LSC-Virgo Project 2b
Joint Burst Search

Peter Shawhan and Jonah Kanner,
for the LSC-Virgo Burst Analysis Group

LIGO / Virgo Scientific Collaborations Meeting
March 20, 2007

LIGO-G070108-00-Z

Overview

Project 2b Definition

- Followed from project 2a
  - (3 hours of real, non-coincident data exchanged: S4 H1 and G1 ; C7 Virgo)
- Designed to involve *coincident* data exchange
- Refined and launched in Fall 2006

Goals

- Exchange a few days of real coincident data from all 5 detectors
- Have people from both collaborations work together on analysis
- Discuss this work in regular Burst Group telecons
- Use data quality and veto information
- Deal with a mixture of network configurations
- Try to draw some conclusions about the quality of the data and the benefit of using the whole network

Project 2b Data

Coincident data from Sept. 8–11, 2006

Virgo Weekend Science Run 1 (WSR1)

LIGO + GEO S5 data

Includes 35 hours of 5-way coincident running

Data exchanged

(Marie Anne Bizouard, Patrick Sutton, Shourov Chatterji, Siong Heng, Laura Cadonati, Keith Thorne)

Frame data with different secret time shift for each site

Virgo data resampled from 20000 Hz → 16384 Hz, 4096 Hz, 4000 Hz

Segment lists

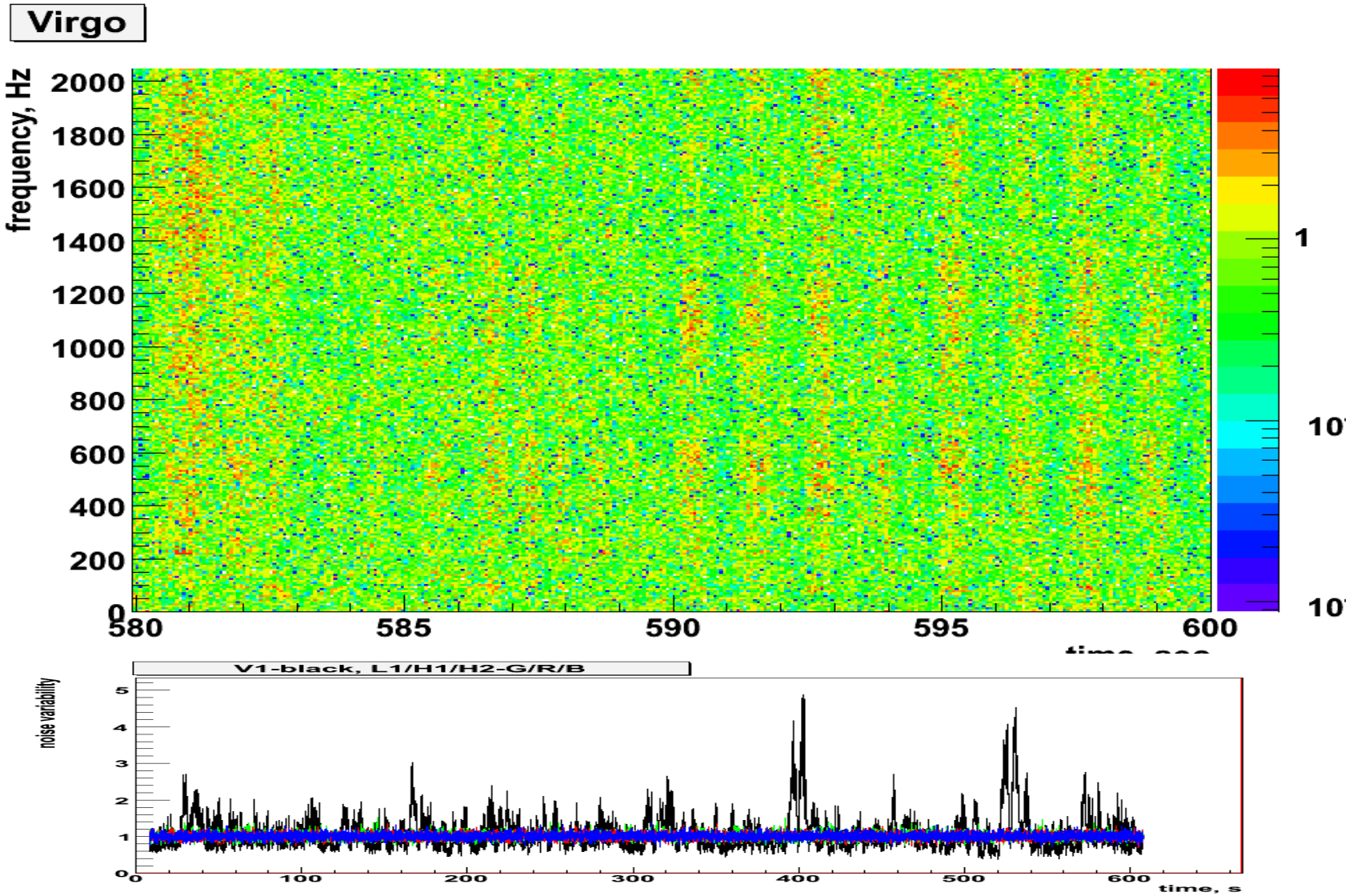
Data quality and veto time intervals

Times of hardware signal injections

MDC frame files containing simulated signals

A laborious task to agree on file contents, produce & copy files

Non-Stationarity of Virgo WSR1 Data



Project 2b Analyses

Coincidence

Gianluca Guidi, Jonah Kanner

Coherent WaveBurst

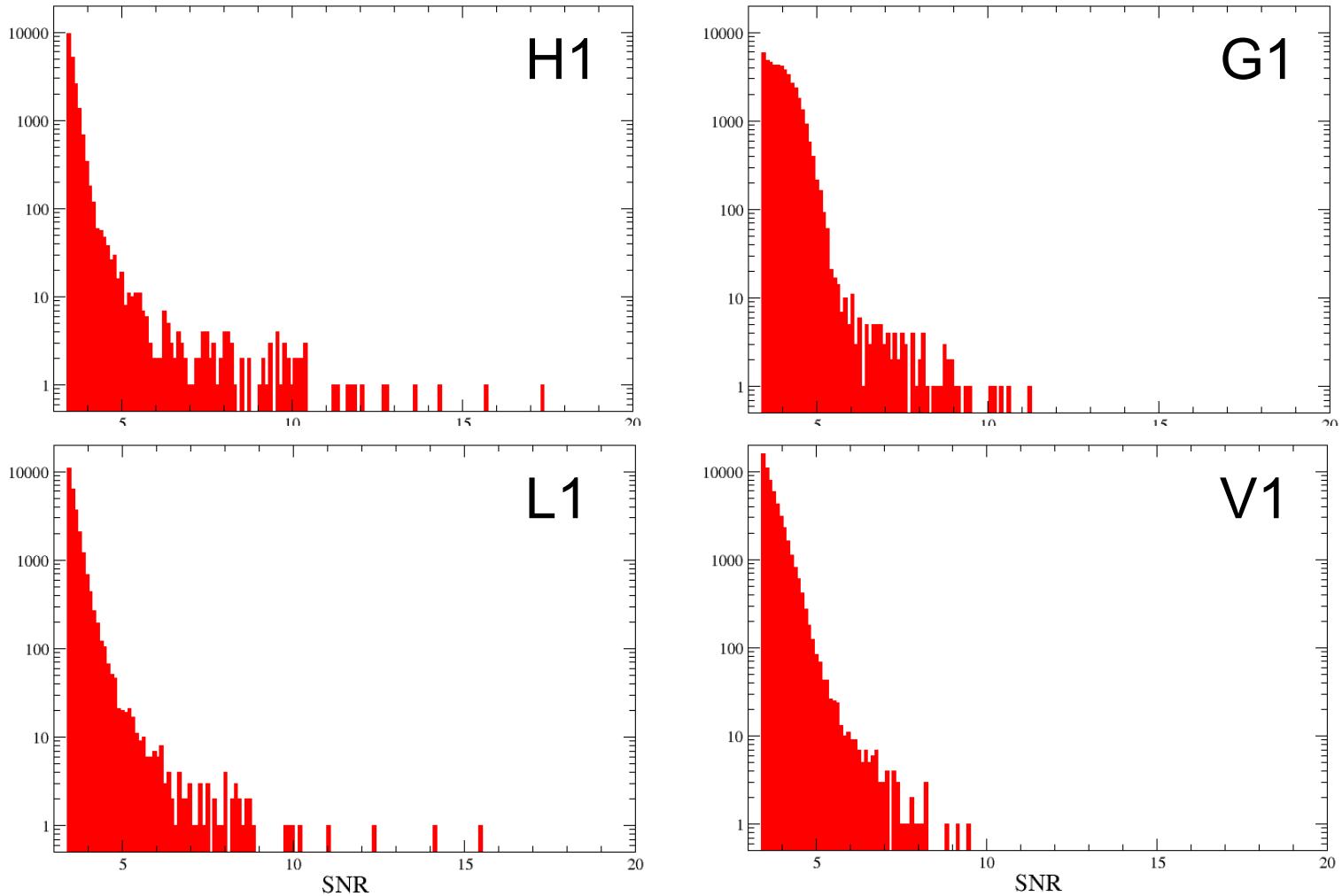
Igor Yakushin, Sergey Klimenko

X Pipeline GRB analysis

Patrick Sutton, Michal Was

Coincidence Analysis

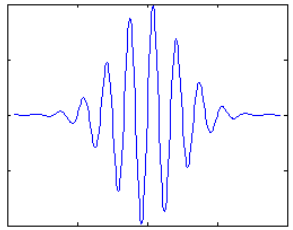
Virgo "Power Filter" trigger generator, 500–2000 Hz

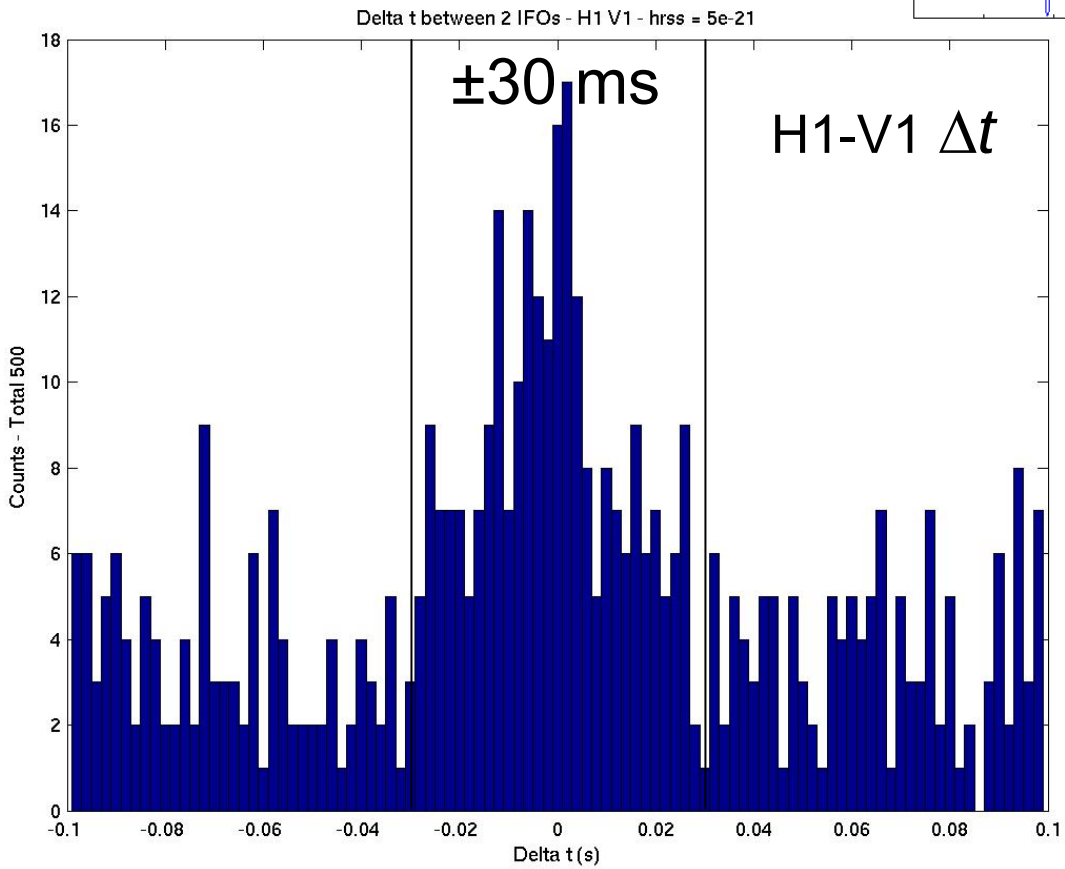


Coincidence Analysis

Define coincidence requirements

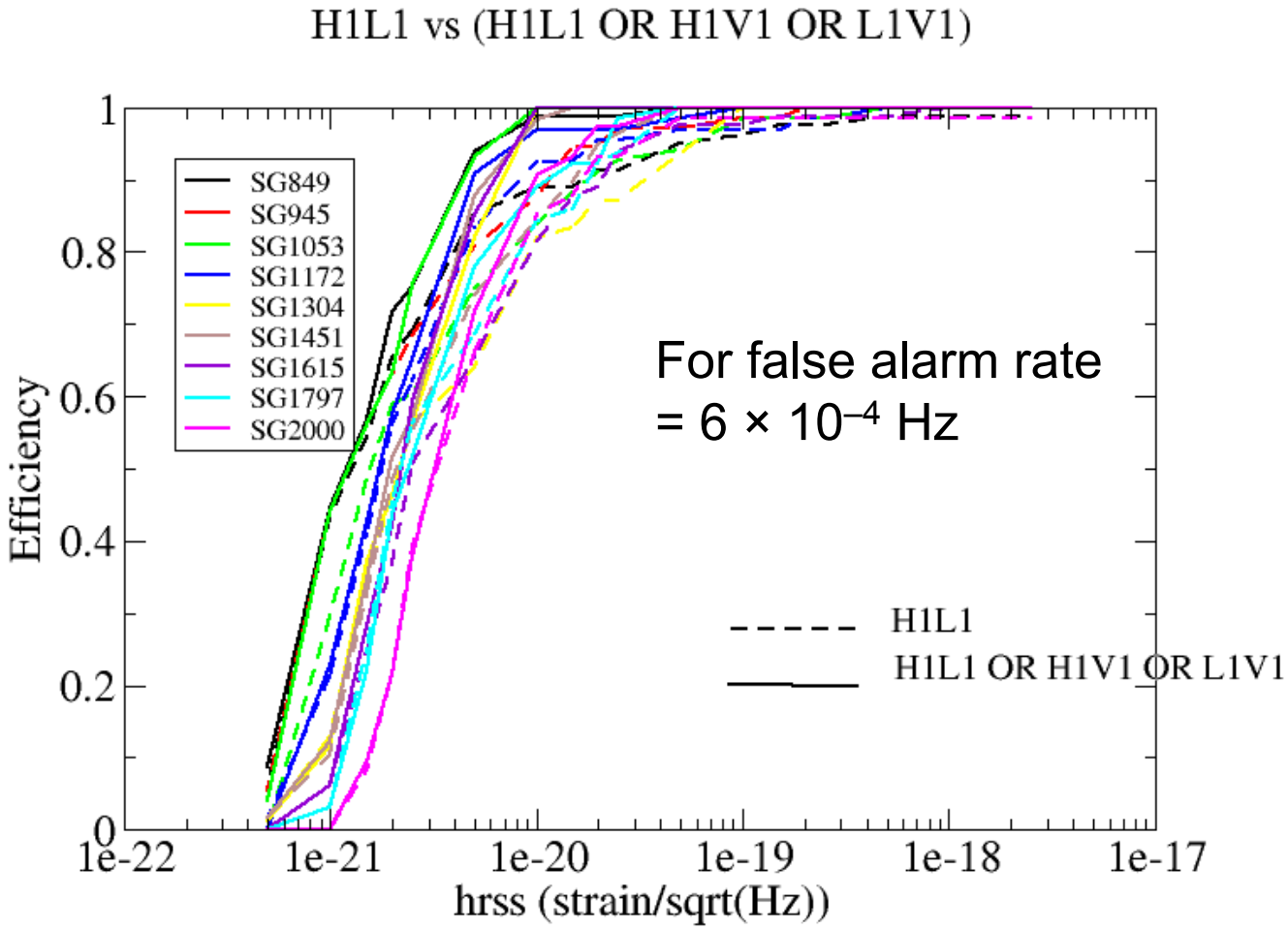
Look at time, frequency, … for simulated signals





Coincidence Analysis

Efficiency for OR of 2-fold coincident triggers



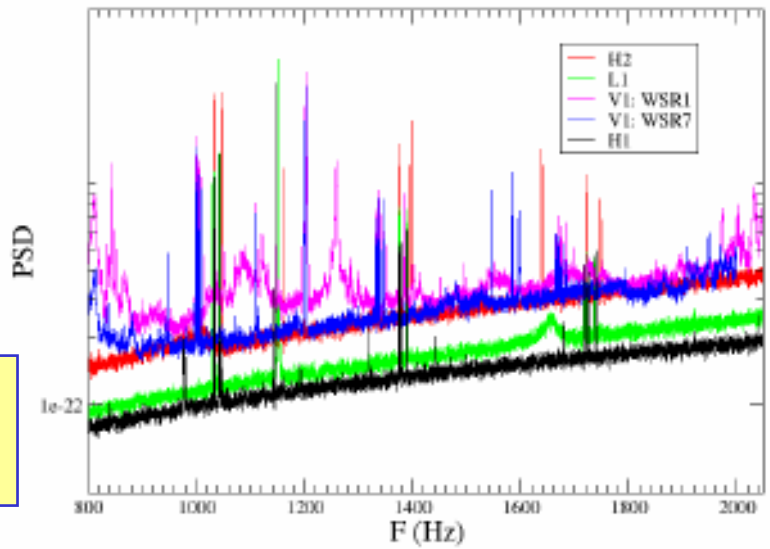
Coherent WaveBurst Analysis

- performance at FA rate of 1μHz h_{rss} errors ~15%

network	hrss@50% sg361q9	hrss@50% sg849q9	hrss@50% sg1615q9	live time sec
H1xH2	11×10^{-22}	16×10^{-22}	31×10^{-22}	182772
L1xH1xH2	8×10^{-22}	14×10^{-22}	37×10^{-22}	157599
L1xH1xH2xV1	9×10^{-22}	17×10^{-22}	40×10^{-22}	104062
L1xH1xH2xG1	9×10^{-22}	16×10^{-22}	41×10^{-22}	140351
L1xH1xH2xV1xG1	9×10^{-22}	16×10^{-22}	42×10^{-22}	102907

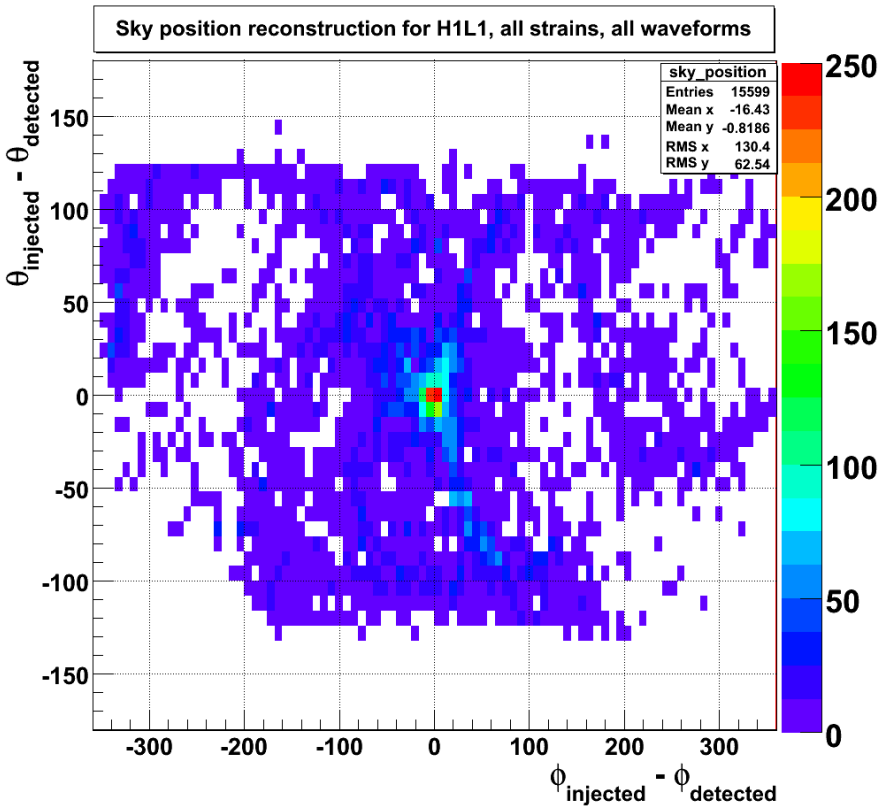
both sensitivity and stationarity of the noise are critical for a detector to be useful in the network

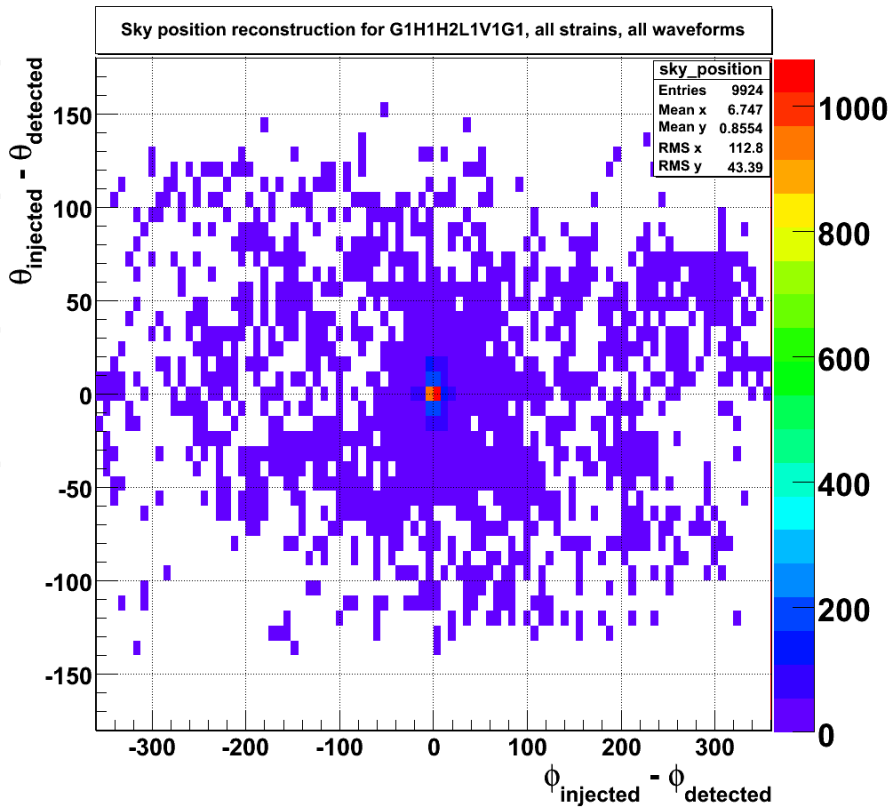
Adding Virgo to network doesn't improve hrss@50% upper limits for this data set



Coherent WaveBurst Analysis

Including Virgo and GEO improves sky position reconstruction





X Pipeline GRB analysis

A fictitious GRB during WSR1: Sky position favorable for GEO & Virgo

```
GPS trigger time = 841896355
right ascension = 217.5255
declination = -28.7510
```

Site	F_+^2+F_x^2
H	0.2598
L	0.3364
V	0.8356
G	0.7691

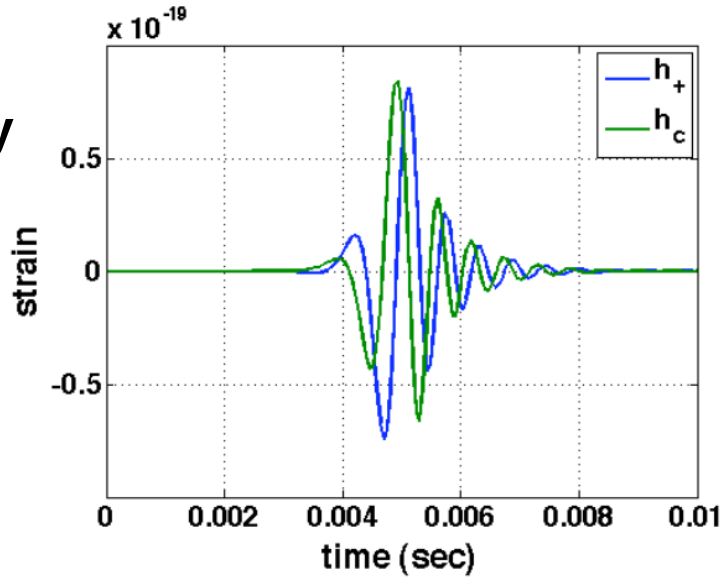
Use X Pipeline with "hard constraint" likelihood

Use off-source and simulation results to tune null energy vs. incoherent energy consistency test

hrss 90% C.L. upper limits:

LIGO-only: 4.6×10^{-22}

LIGO-Virgo: 3.7×10^{-22}



Lazarus merger waveform

Conclusions

The Project 2b exercise has been (and still is) useful

- Coherent WaveBurst analysis is pretty much complete
- Would like to implement complete coincidence analysis pipeline

We have had to deal with a number of practical issues

WSR1 data is glitchy

- Value added to these analyses is marginal (?)

More recent Virgo data is better!