

Non-parametric method for detecting non- stationarity

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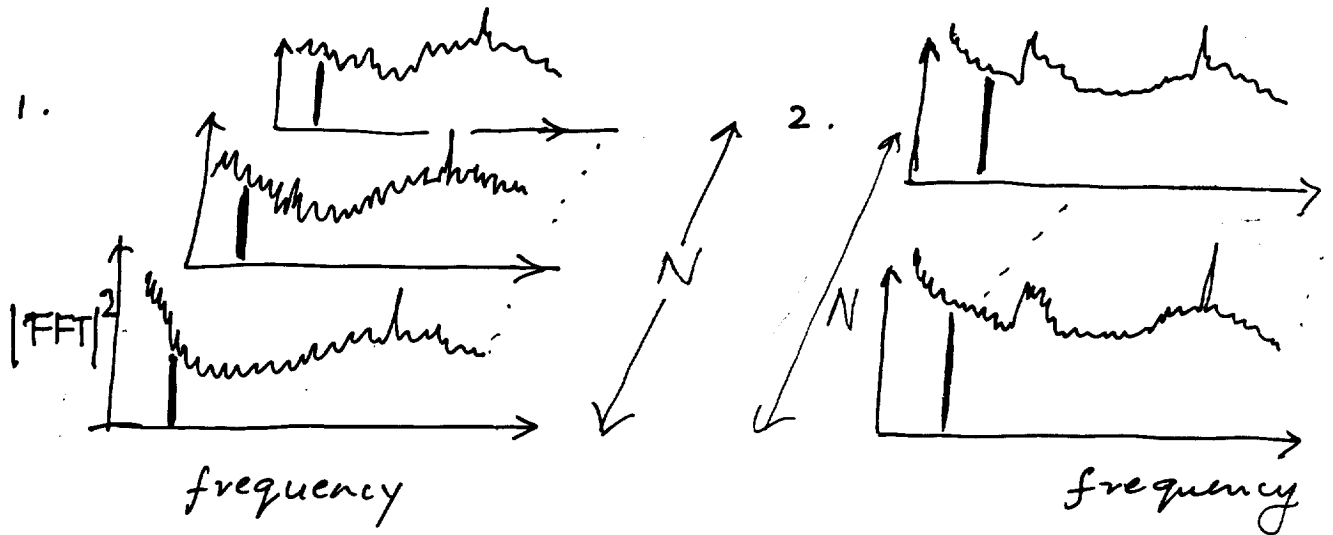
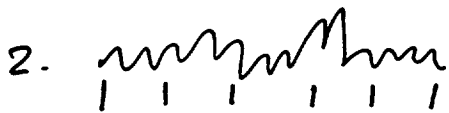
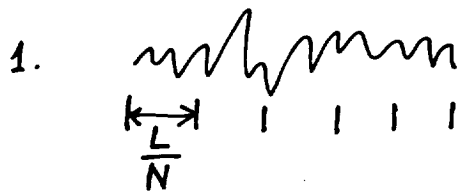
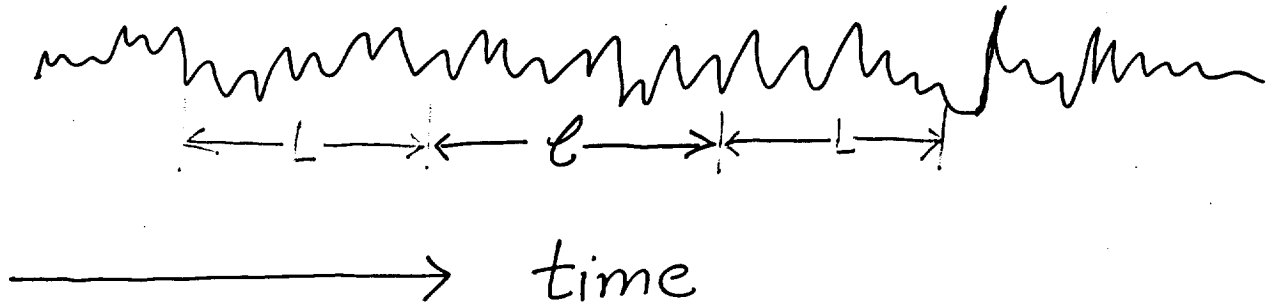


PLAN OF THE TALK

- Description of the test
- Non-parametric tests & their importance.
- Examples / Results
(Simulated & 40m data)



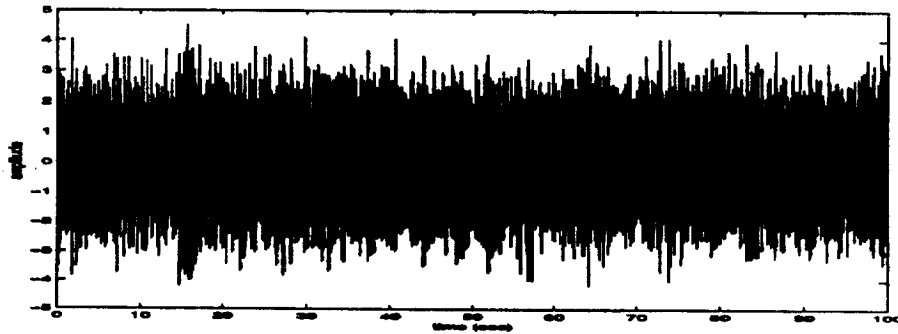
A schematic of the test



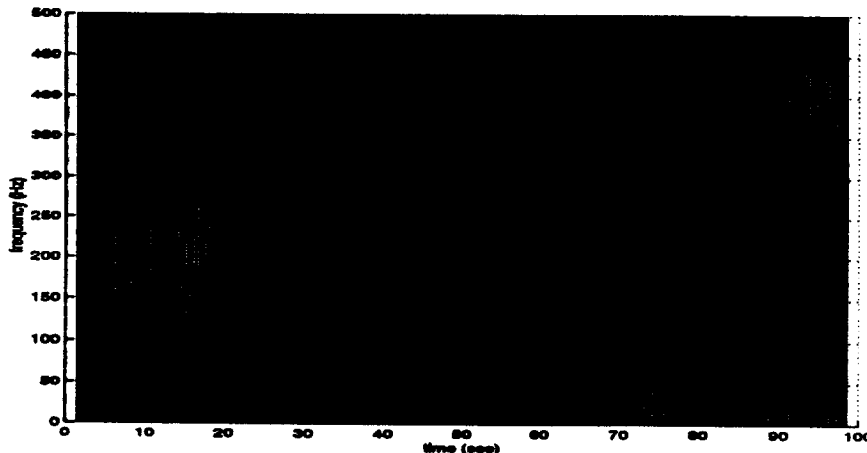
$$t = \frac{|\hat{\mu}_1 - \hat{\mu}_2| \sqrt{N}}{\sqrt{\hat{\sigma}_1^2 + \hat{\sigma}_2^2}}$$

The test in action

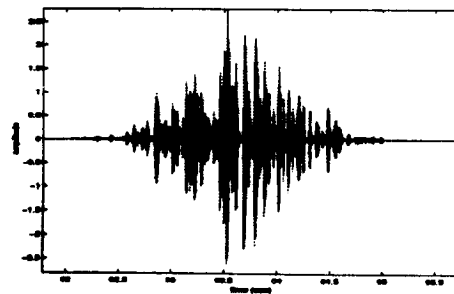
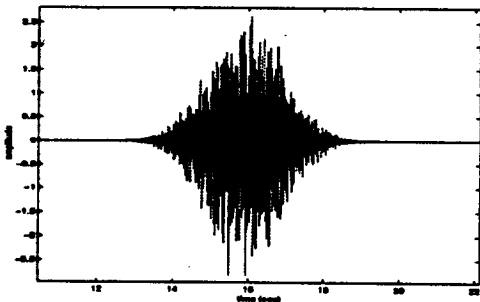
Simulated data



Output of the test



Injected bursts



Non-parametric tests

Example: χ^2 test !

significance level computed independently of any assumptions about the distribution of the data.

Counter Example: t - test

(But t-test is a robust test)

Need for non-parametric tests

- Parametric tests for non-stationarity
→ Assume a "prior" value for data descriptor and look for changes from this value.

- But "prior" estimated from non-stationary data itself !!

- Many channels + adaptive estimation of priors
⇒ STATISTICAL CHAOS !

False alarm rate from Monte Carlo simulation

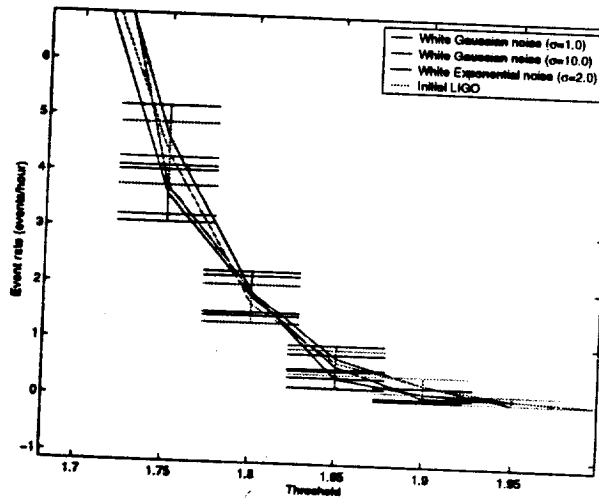
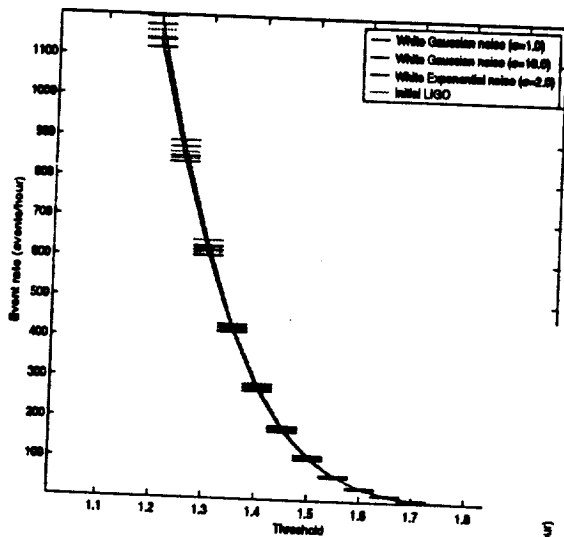
◆ Fix test parameters L , N and l .

Input : Different Noise distributions:

Gaussian, Exponential

Different Noise PSDs :

White, Coloured (LIGO I).



Note : false alarm rate independent of distribution and color of data.



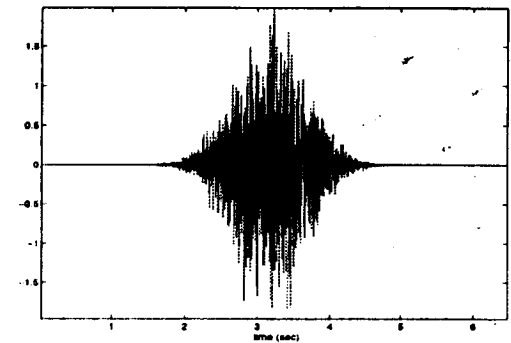
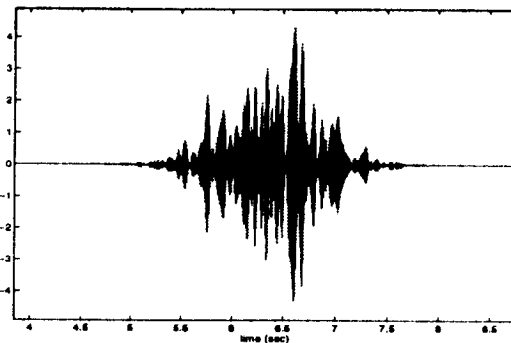
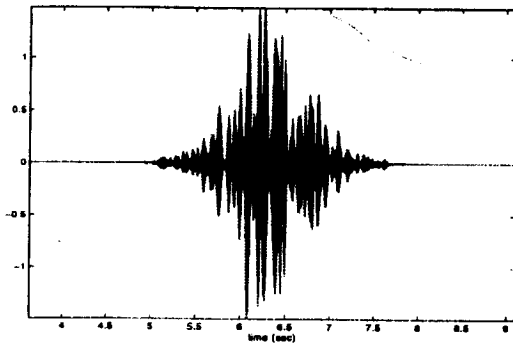
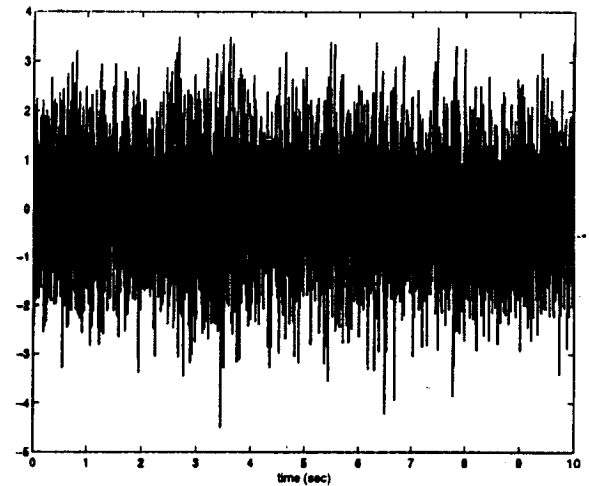
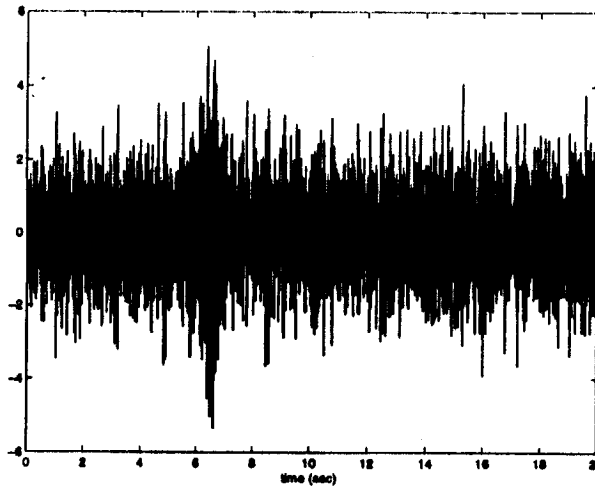
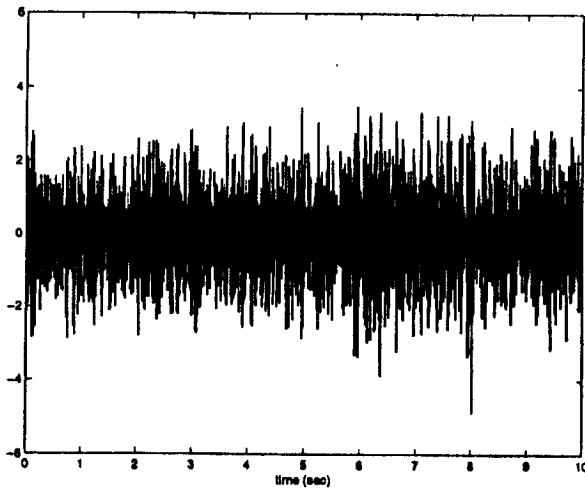
Power of test

Fix false alarm rate at $\sim 1 / \text{hour}$.

Gaussian noise (LIGO-I PSD)
plus narrowband Gaussian noise
burst (center frequency 200Hz).

Center frequency of burst is
100Hz.

White Gaussian noise plus white
Gaussian noise burst

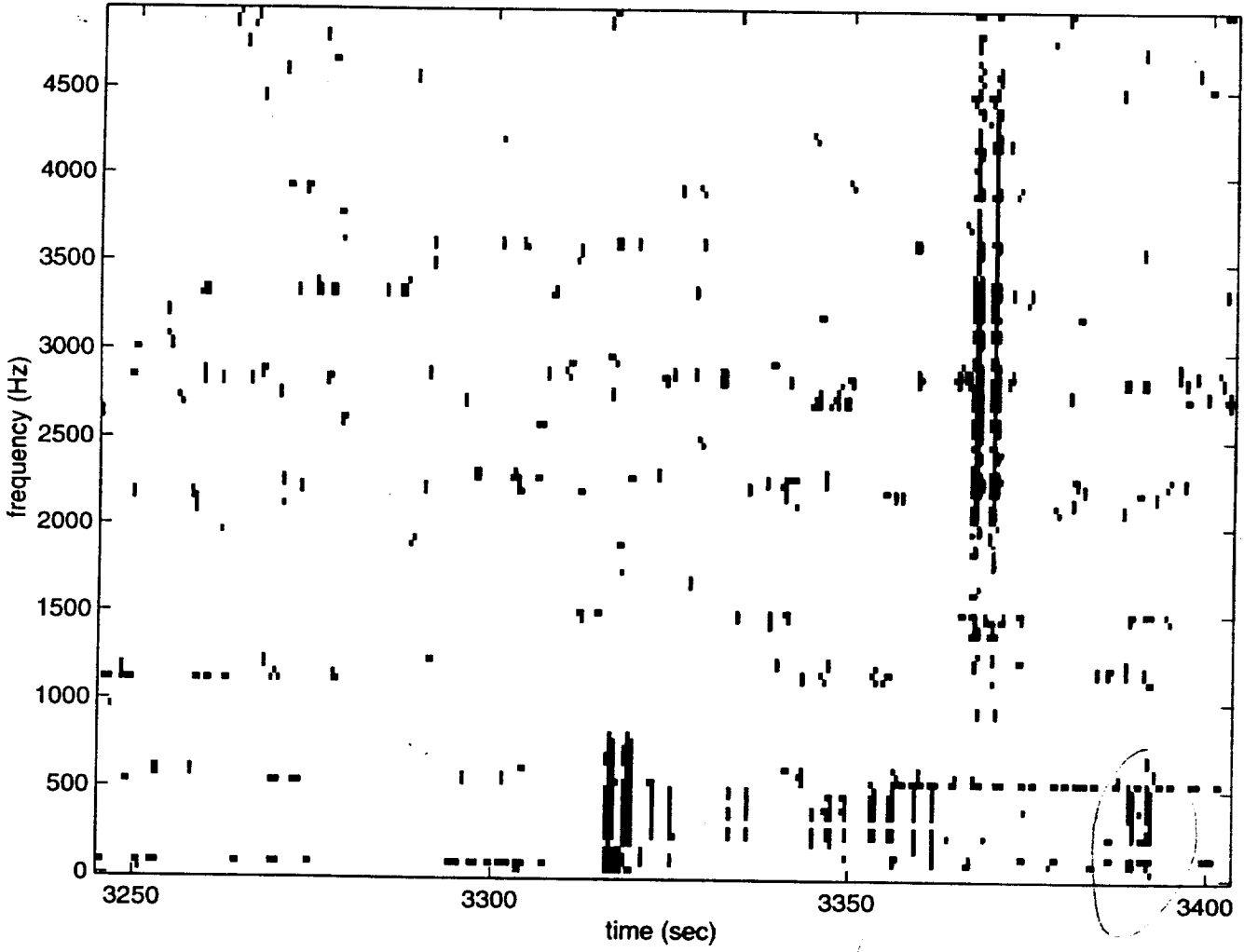


Peak amplitude required for 80%
detection probability : 1.5σ

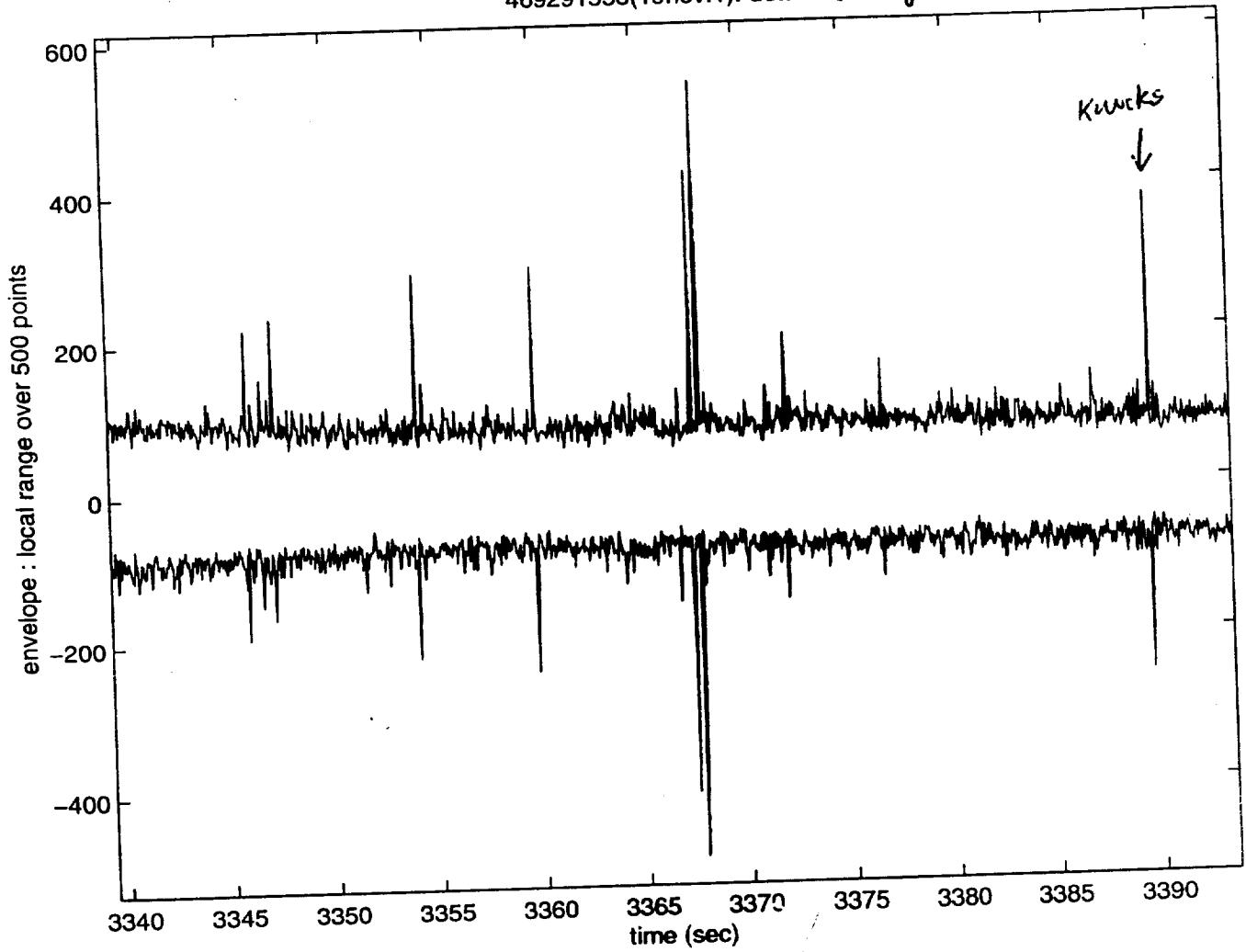
4.3σ

2.0σ

469291558.mat lag=5;threshold=10%;len_psd=10,000;nfft=256;fs=9868.421



469291558(19nov.1): detail (UNfiltered)



CONCLUSIONS

- User friendly (No information overload)
- "Clean" test (Simple enough to make out what's going wrong!)
- Computationally trivial (fast)
- STATISTICALLY WELL CHARACTERIZED ("SAFE" because ROBUST)
- Surprisingly powerful (peak amplitude $\approx 4\sigma$)
- Problem of narrowband features
 - * Use either cleaned data OR
 - * simply notch the lines



Note 1, Linda Turner, 08/17/99 09:09:01 PM
LIGO-G990079-38-M