

Stochastic Background Detection Correlation Techniques Between Bar & Interferometer Data

Martin P. McHugh^{1,*} & John T. Whelan^{2,*†}

*Loyola University New Orleans

†The University of Texas at Brownsville

¹mmchugh@loyno.edu, ²jtwhean@loyno.edu

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Outline

I Background and Motivation (Whelan)

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- Review of Cross-Correlation Technique
- Motivations for Bar-IFO (e.g. ALLEGRO-LLO) Correlations

II Implementation and Technical Challenges (McHugh)

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Review of Stochastic Background Cross-Correlation Measurements

- Stochastic background strength defined by

$$\Omega_{\text{GW}}(f) = \frac{1}{\rho_{\text{crit}}} \frac{d\rho_{\text{GW}}}{d \ln f} = \frac{f}{\rho_{\text{crit}}} \frac{d\rho_{\text{GW}}}{df}$$

- Measured with cross-correlation

$$Y_Q = \int df \tilde{h}_1^*(f) \tilde{Q}(f) \tilde{h}_2(f)$$

- Uses optimal filter

$$\tilde{Q}(f) \propto \frac{f^{-3} \Omega_{\text{GW}}(f) \gamma_{12}(f)}{R_1^*(f) P_1(f) P_2(f) R_2(f)}$$

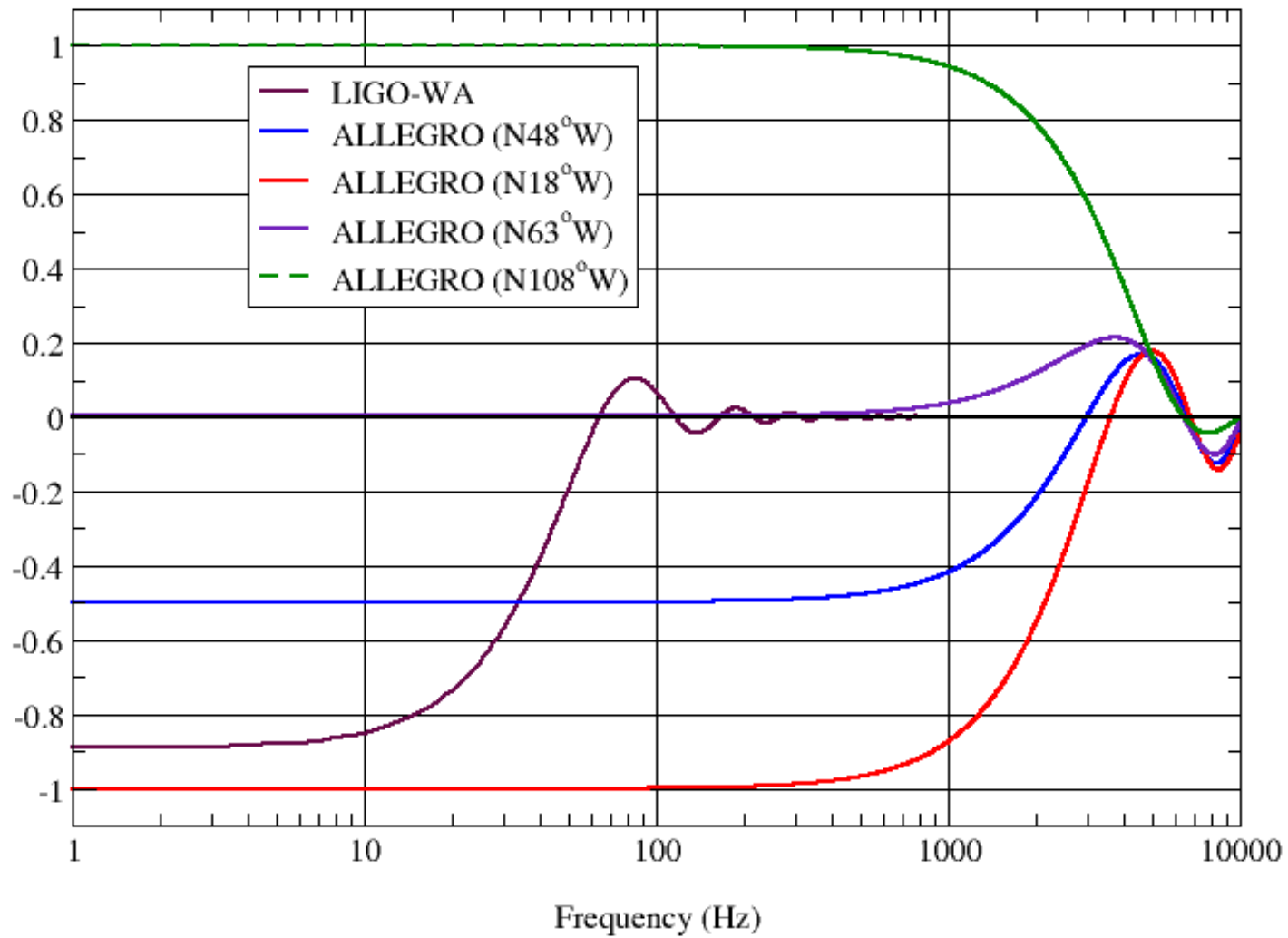
(\tilde{h}_1, \tilde{h}_2 in ct/Hz; P_1, P_2 in strain²/Hz; R_1, R_2 in ct/strain)

- Overlap Reduction Function

$$\gamma_{12}(f) = d_{1ab} d_2^{cd} \frac{5}{4\pi} \int_{S^2} d\hat{\Omega} e^{i2\pi f \hat{\Omega} \cdot \Delta \vec{x} / c} P_{cd}^{ab}(\hat{\Omega})$$

Overlap Reduction Function

(LIGO-LA and other detectors)



LLO-ALLEGRO Correlations

- LLO & ALLEGRO 40 km apart;
probe different frequency range from LLO/LLO
 - LLO/LLO upper limit set on 40–215 Hz
 - LLO/ALLEGRO sensitive at bar frequency ~ 900 Hz
- Can rotate ALLEGRO to change γ (900 Hz)
 - Can combine aligned & anti-aligned to cancel CC noise [Finn & Lazzarini, PRD **64**, 082002 (2001)]
 - Null alignment allows “off-source” CC noise measurement

Presentation continues as [G020366-00-Z](#)