LIGO

ETG Sensitivity and Efficiency to Simulations: BlockNormal and SLOPE

Amber L. Stuver

Penn State University

LIGO-G050331-00-Z

LIGO

Background and Motivation

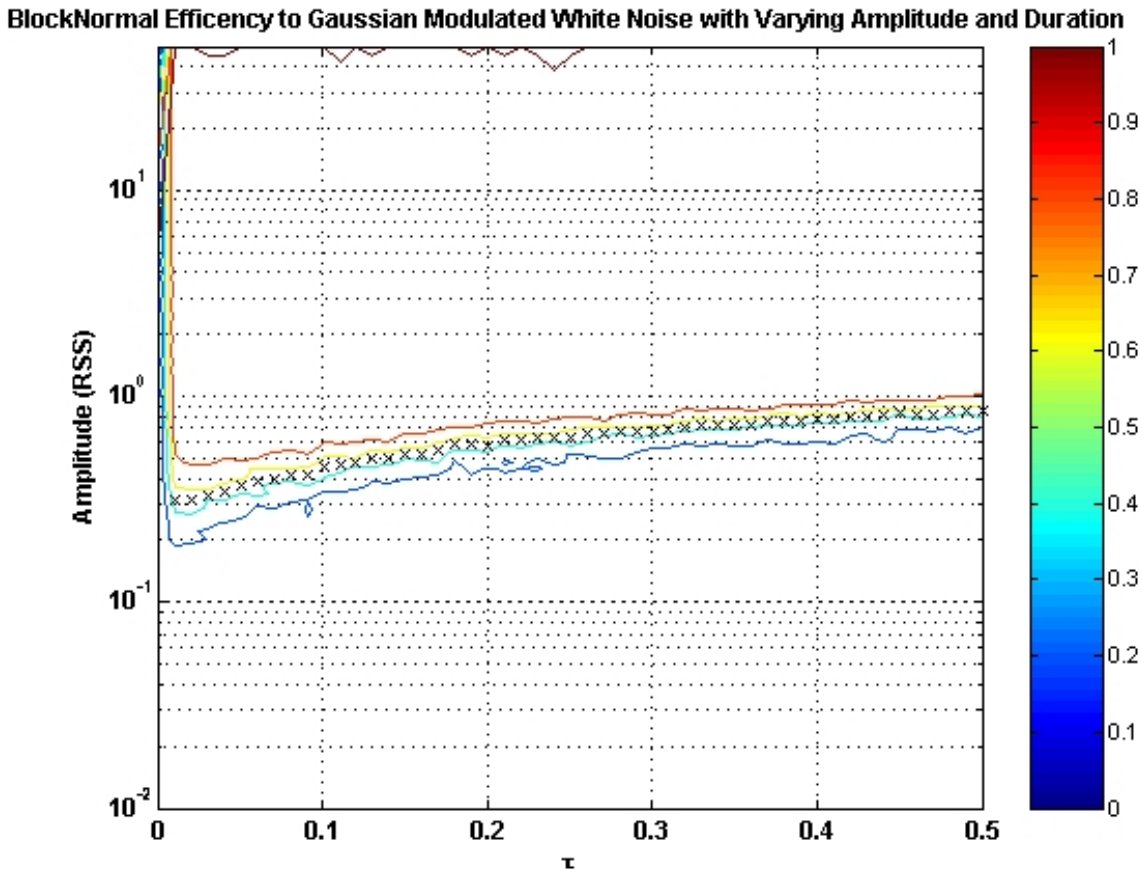
- ETGs are *not* fundamentally equivalent
- Signal properties that ETGs were sensitive to was not initially obvious (see LIGO-G050110)

- What, then, are the signal properties that each ETG favor?
- To determine specific signal sensitivities:
  - » Simulate signals of different lengths and amplitudes and inject into a white noise background (zero mean and unit variance)
  - » Compare efficiencies for various signals to a baseline efficiency using Gaussian modulated white noise bursts

LIGO

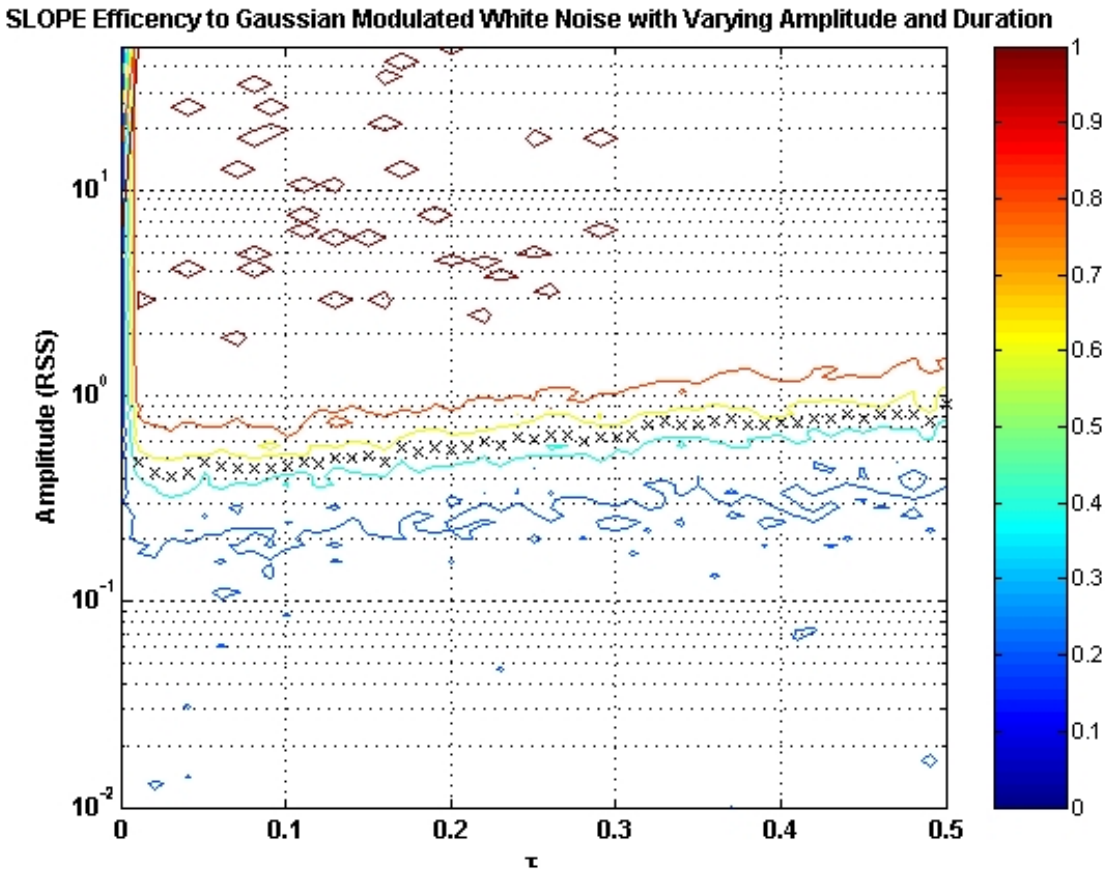
Gaussian Modulated White Noise

BlockNormal



LIGO

Gaussian Modulated White Noise



SLOPE

LIGO

Baseline Observations

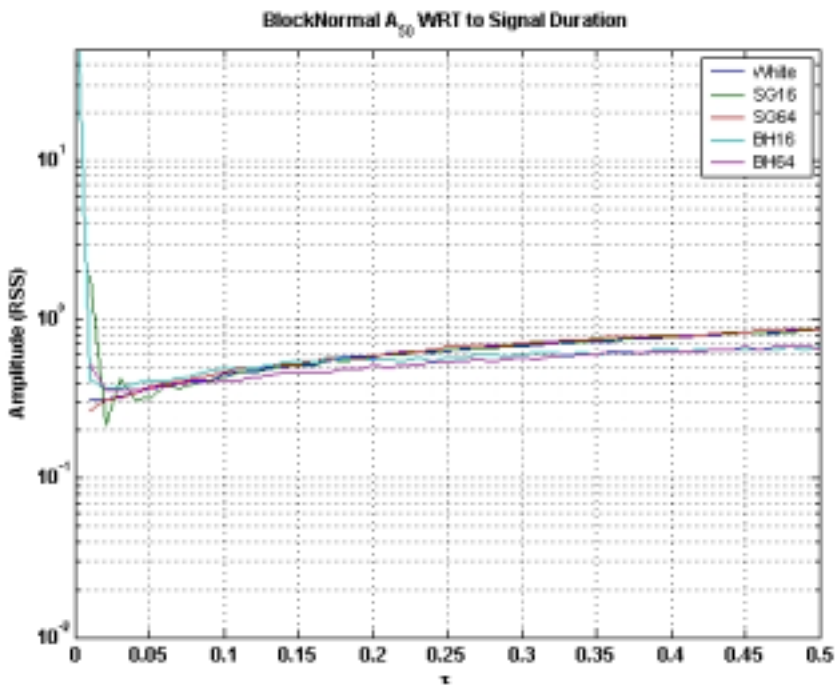
- The efficiencies of both ETGs are dominated by the amplitude of the burst as long as the duration is not “very short” (< ~0.025 sec)
- The A_{50} is in about the same area (A_{rss} = 0.4 – 0.8 σ) for both ETGs. However, the efficiency increases faster, wrt A_{rss}, for BlockNormal than SLOPE
- There is a much higher false rate for SLOPE than BlockNormal:

	Tuned False Rate	Current False Rate
BlockNormal	0.55 events/s	1.52 events/s
Slope	0.56 events/s	4.33 events/s

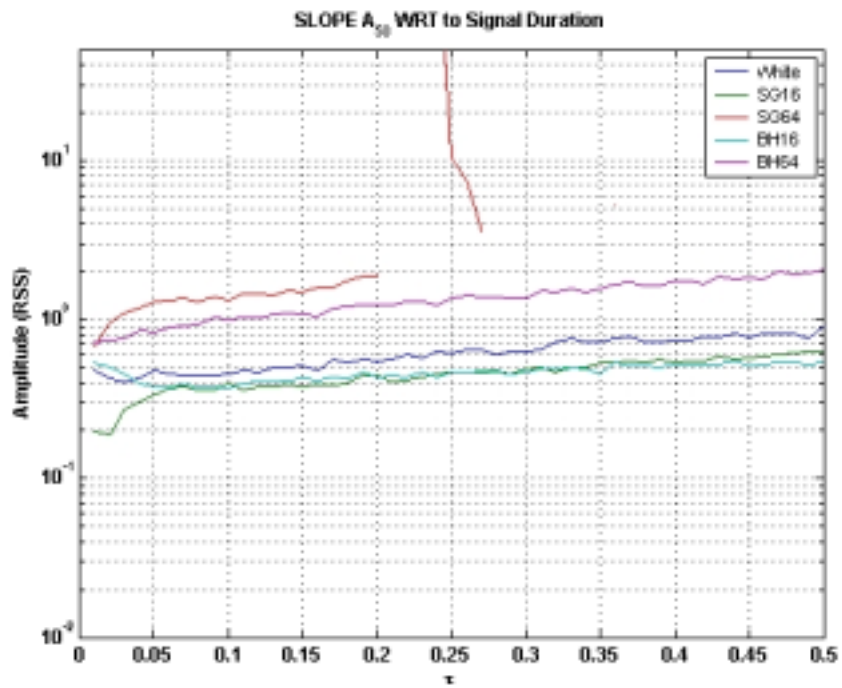
LIGO

A_{50} for Different Signals

BlockNormal



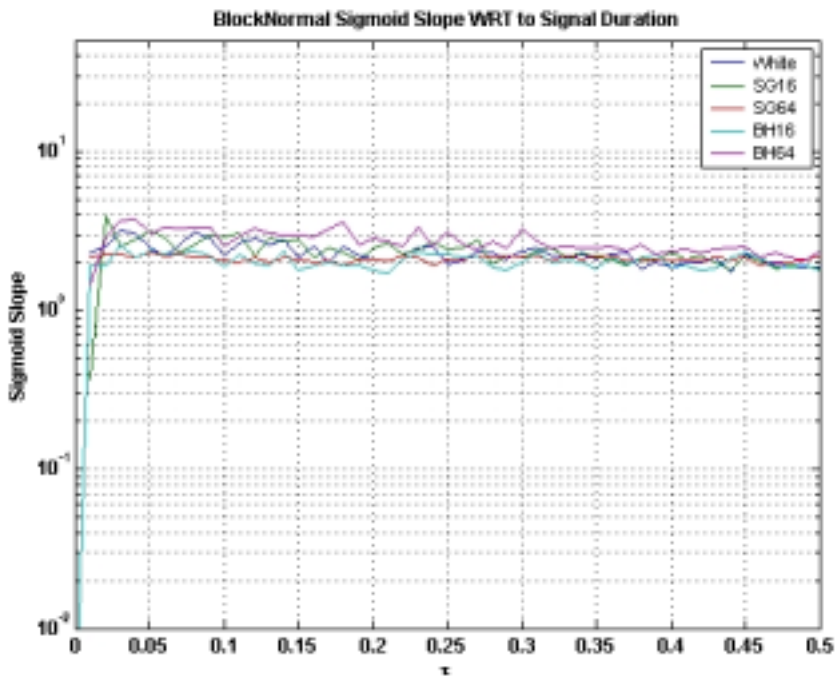
SLOPE



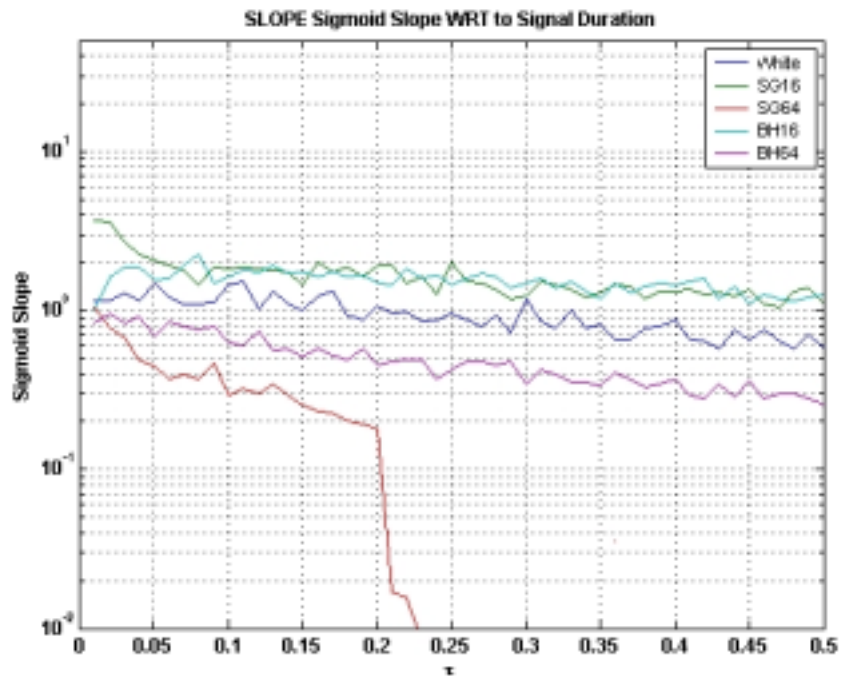
LIGO

Sigmoid Slopes for Different Signals

BlockNormal



SLOPE



Measuring ETG Performance WRT a Population

- Convolve the efficiency surface with a population
- The integral of this gives a measure of and ETG's performance WRT a population

$$P \propto \begin{cases} \int\int \varepsilon(A_{rss}, \tau) A_{rss}^{-3} dA_{rss} d\tau, & \text{for disk} \\ \int\int \varepsilon(A_{rss}, \tau) A_{rss}^{-4} dA_{rss} d\tau, & \text{for isotropic} \end{cases}$$

LIGO

ROUGH

Measured Population Performances

		Disk (~ A^{-3})		Isotropic (~ A^{-4})	
		BlockNormal	SLOPE	BlockNormal	SLOPE
White Noise		0.81	1*	0.41	1*
SG	16 Hz	1.08	2.72	0.81	8.34
	64 Hz	1.07	0.85	0.92	1.89
BH	16 Hz	1.23	2.53	1.11	7.49
	64 Hz	0.97	0.44	0.49	1.59

- BlockNormal has fairly consistent performance over different signal types
- While SLOPE's performance can be higher, it is not as reliable

* Population values are normalized to this

LIGO

Conclusions

- The ***overall*** shape of the efficiency sigmoid is more meaningful than just the A_{50} for describing an ETG's performance
- BlockNormal's efficiency does not have a significant frequency dependence while SLOPE does.
- BlockNormal's performance is relatively constant over different signals and frequencies. SLOPE can perform much better on some signals and much worse on others.
- The background noise largely effects the tuning performance of the ETGs.