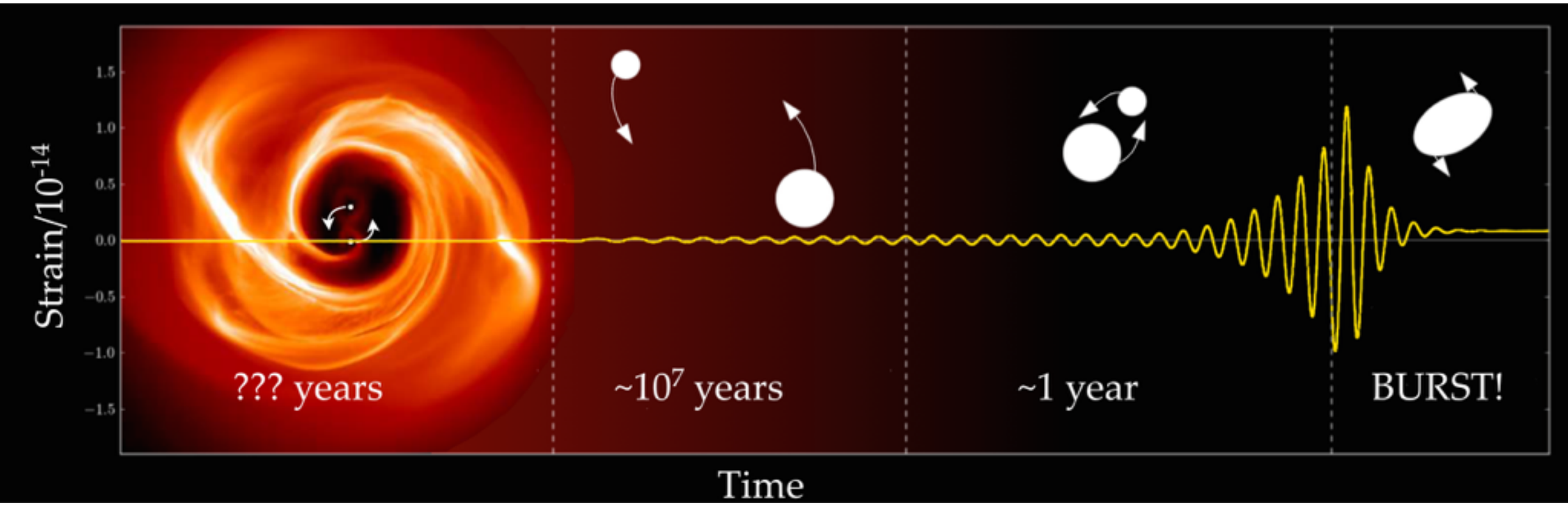
Dusty Madison

Jansky Fellow

NRAO Charlottesville



Our Sources


Strain/10-14
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
??? years
~10^7 years
~1 year
BURST!
Time

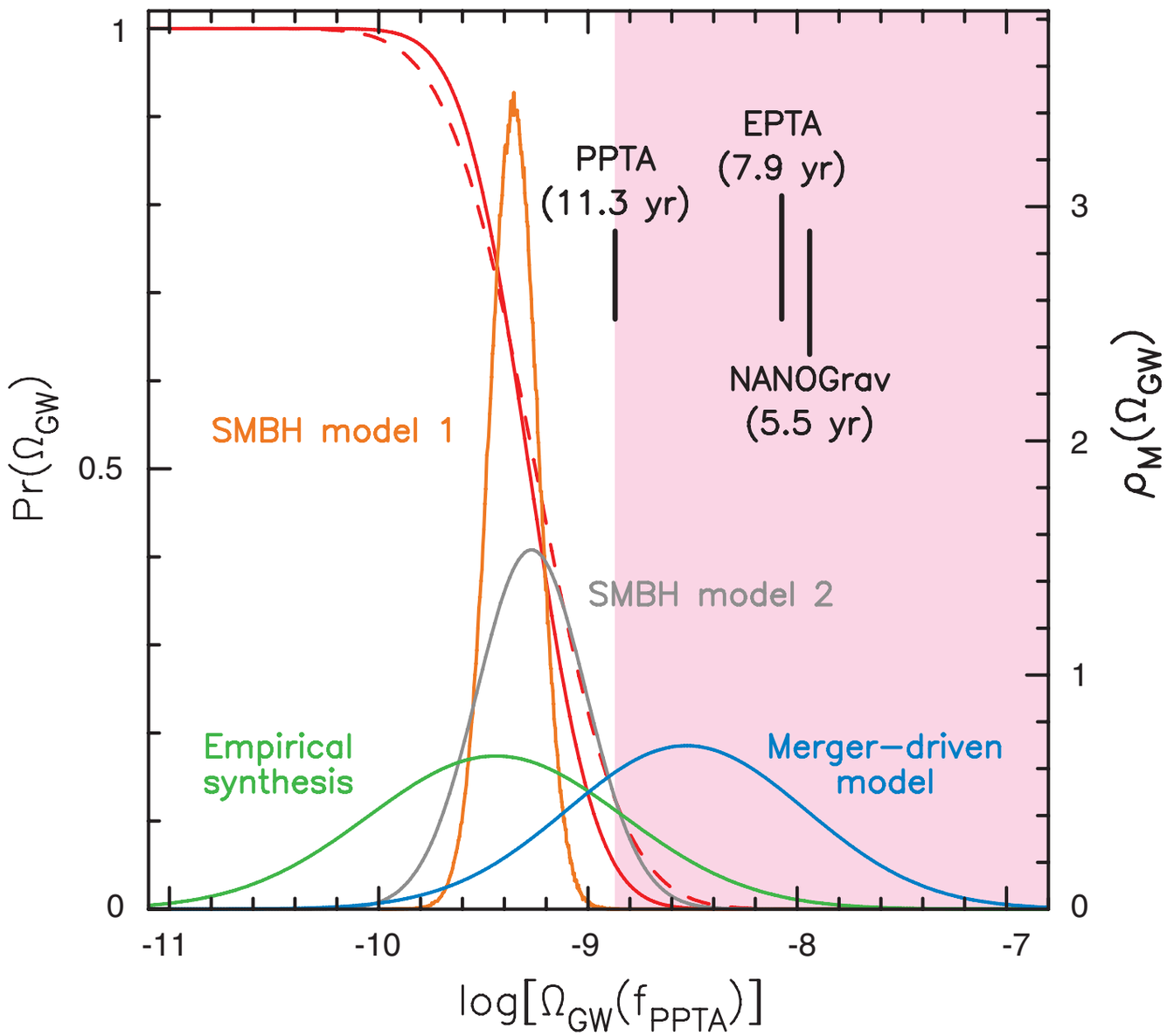
A Stochastic GW Background

Circular GW-driven binaries assuming isotropy and homogeneity of population

$$h_c^2(f) = \frac{4f^{-4/3}}{3\pi^{1/3}} \int\int dz d\mathcal{M} \frac{d^2n}{dz d\mathcal{M}} \frac{\mathcal{M}^{5/3}}{(1+z)^{1/3}}$$

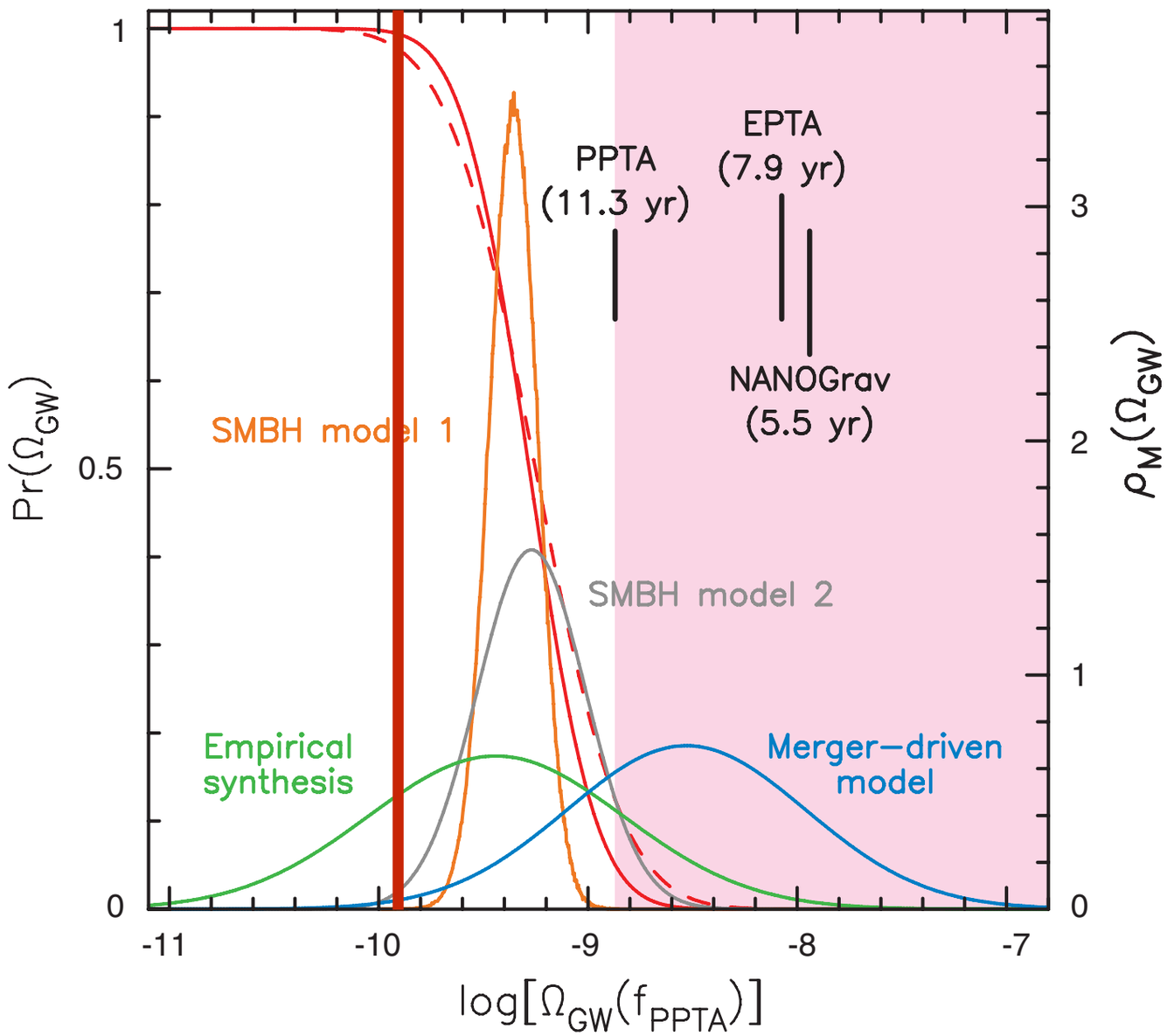
Sesana (2013)

We Haven't Made a Detection Yet???



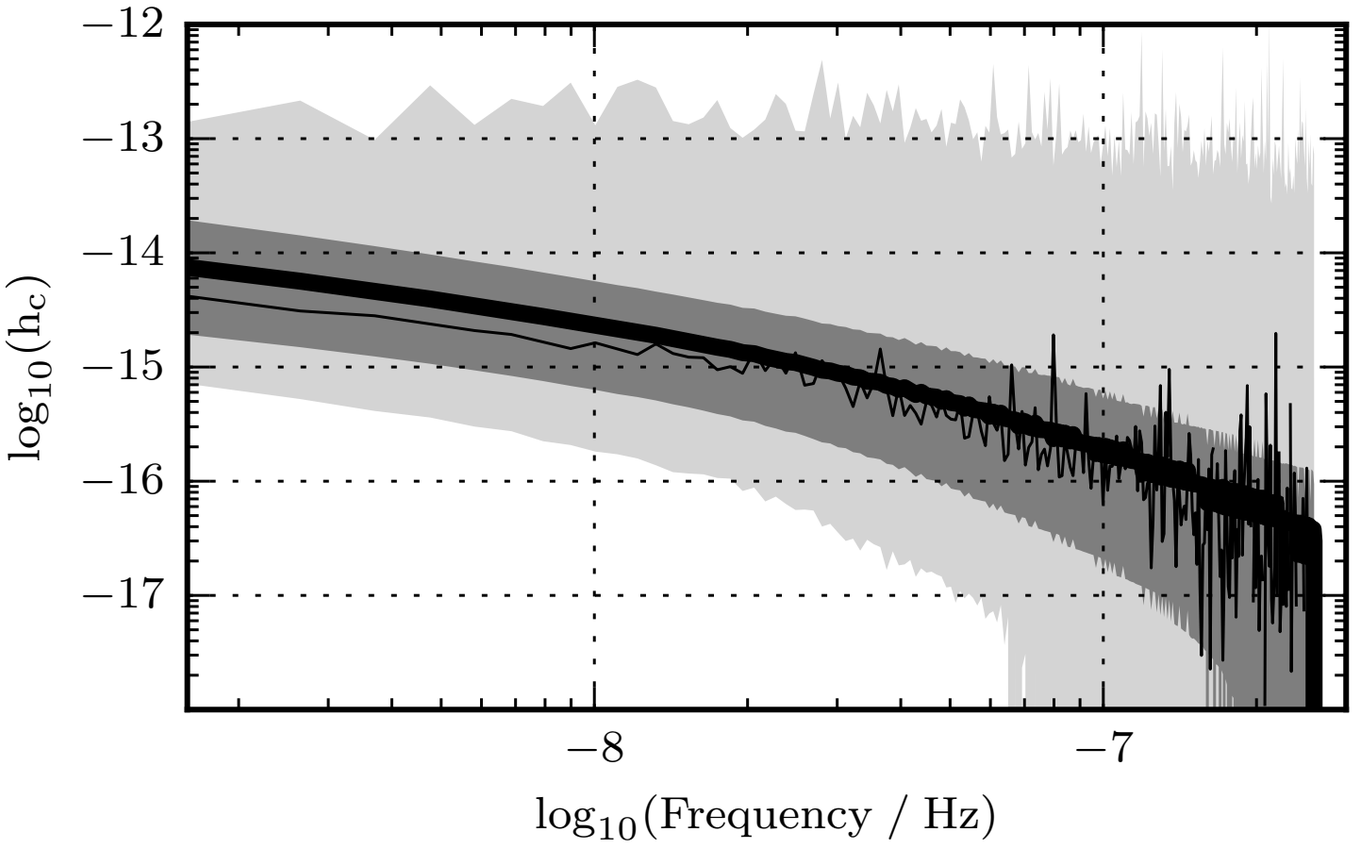
Shannon et al. (2013)

We Haven't Made a Detection Yet???

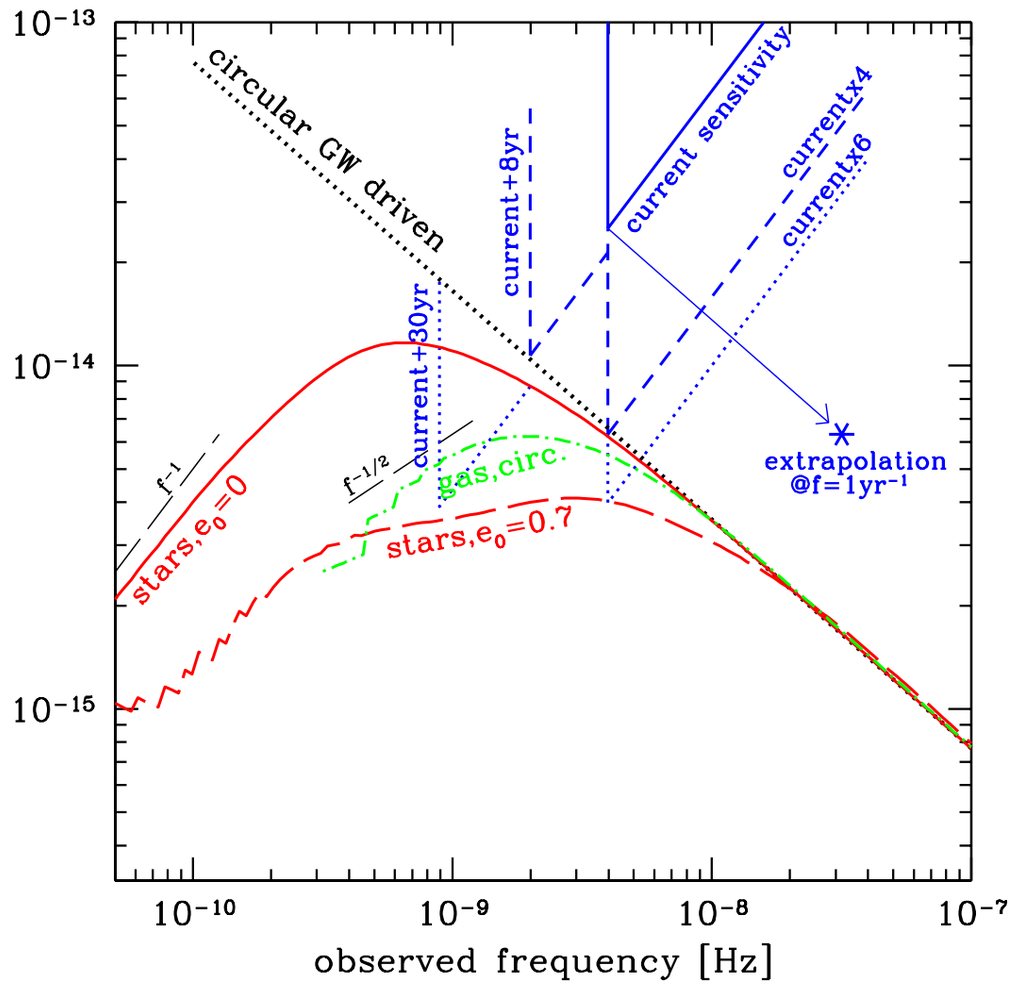


Shannon et al. (2013)

Realities of the Background

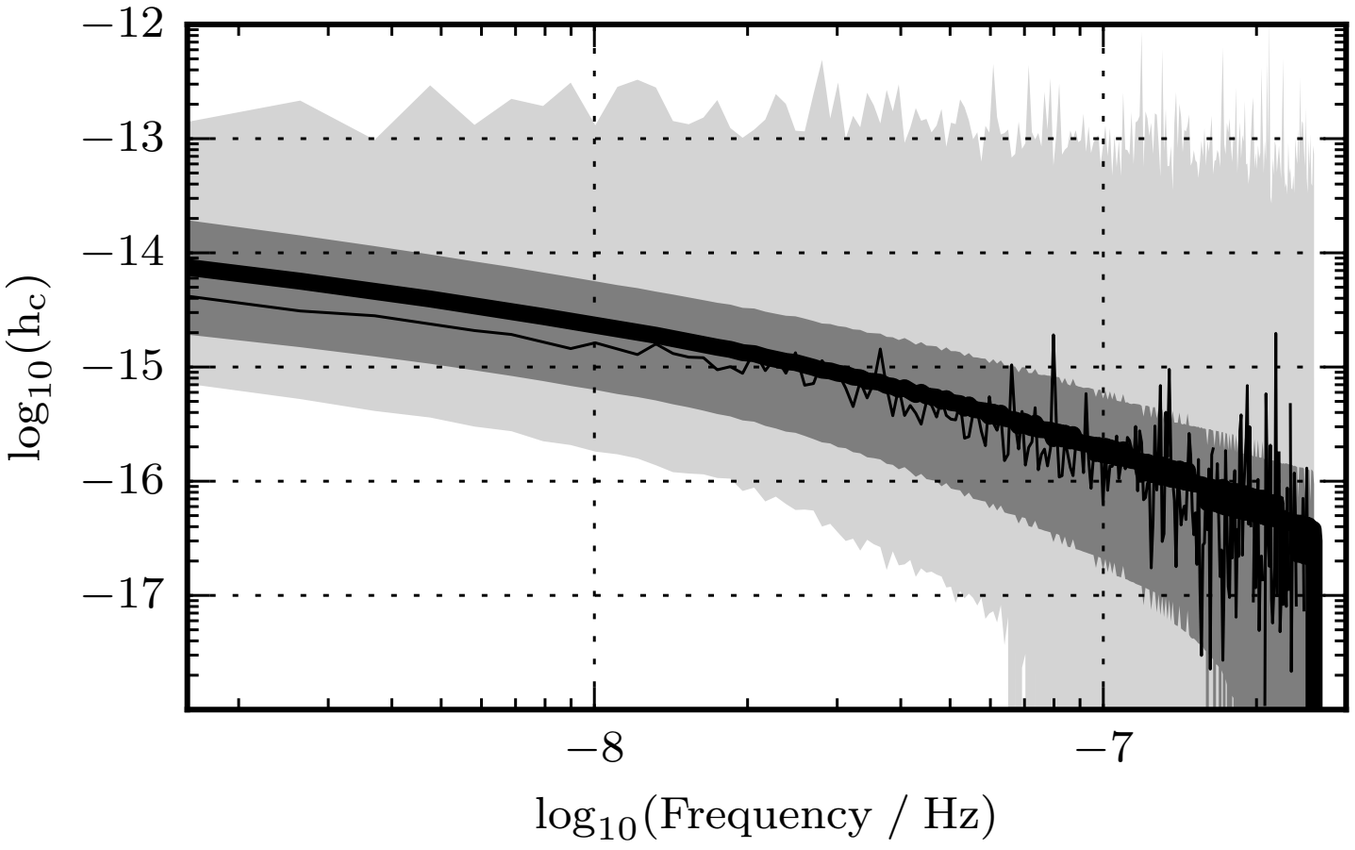


Rosado, Sesana & Gair (2015)

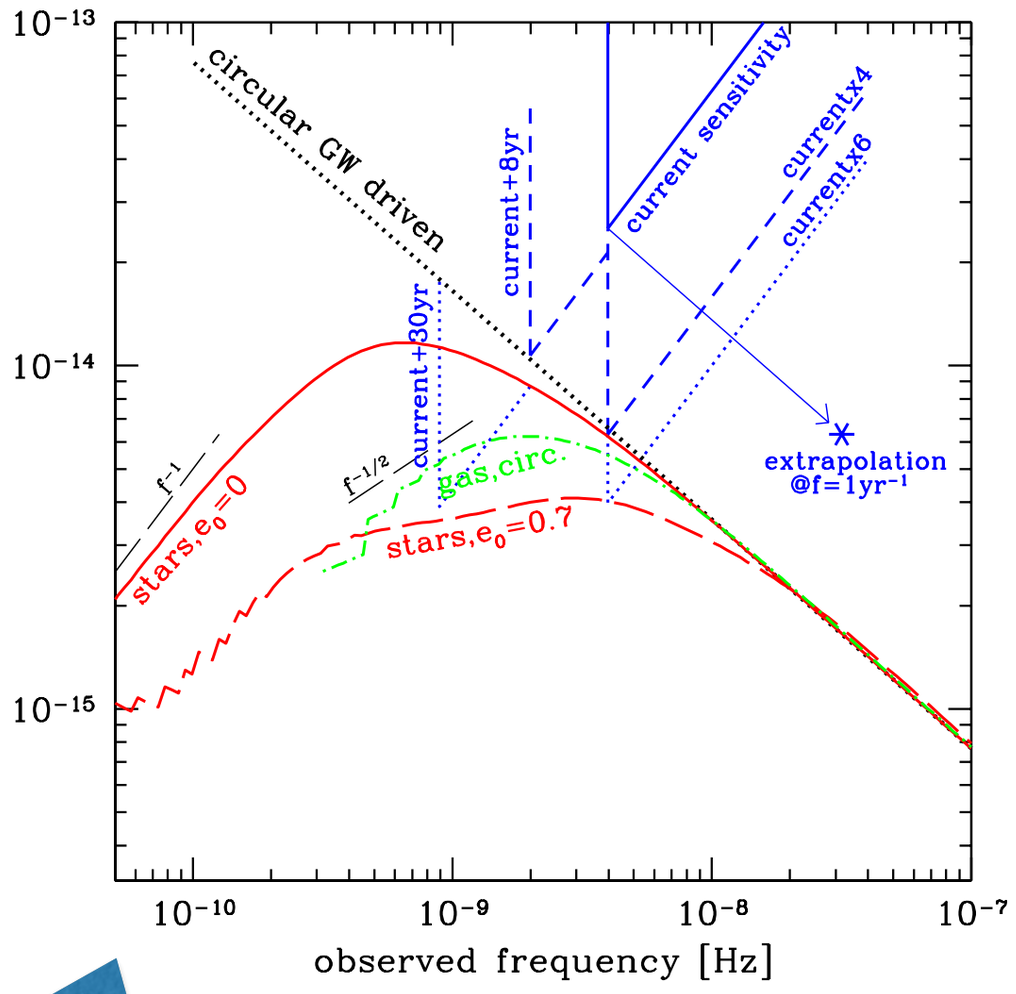


Sesana (2013)

Realities of the Background



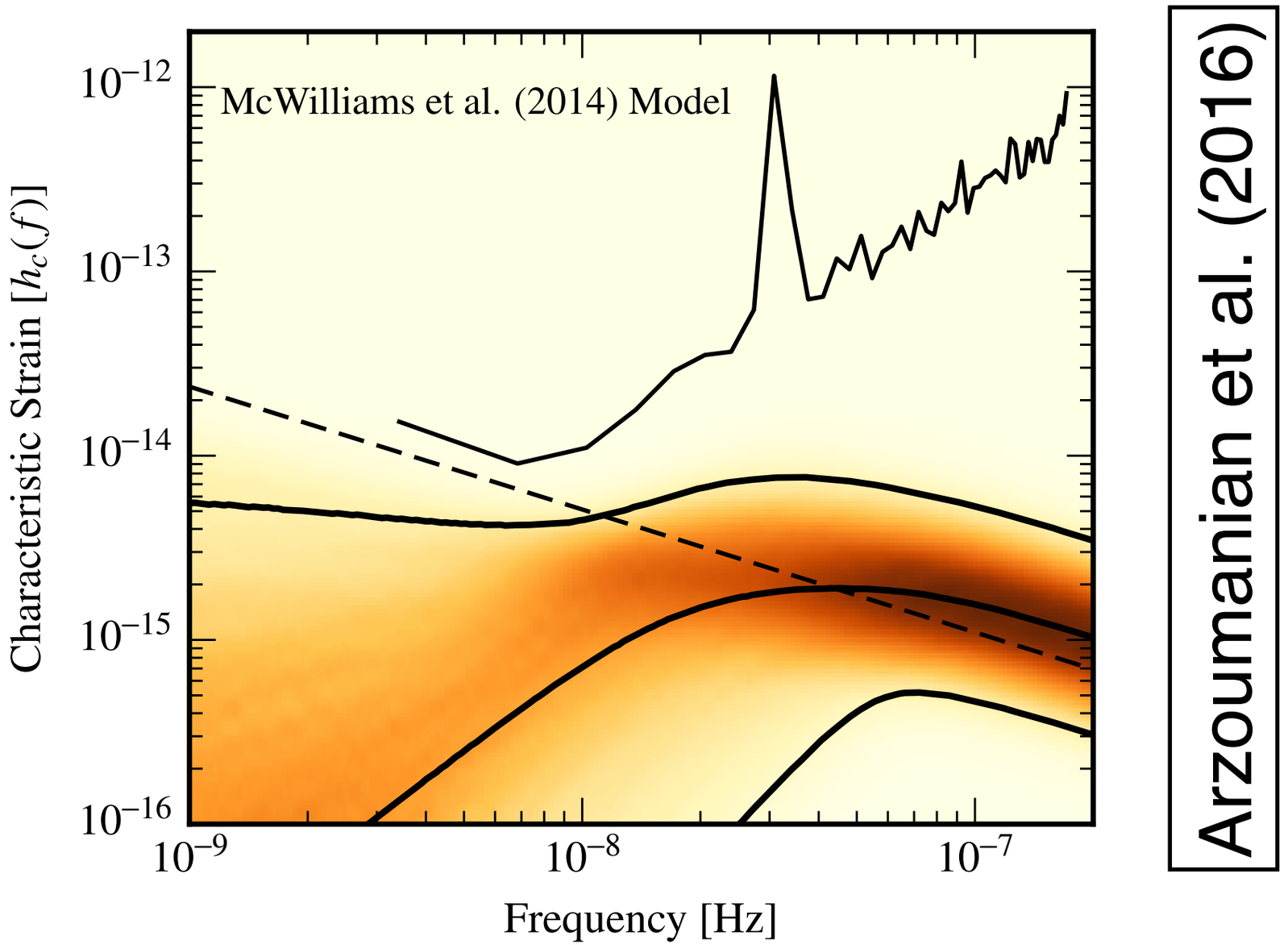
Rosado, Sesana & Gair (2015)



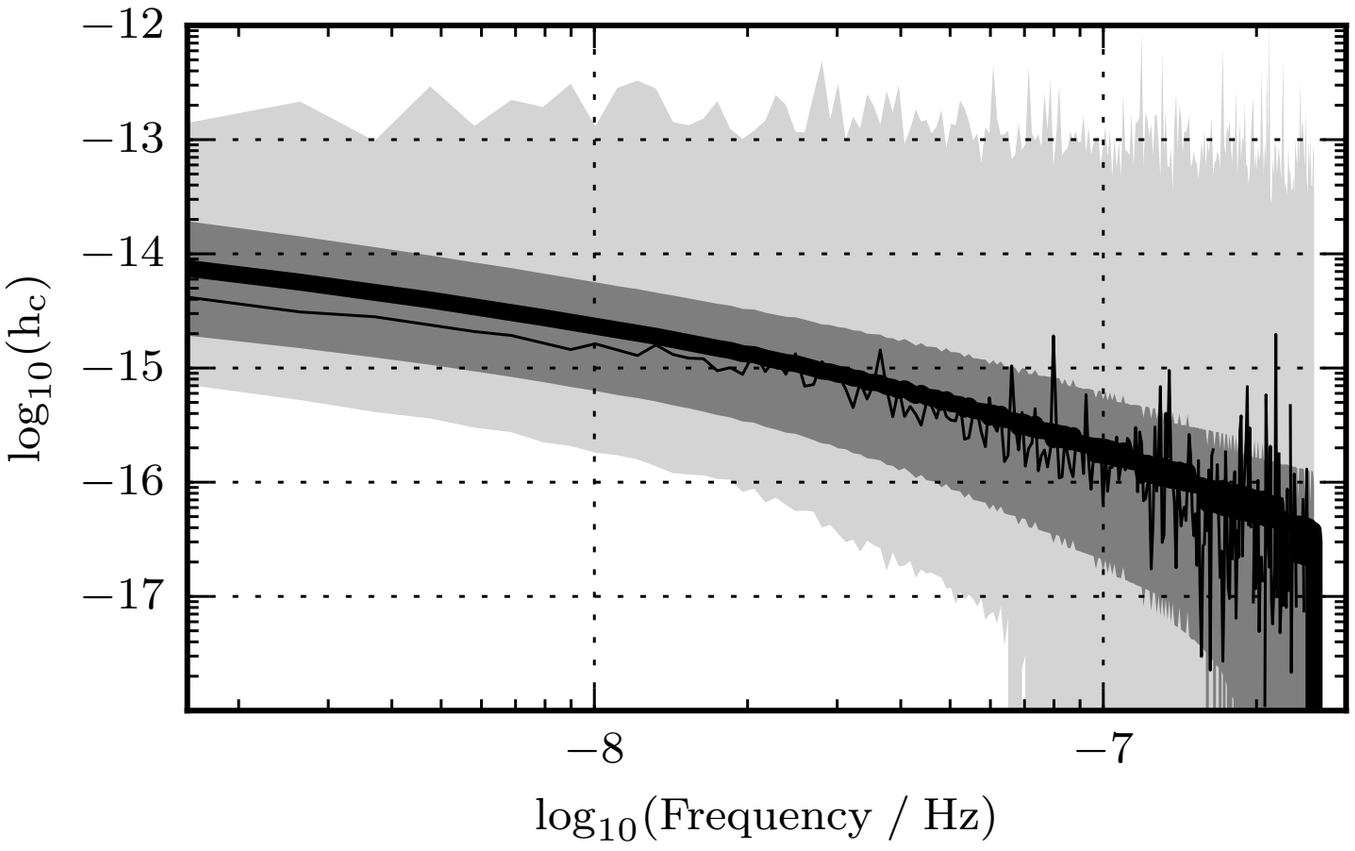
Sesana (2013)

Environmental Attenuation

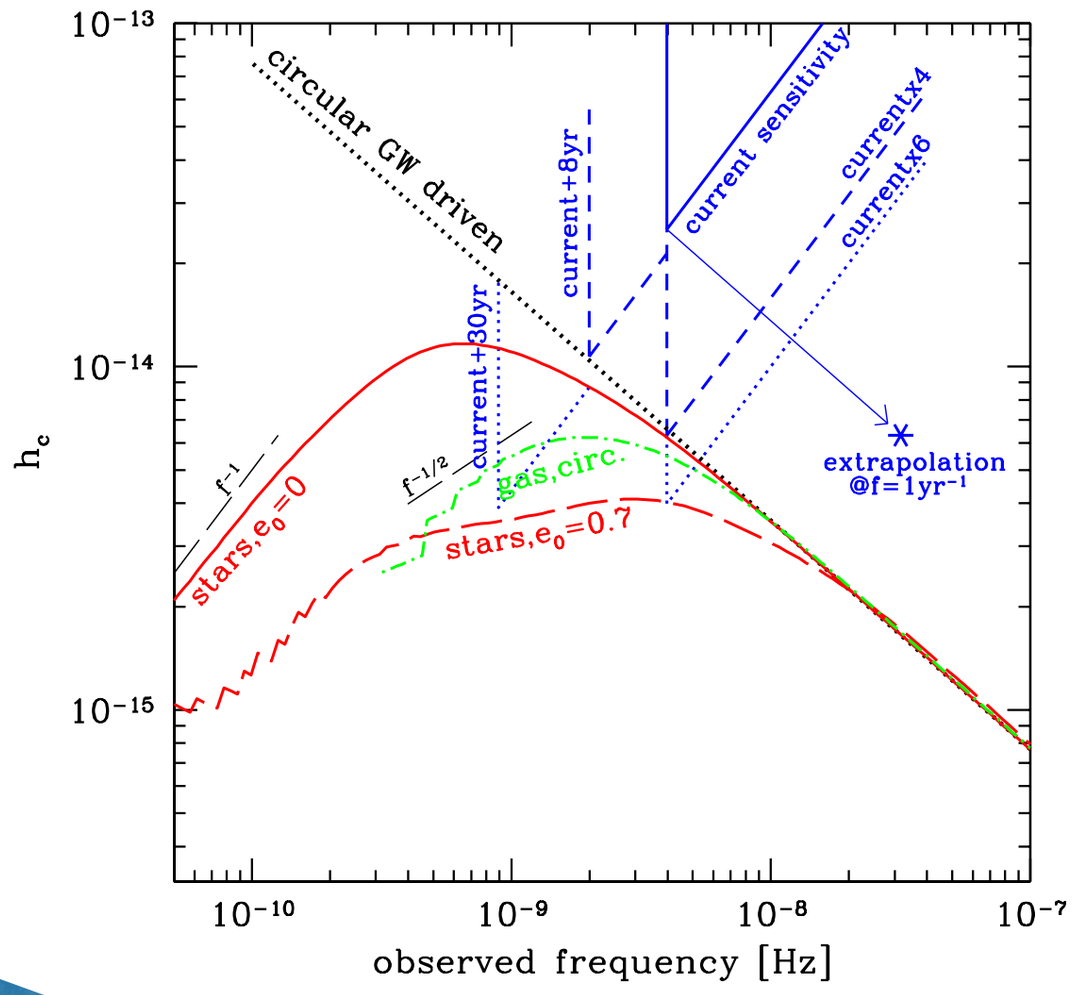
$$h_c(f) = A \frac{(f/f_{\rm yr})^{\alpha}}{(1+(f_{\rm bend}/f)^{\kappa})^{1/2}}$$



Realities of the Background

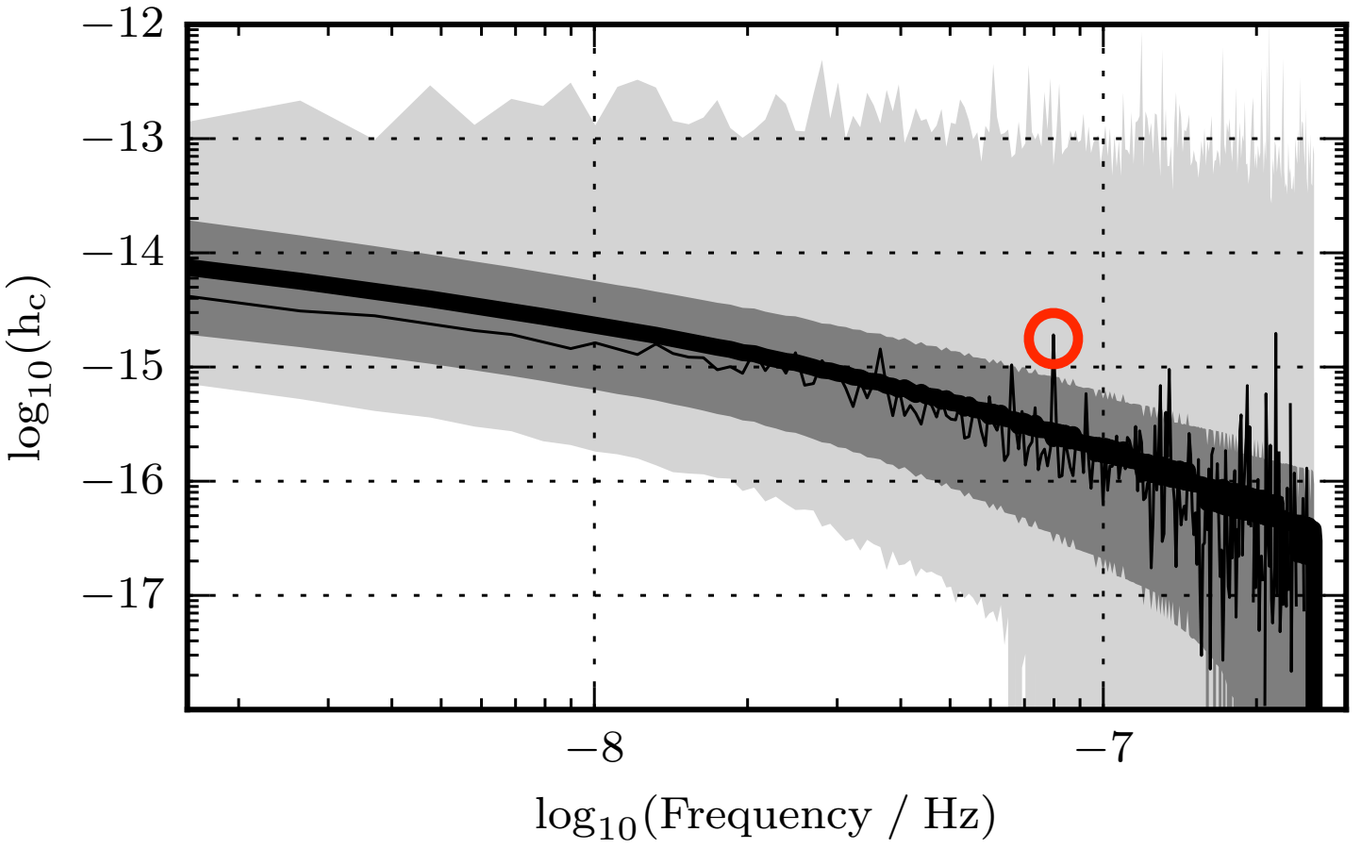


Rosado, Sesana & Gair (2015)

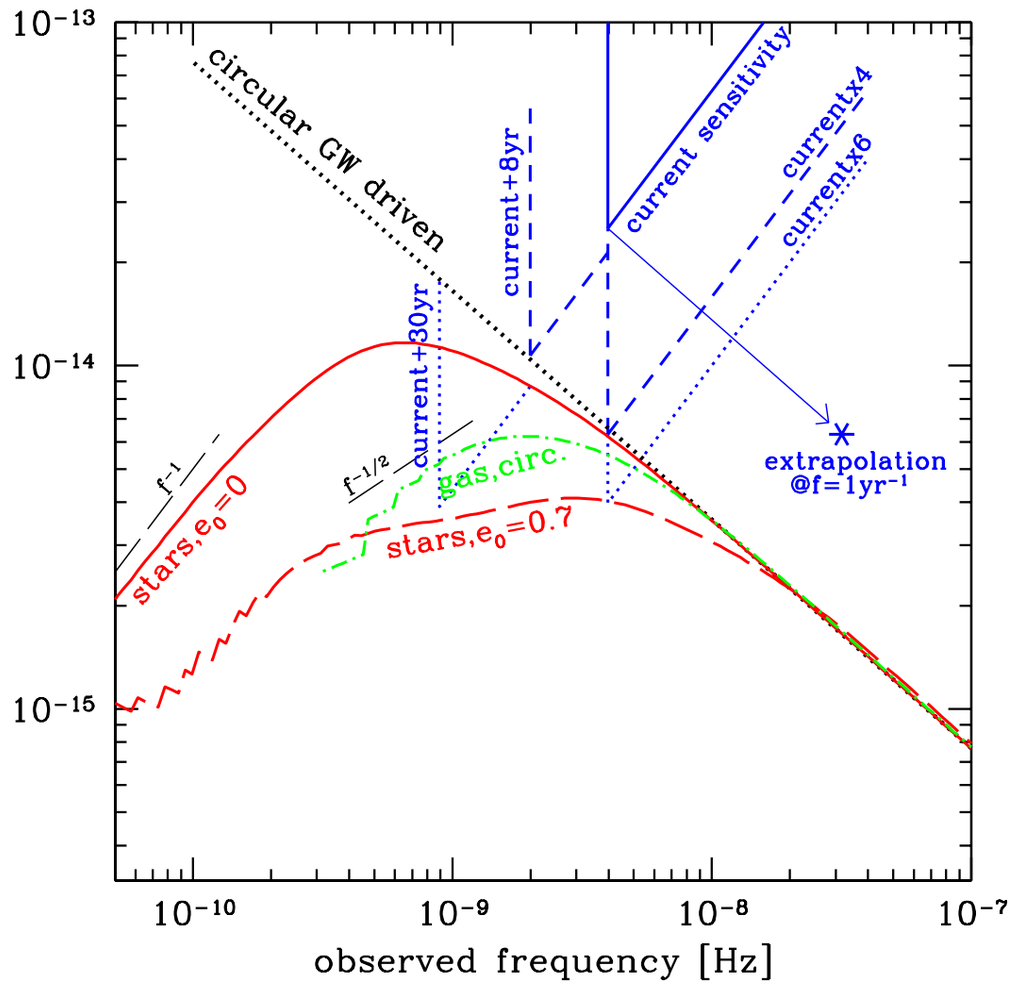


Sesana (2013)

Realities of the Background

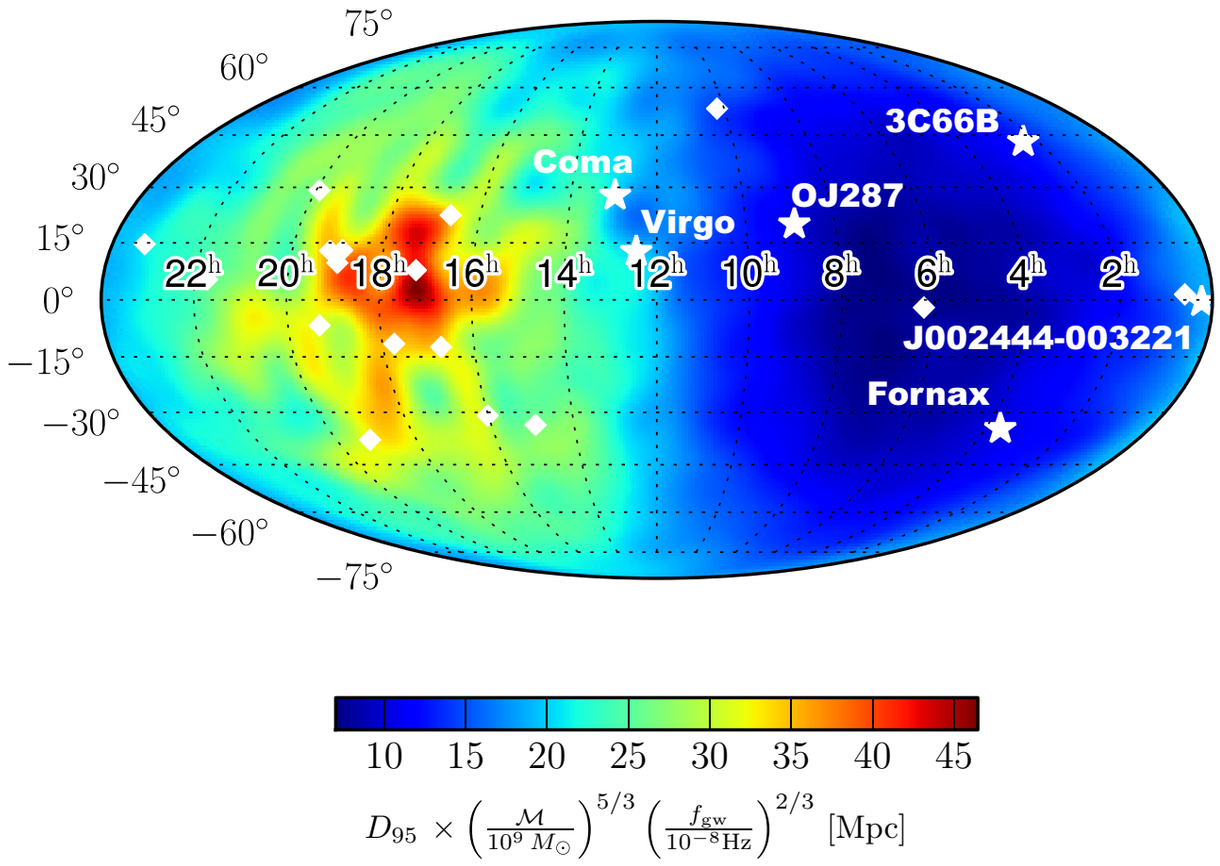


Rosado, Sesana & Gair (2015)

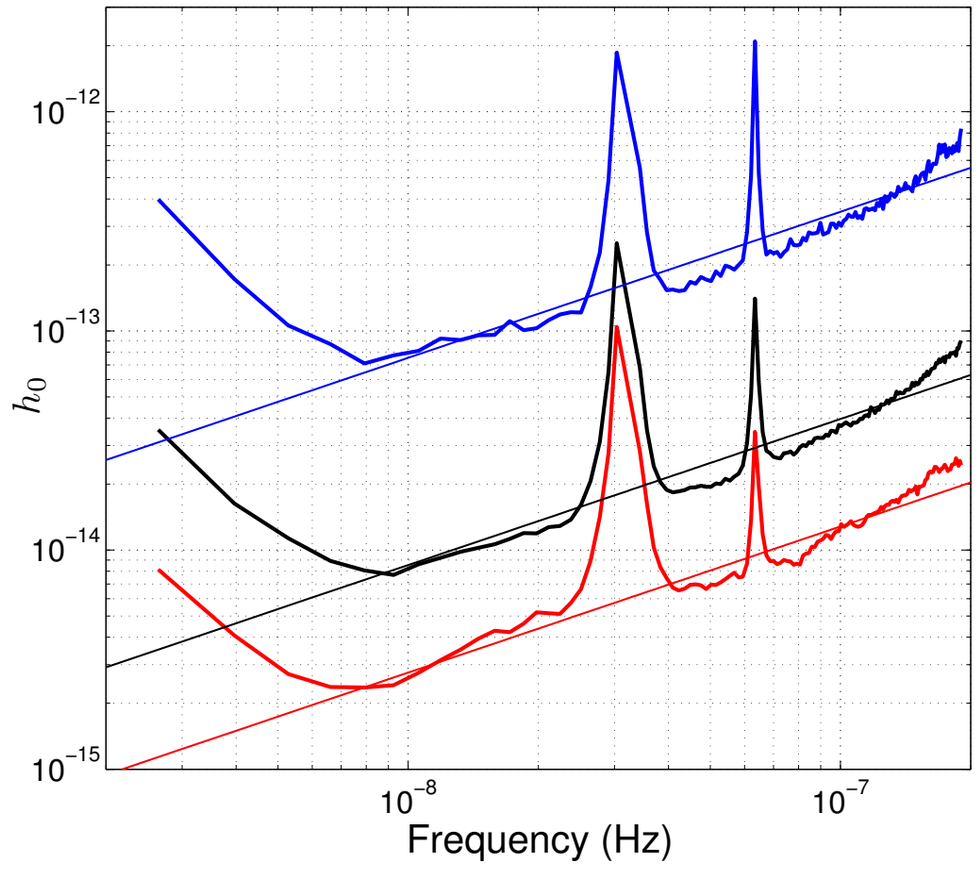


Sesana (2013)

Continuous Wave Searches



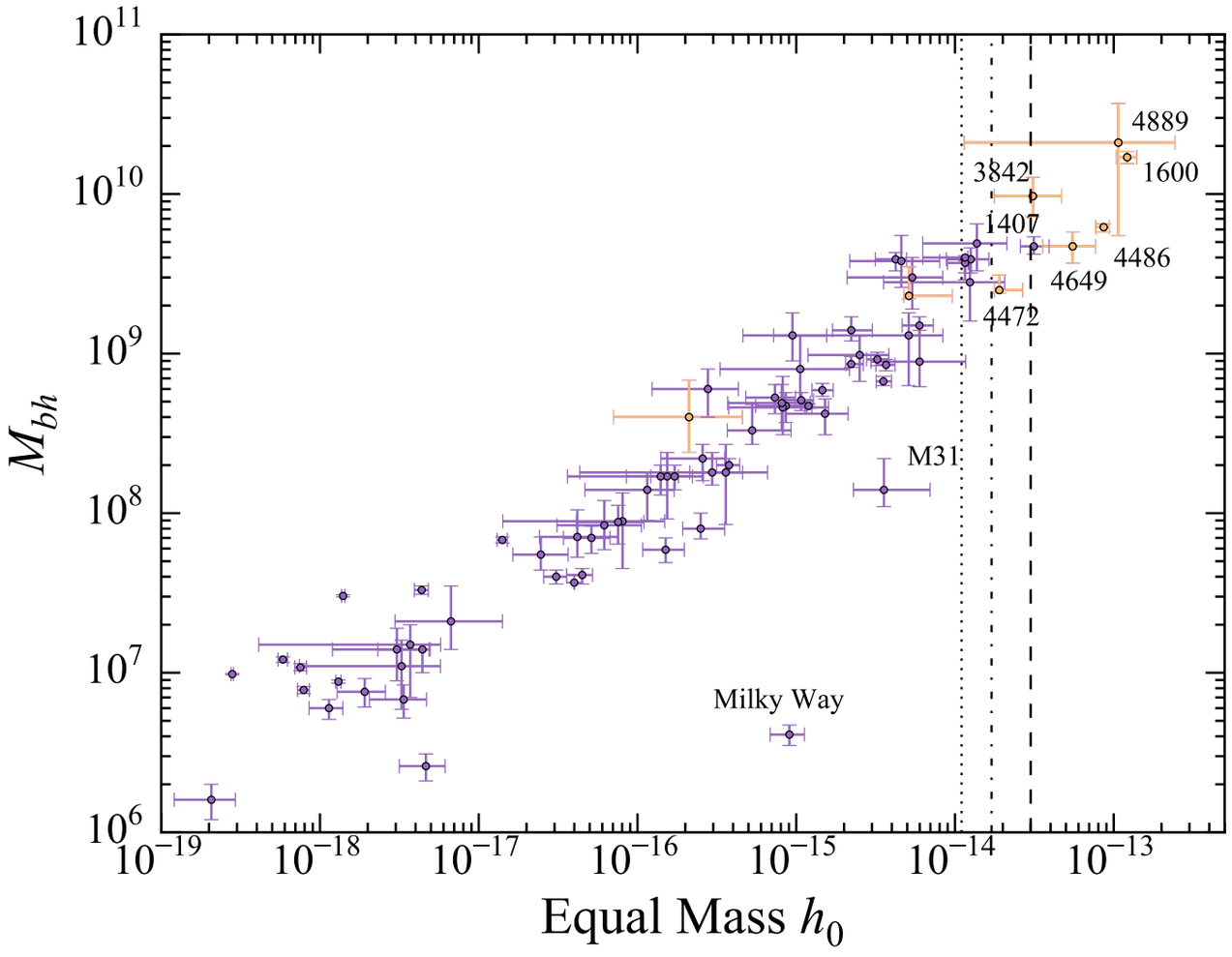
Arzoumanian et al. (2014)
NANOGrav



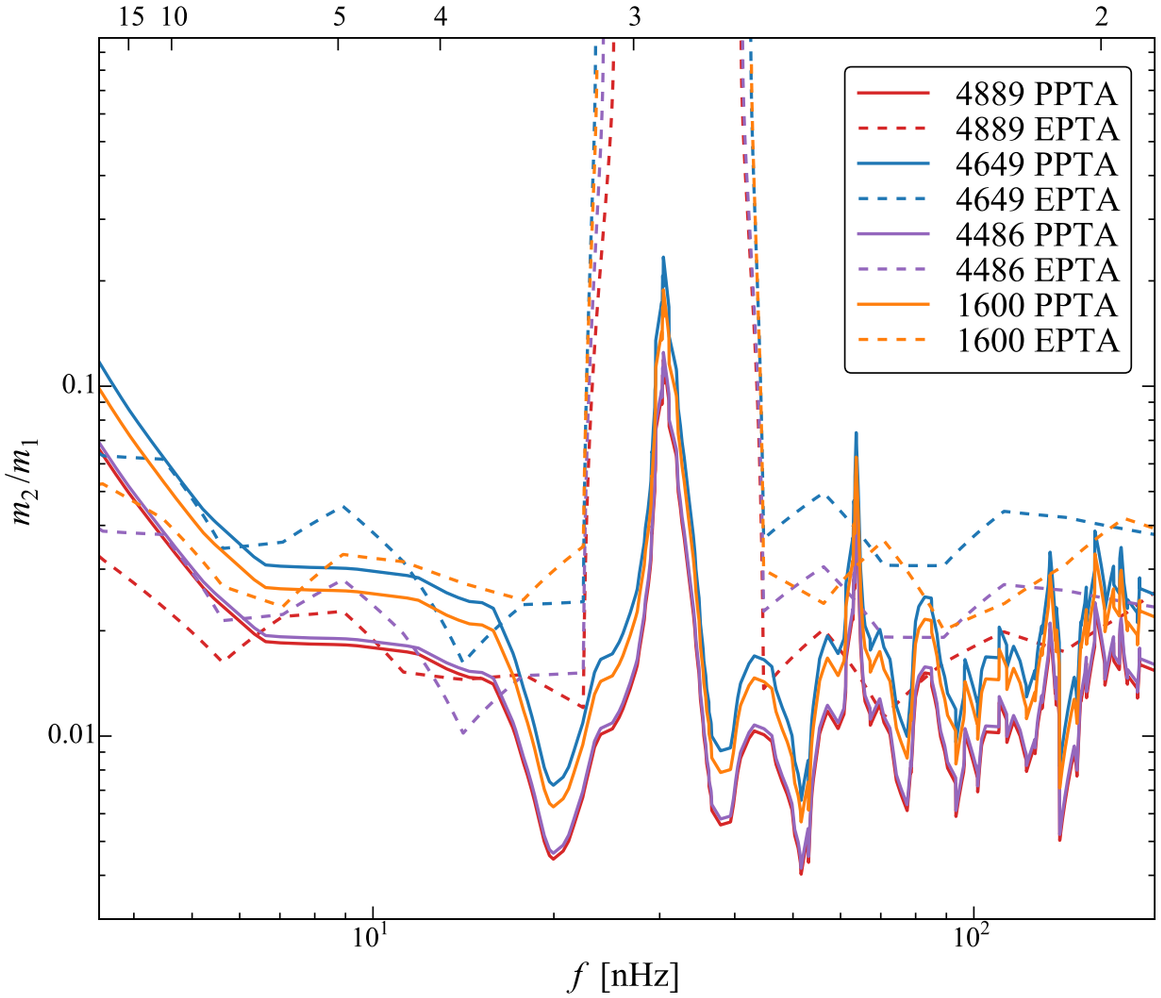
Zhu et al. (2014)
PPTA

Constraining Local Binarity

Measured SMBHs

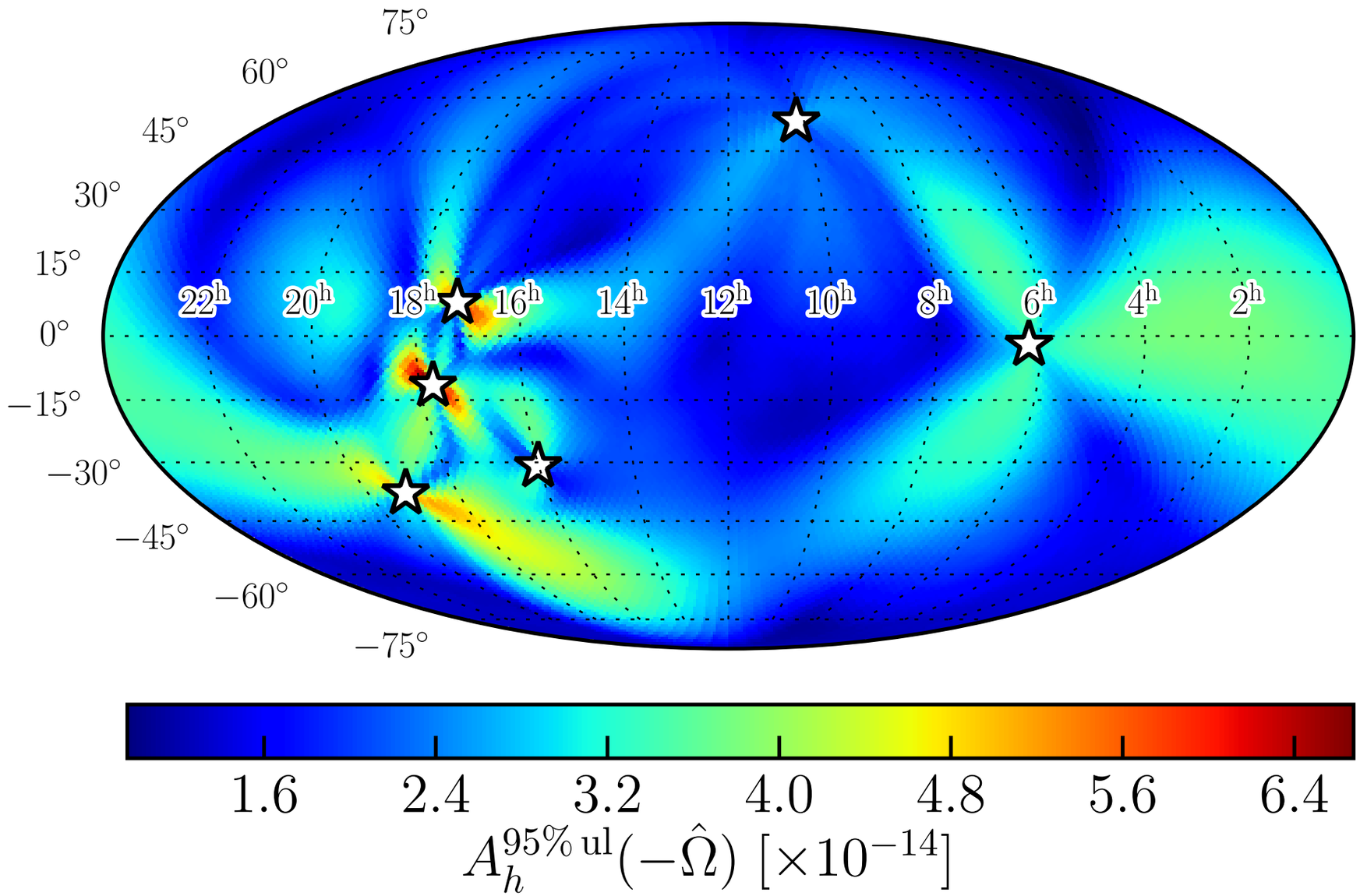


Mass Ratio Upper Limits



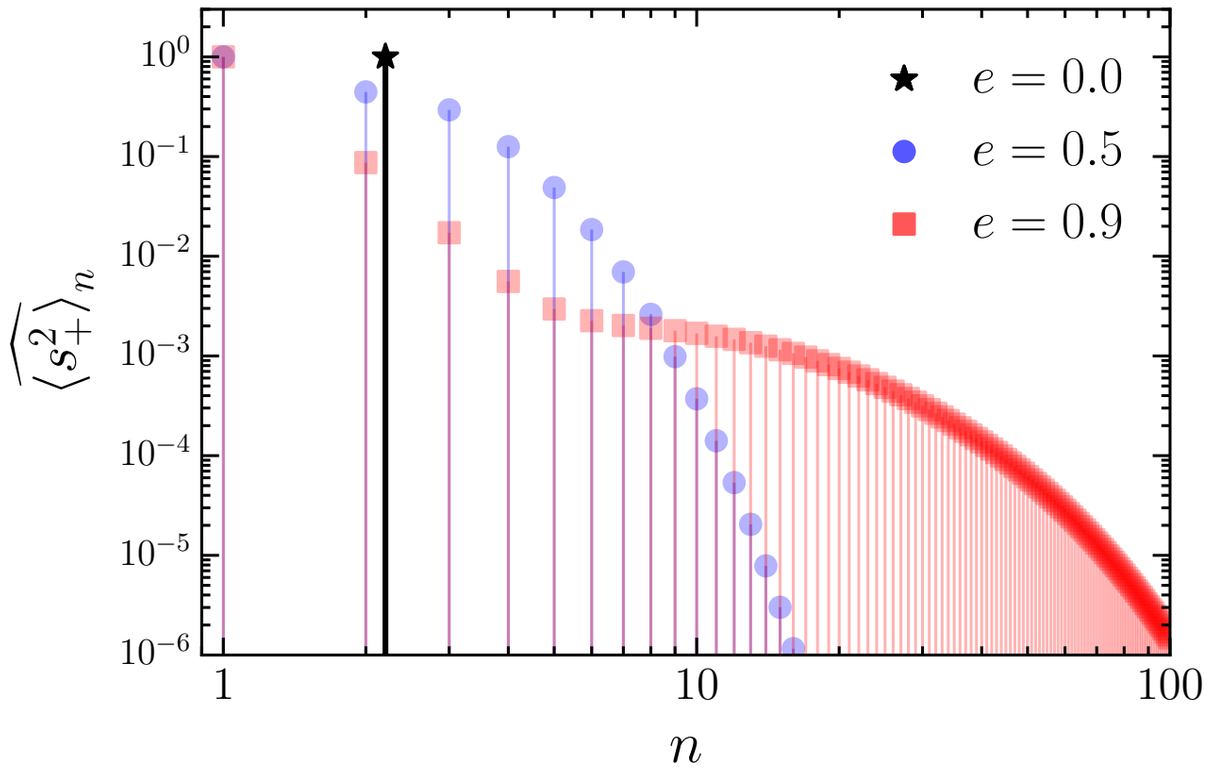
Schutz & Ma (2016)

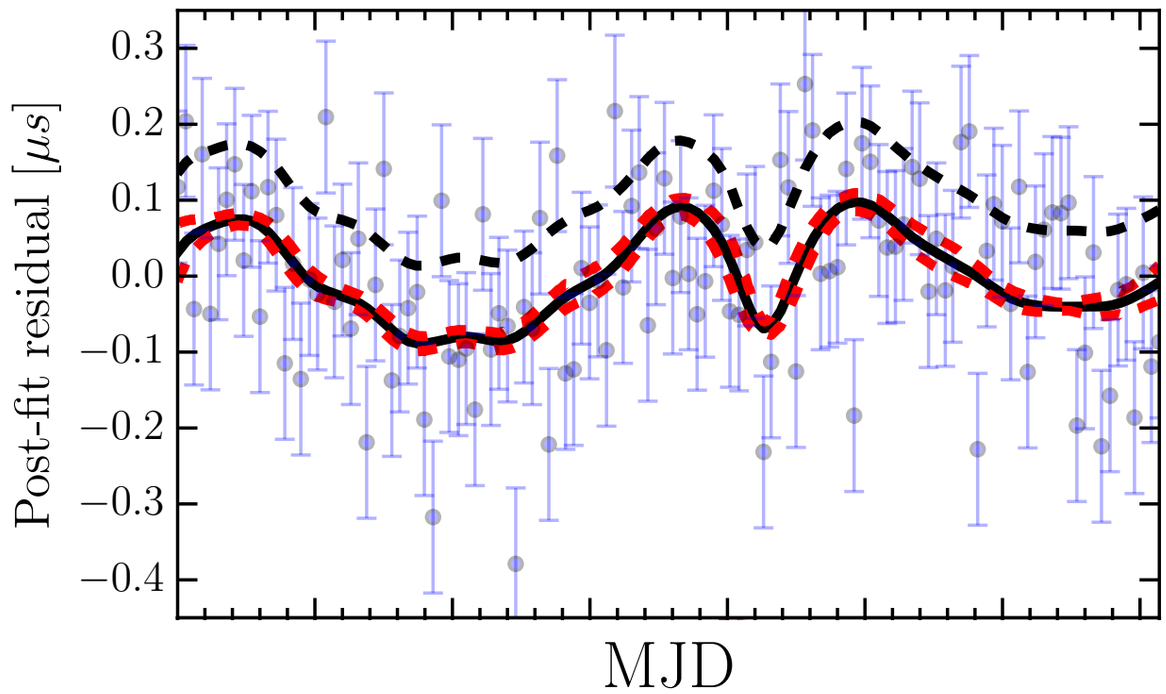
Anisotropic Background



Taylor, Mingarelli, et al. (2016)

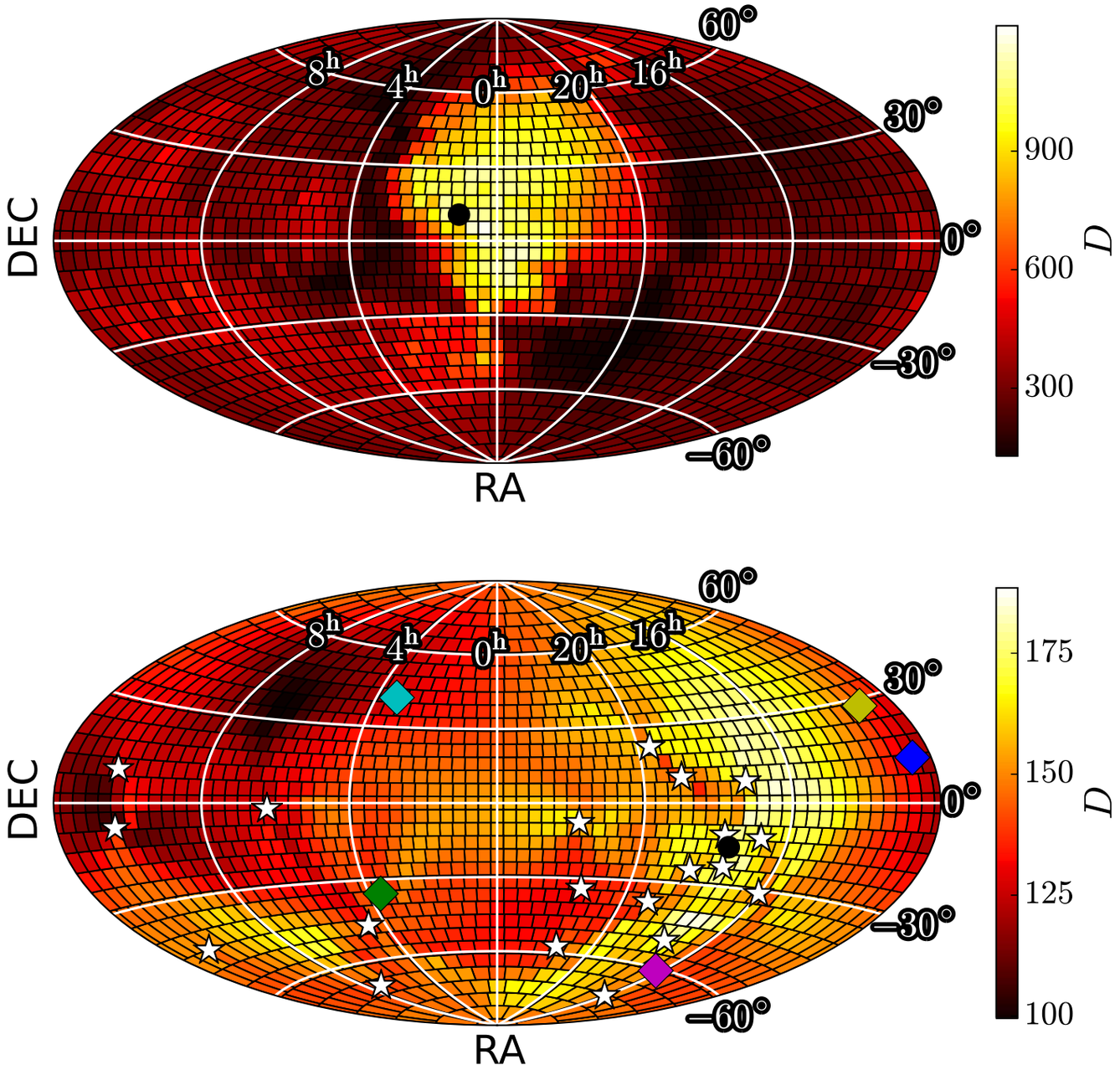
Eccentric Binaries

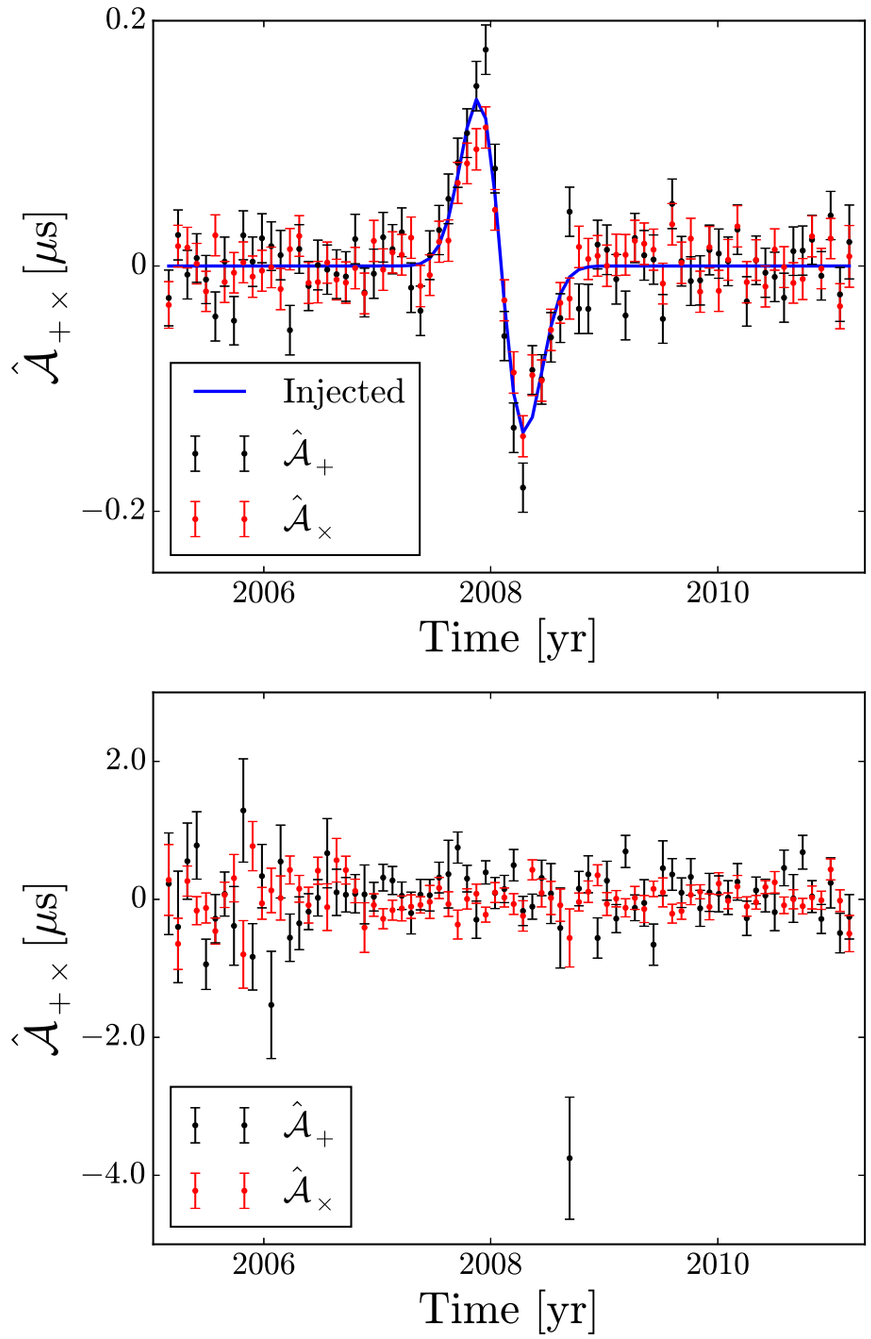




Taylor, Huerta, et al. (2016)

Flexible GW Searches

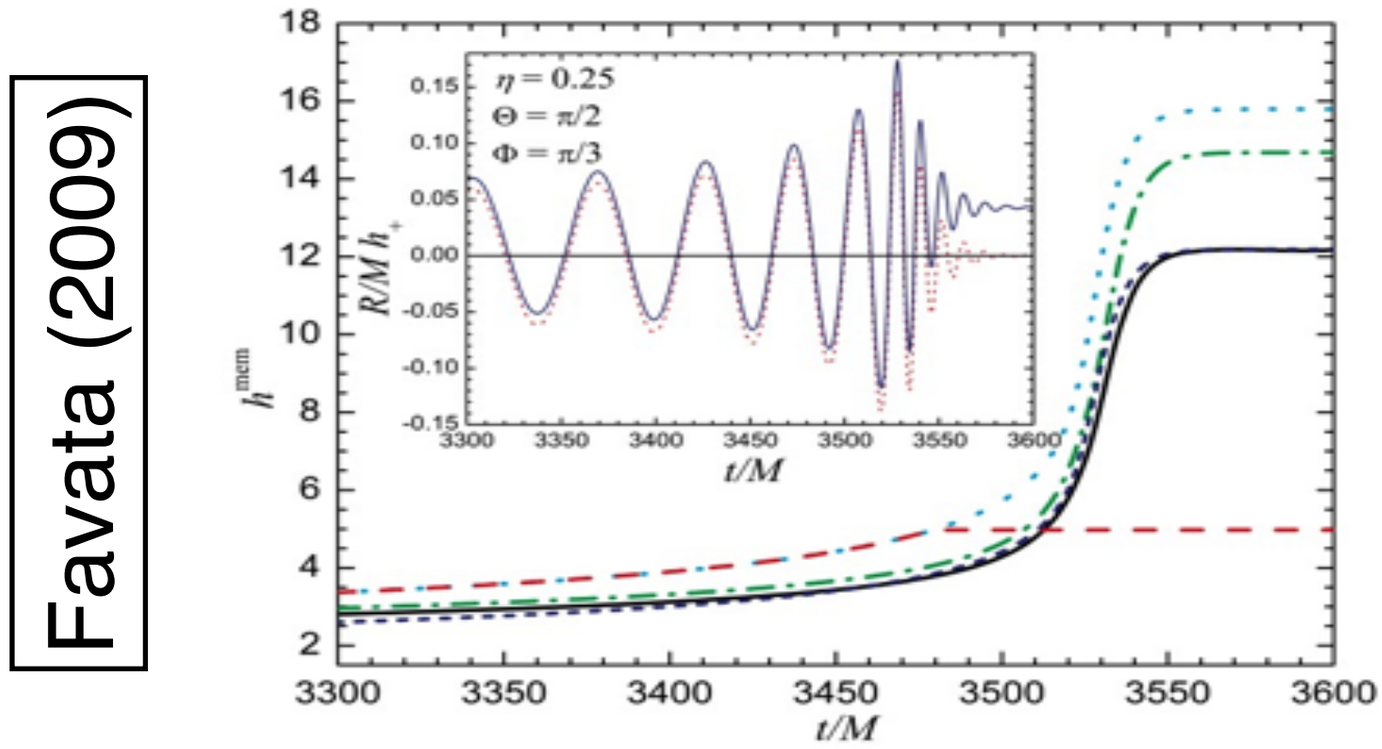


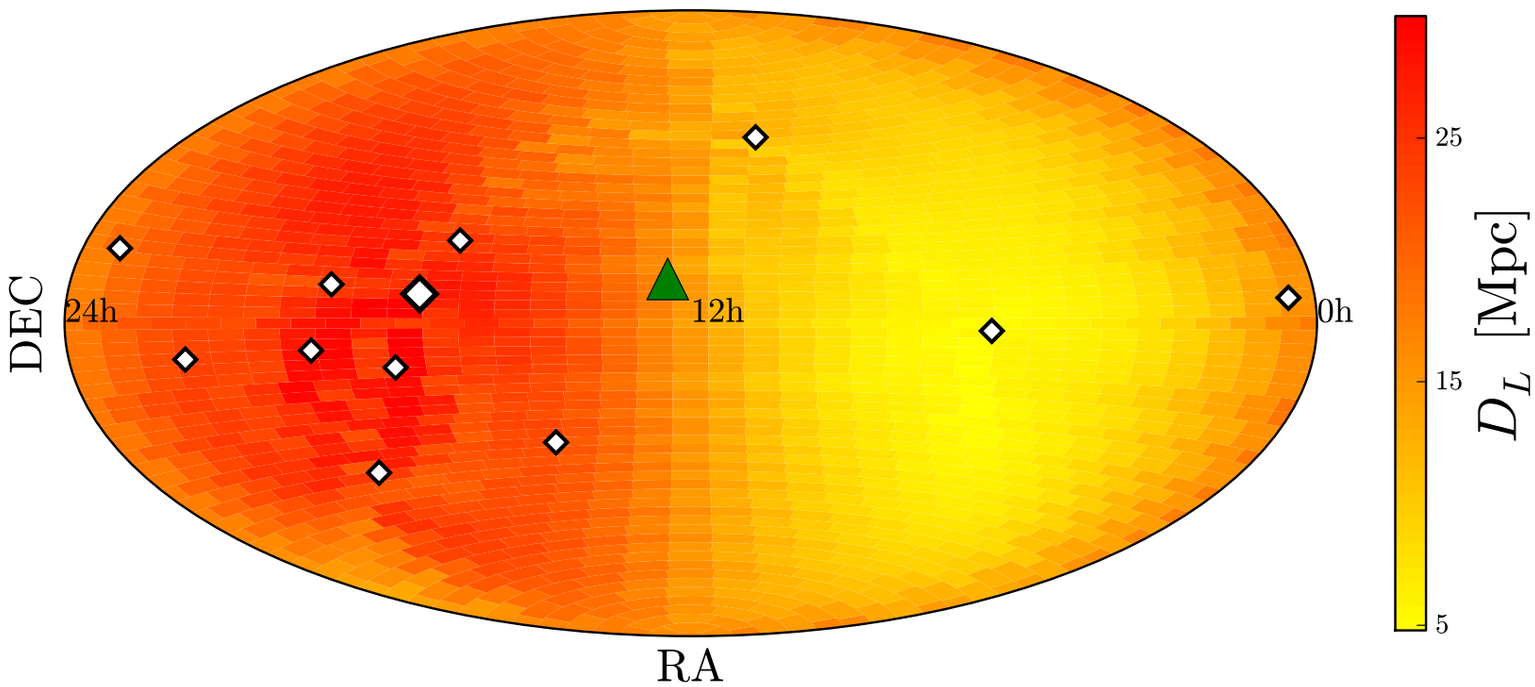


Madison et al. (2016)

Bursts with Memory

Favata (2009)

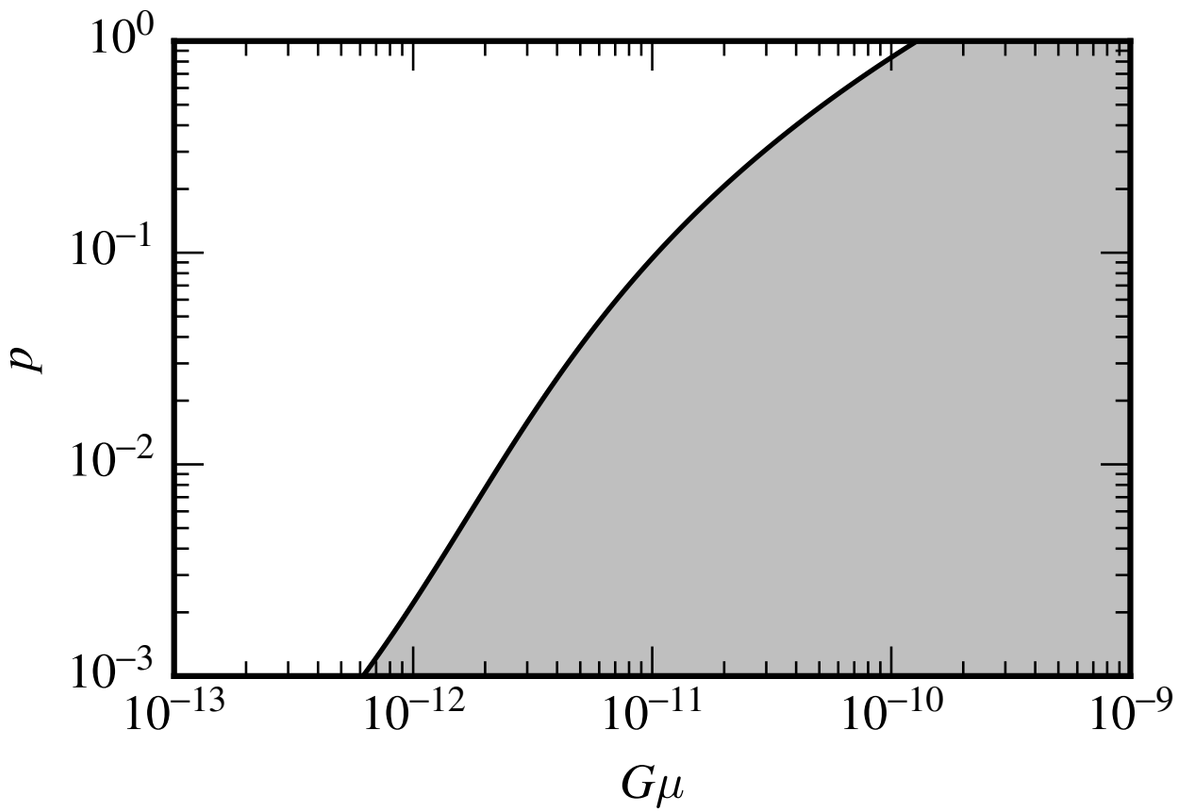


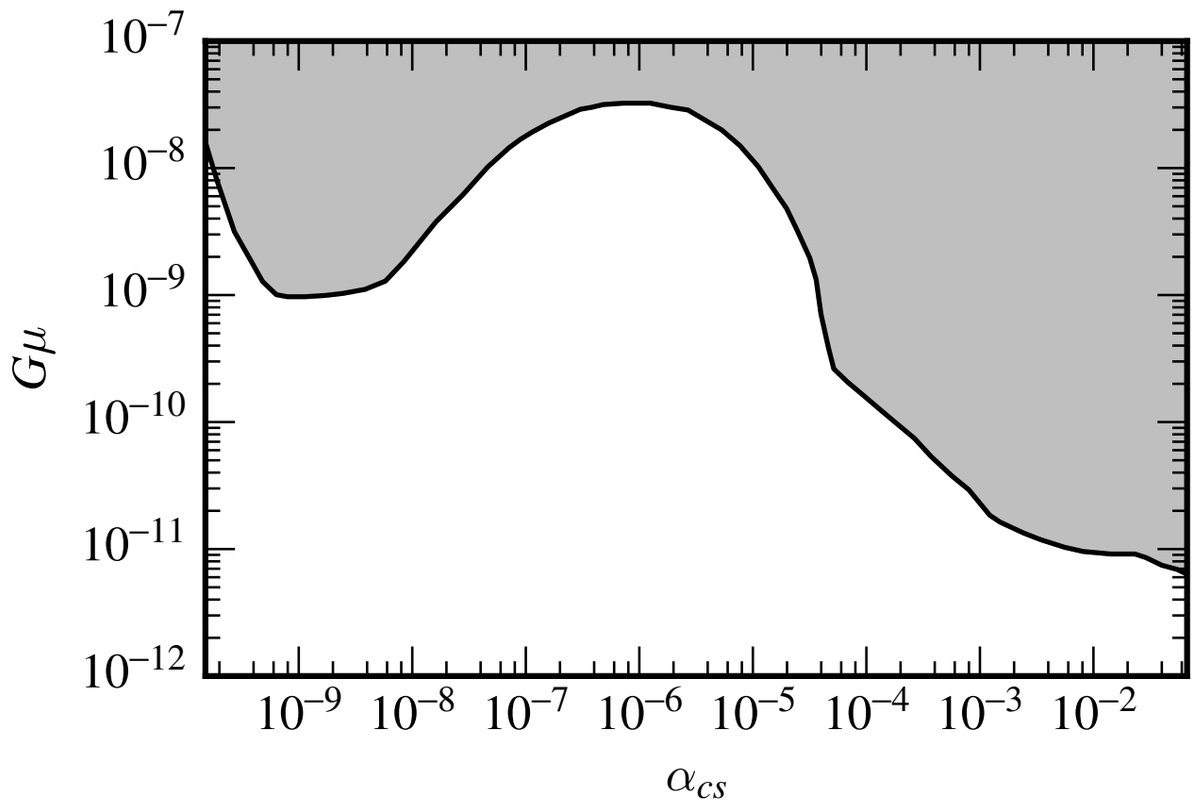


Arzoumanian et al. (2015)

Bonus: Cosmic Strings

Stochastic Background Redux





Arzoumanian et al. (2016)

Detection Technique

UPPER LIMITS ON THE ISOTROPIC GRAVITATIONAL RADIATION BACKGROUND FROM PULSAR TIMING ANALYSIS[1]

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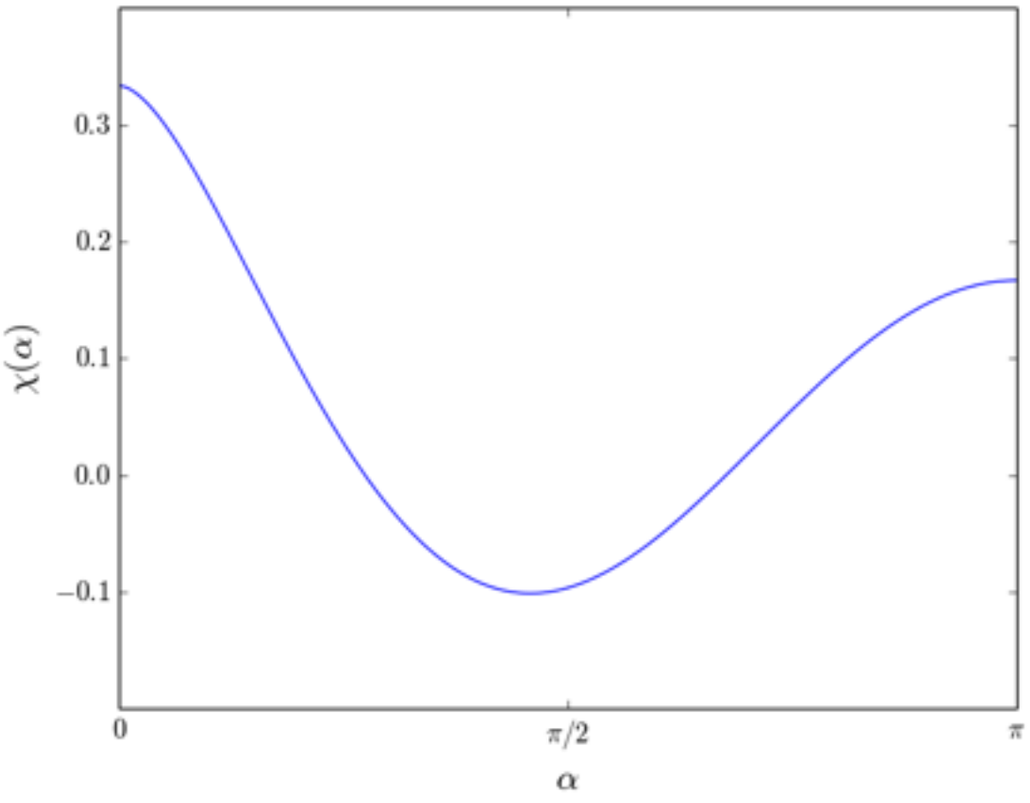
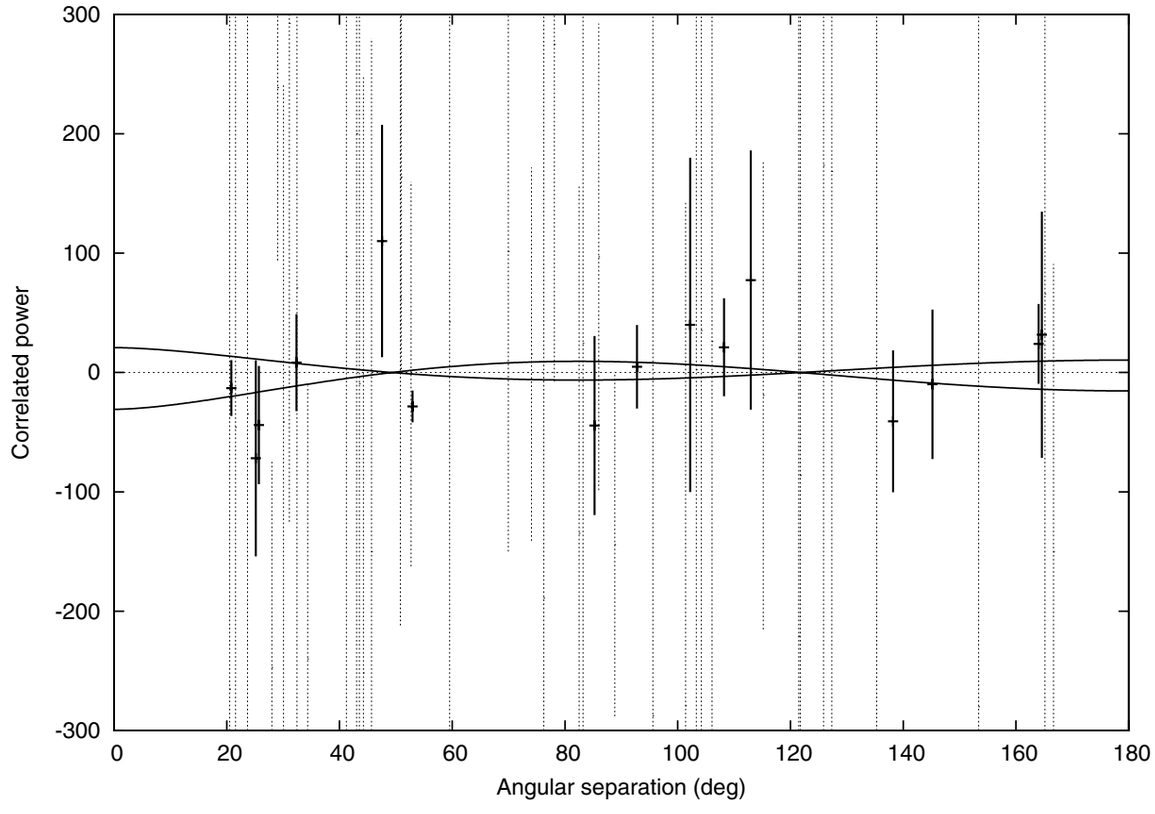
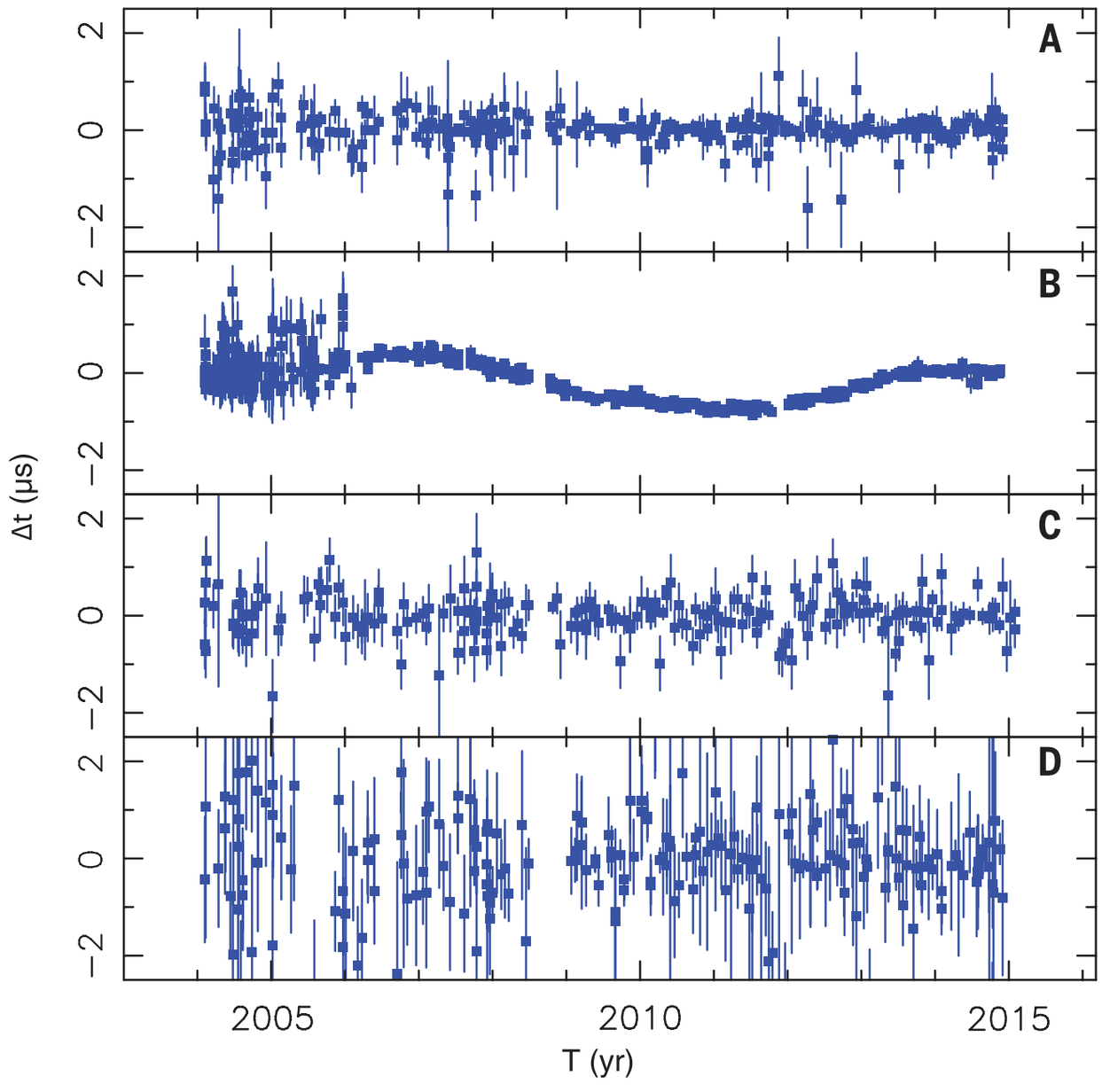
$$C(\alpha) = \chi(\alpha)\langle h_c^2 \rangle + N$$

Demorest et al. (2013)



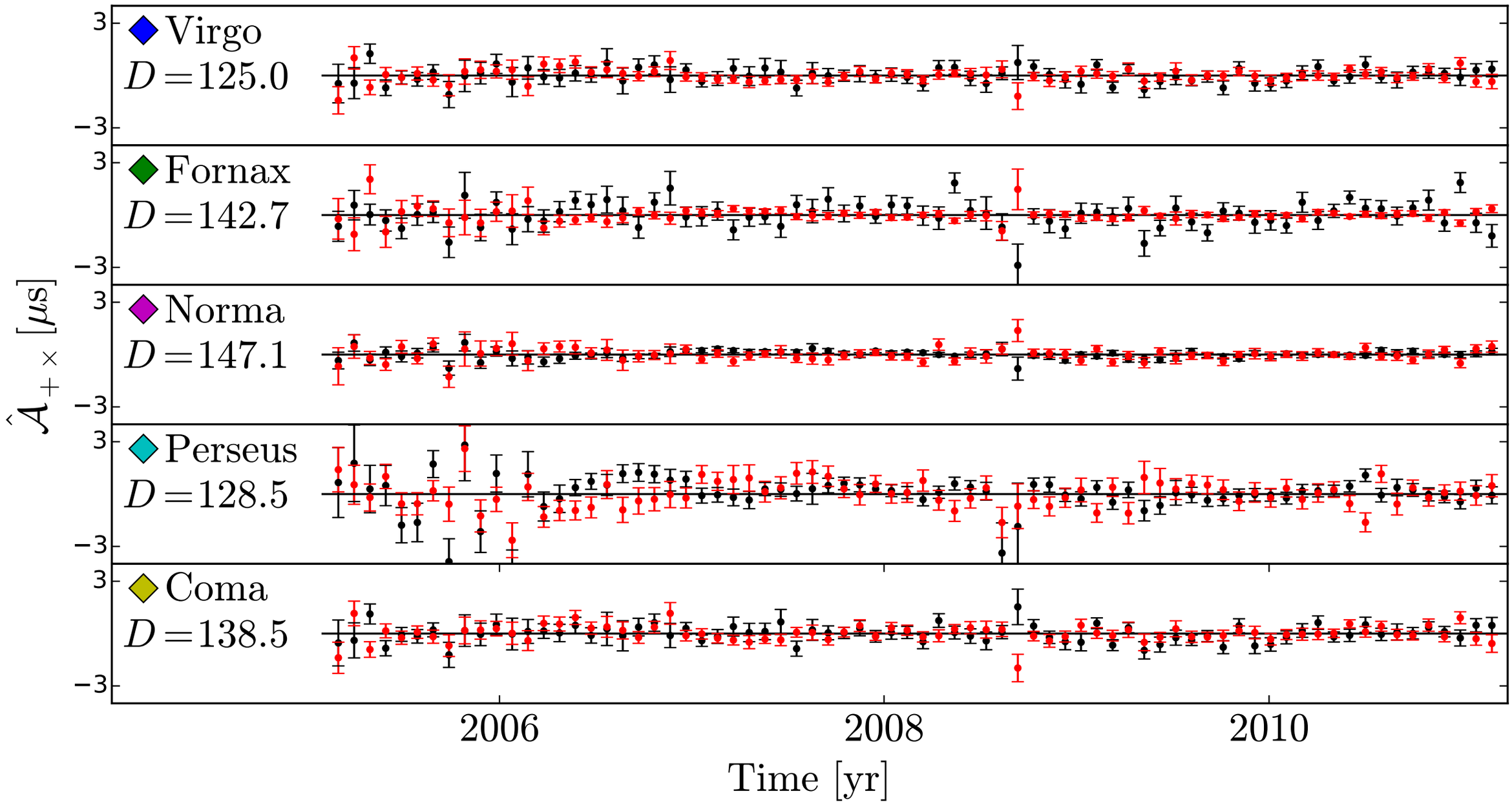


We Haven't Made a Detection Yet???



Shannon et al. (2015)

Hotspots



Madison et al. (2016)