Status of the burst search with LIGO and GEO detectors

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Outline

- **Introduction**
  - **overview of detectors, pipeline**
  - **playground analysis**
- **Results**
  - **background rates**
  - **pipeline efficiency**
- **Summary**

Overview

- **S3 run**
  - **LIGO: October 31, 2003 – January 13, 2004**
  - **GEO S3a: November 5, 2003 – November 12, 2003**
  - **GEO S3b: December 30, 2003 – January 13, 2004**
- **Un-triggered burst search**
  - **using coincidence of LIGO and GEO detectors**
  - **in the frequency band 768 – 2048 Hz**
  - **with the WaveBurst algorithm**

Class.Quantum Grav. 21 (2004) S1819-S1830 and S1685-S1694

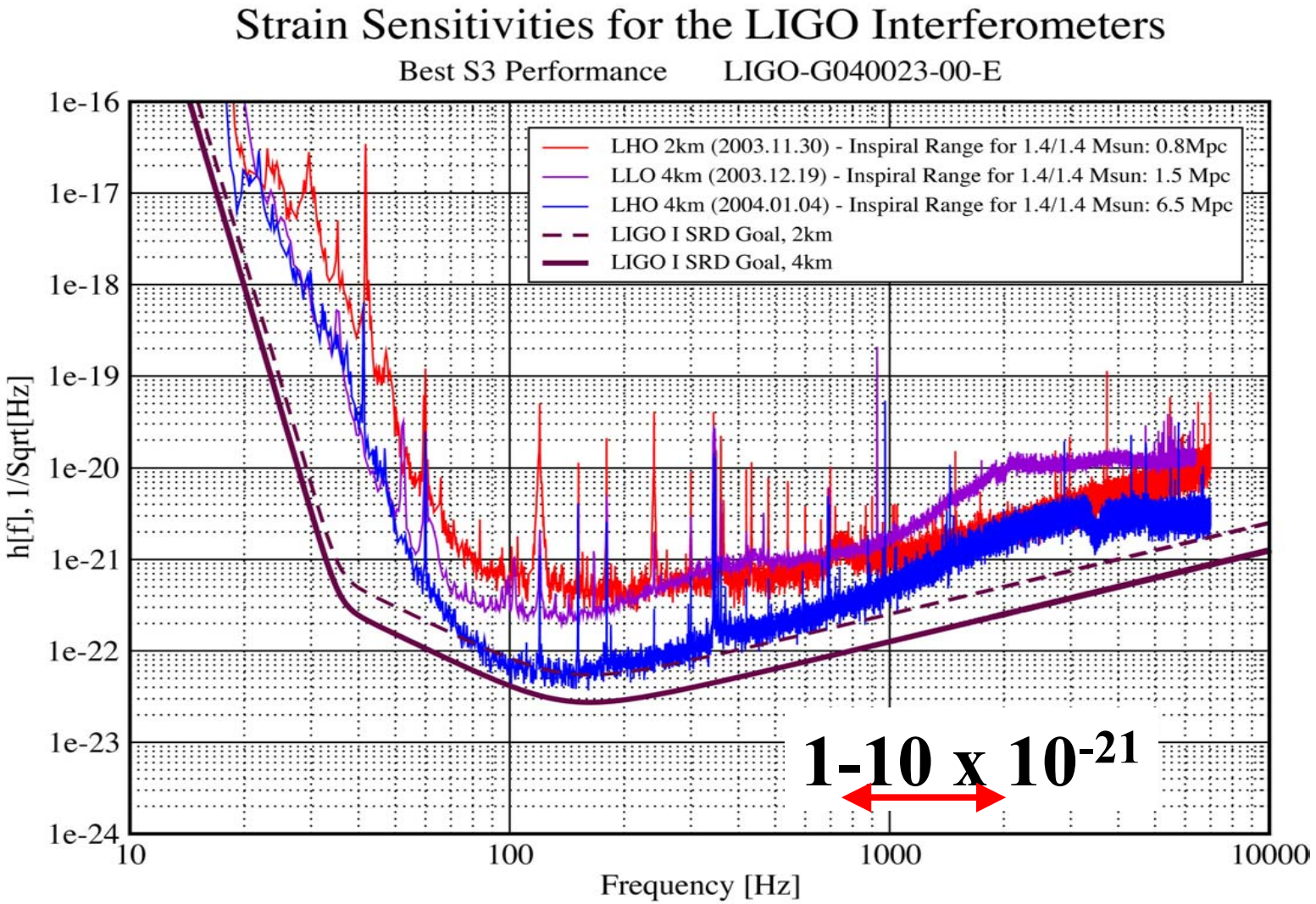
Data

- **Quadruple coincidence**
  - **L1+H1+H2+G1(II) 59.3 hours**
  - **L1+H1+H2+G1(I) 18.9 hours**
- **Triple coincidence**
  - **L1+H1+G1(II) 7.8 hours**
  - **L1+H1+G1(I) 6.0 hours**
  - **L1+H2+G1(II) 3.6 hours**
  - **L1+H2+G1(I) 3.4 hours**
  - **H1+H2+G1(II) 105.6 hours**
  - **H1+H2+G1(I) 46.3 hours**

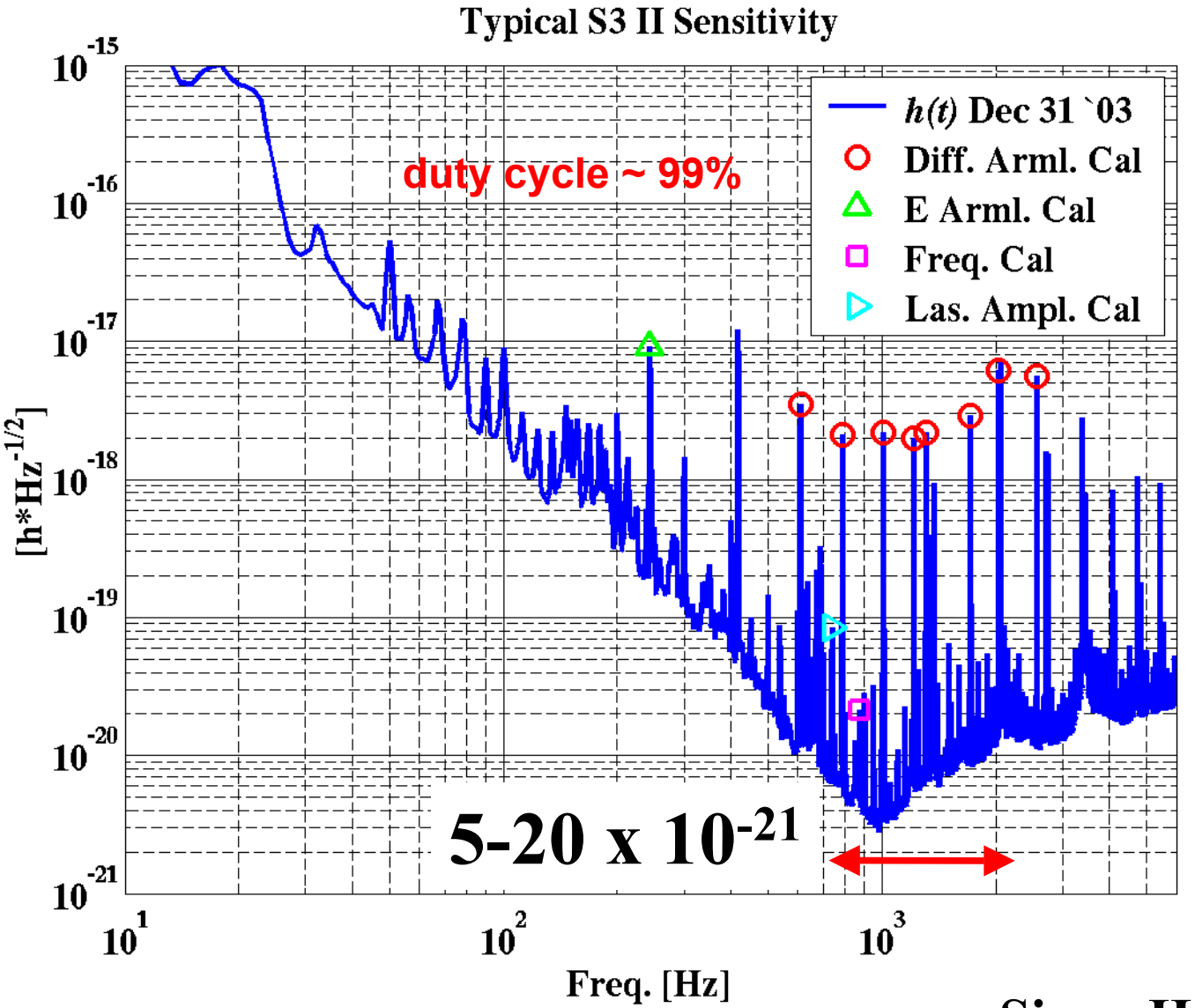
- **Detectors**
  - **Livingston 4k (L1)**
  - **Hanford 4k (H1)**
  - **Hanford 2k (H2)**
  - **GEO (G1)**

- **Analysis plans:**
  - **H1 x H2 x G1(II)**
    H1 x H2 x L1 x G1(II)
    samples (164.6 hours)
- **Current playground studies:**
  - **full PG set (15h), but 3 IFO combination only (H1 x H2 x G1(II))**

LIGO Sensitivity

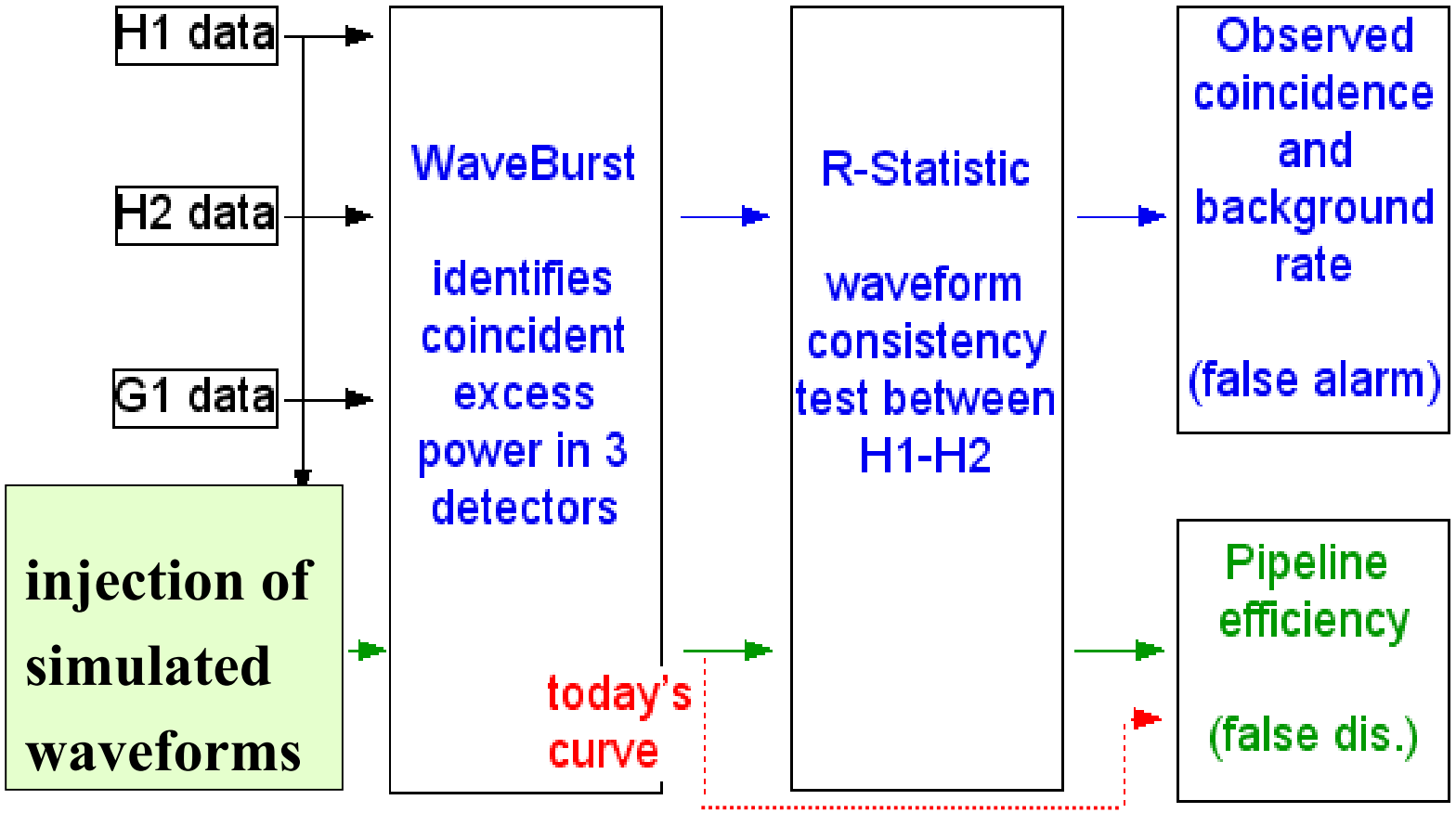


Typical GEO600 S3II sensitivity



Analysis pipeline

The same as for S3 LIGO low frequency search
except that the r-statistics is applied to H1-H2 only

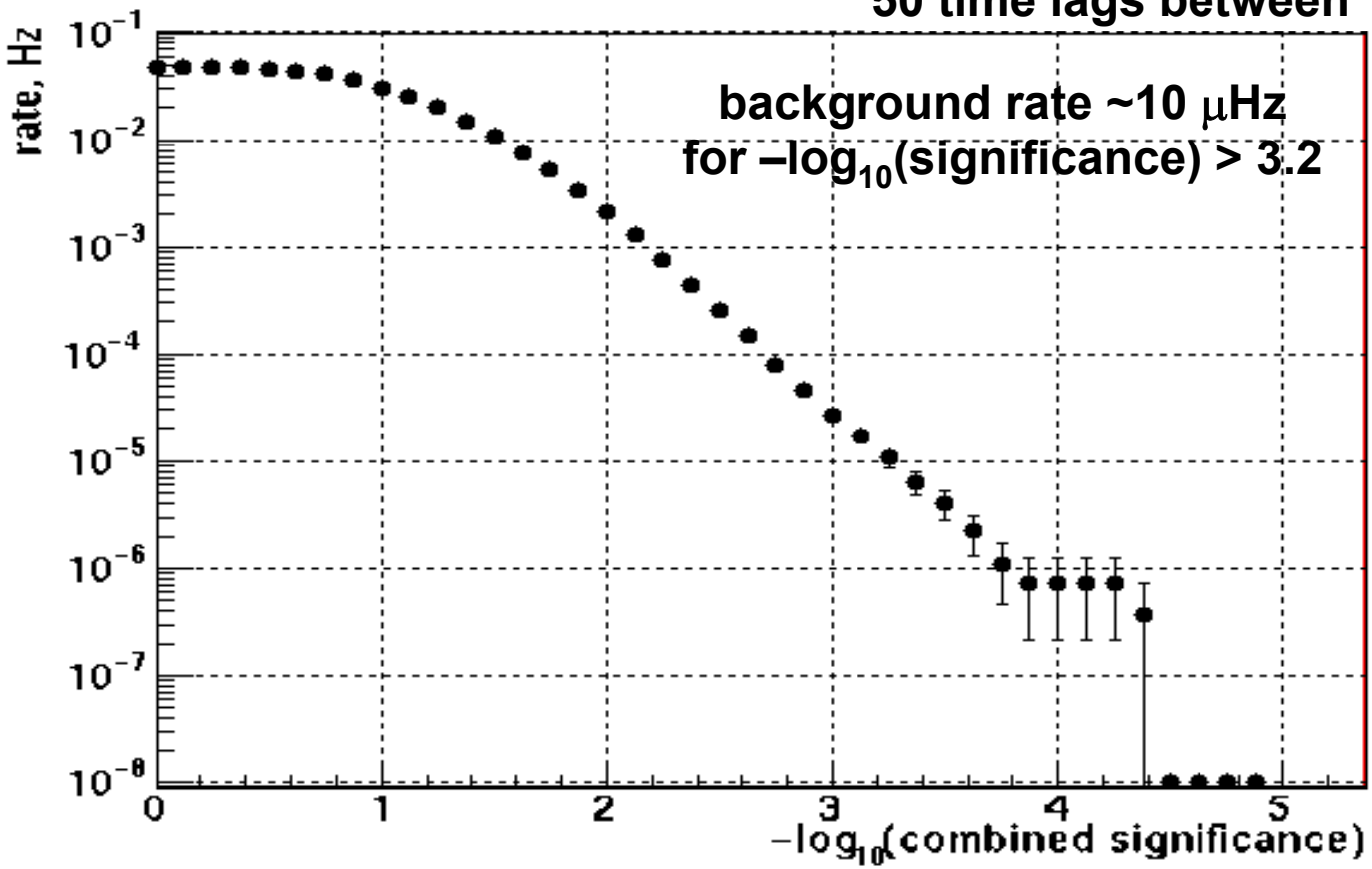


Background rates

Output of WaveBurst pipeline

~53326 seconds analysed

50 time lags between ±106 sec



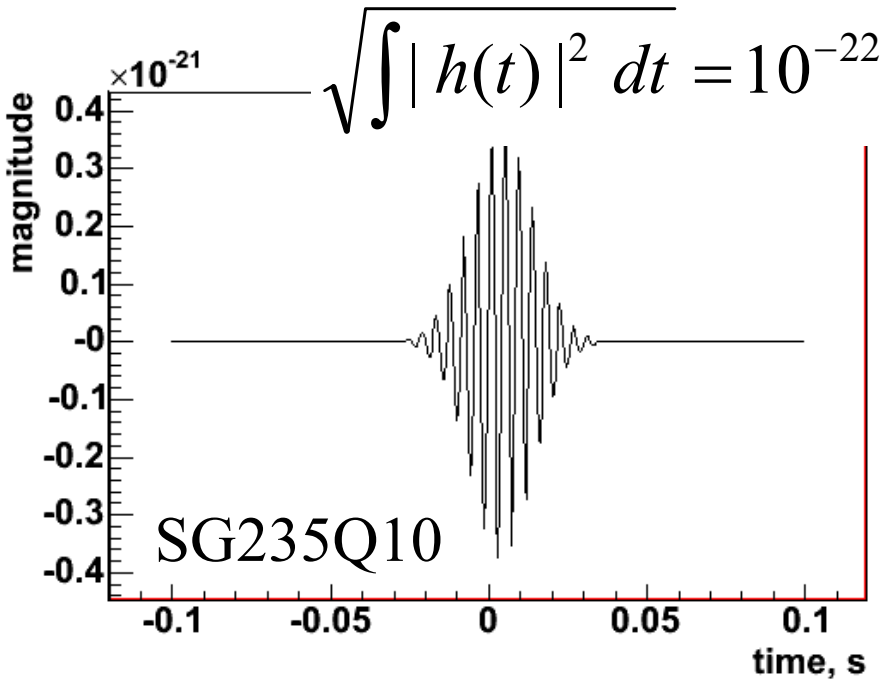
$$\log_{10}(S_{tot}) = \sqrt[3]{\log_{10}(S_{H1}) \times \log_{10}(S_{H2}) \times \log_{10}(S_{GEO})}$$

Simulation

- **Software injection of sine-gaussian signals are performed to estimate the detection efficiency of the pipeline**
- **signals are uniformly distributed over the sky locations.**

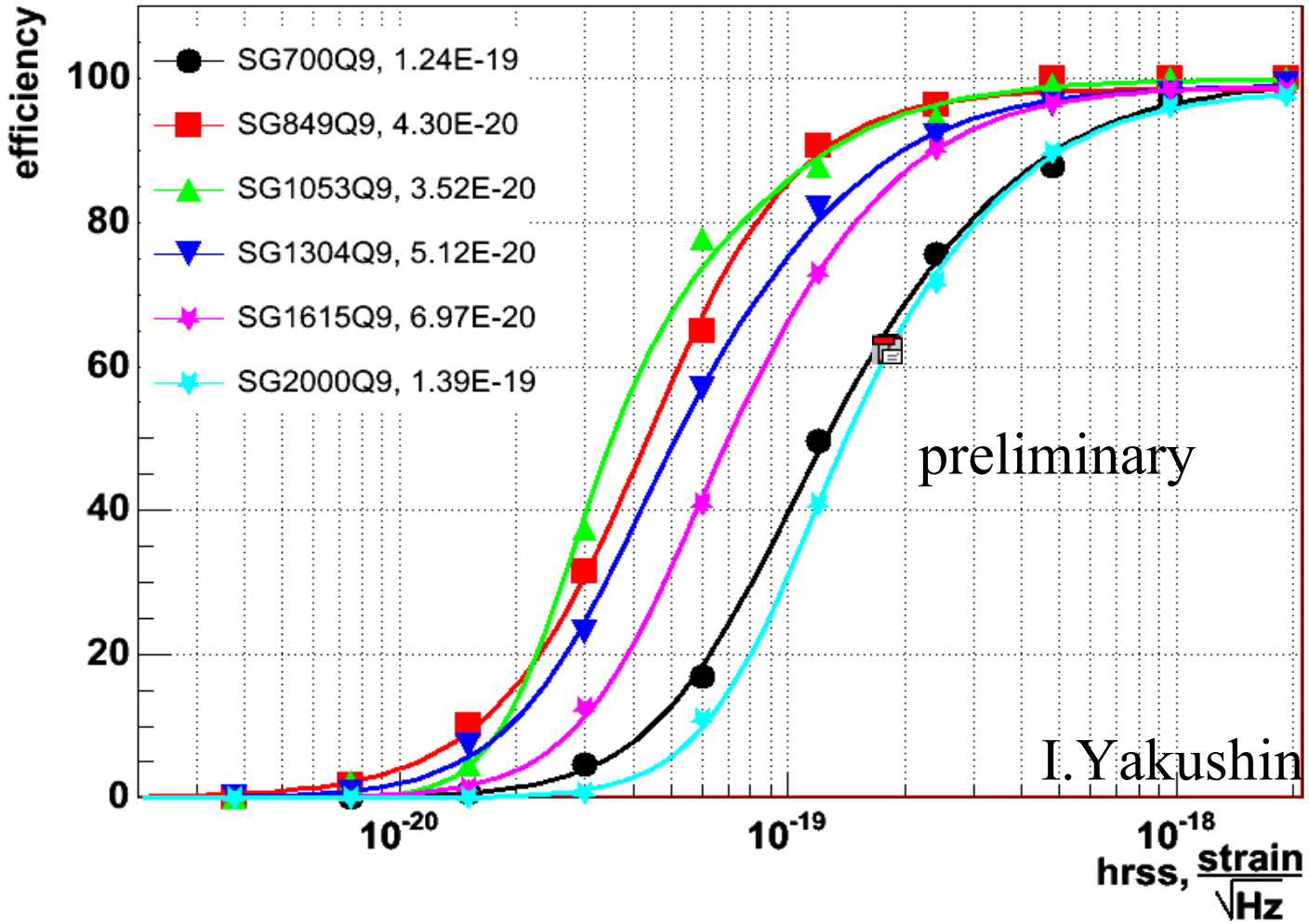
$$Q = f_0\sqrt{2\pi\tau}$$

τ –duration
f_0-central frequency



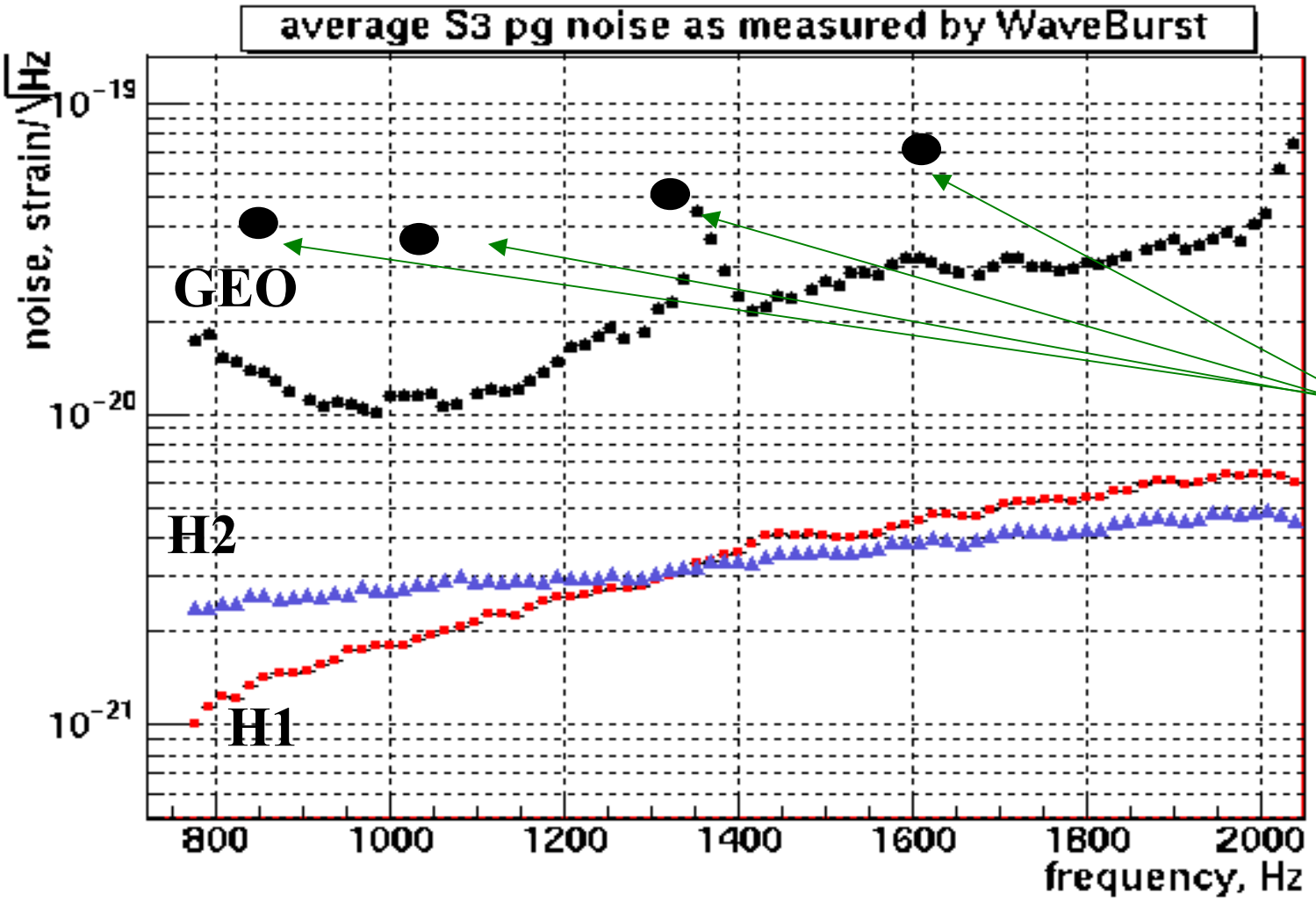
Detection efficiency

Efficiency for SG signals for WB threshold -$\log_{10}$(significance)>3.2



At 1053 Hz, hrss at 50% efficiency point = 3.5 x 10^{-20} $Hz^{-1/2}$

Average detector noise



injected hrss @50% efficiency

R-statistic test

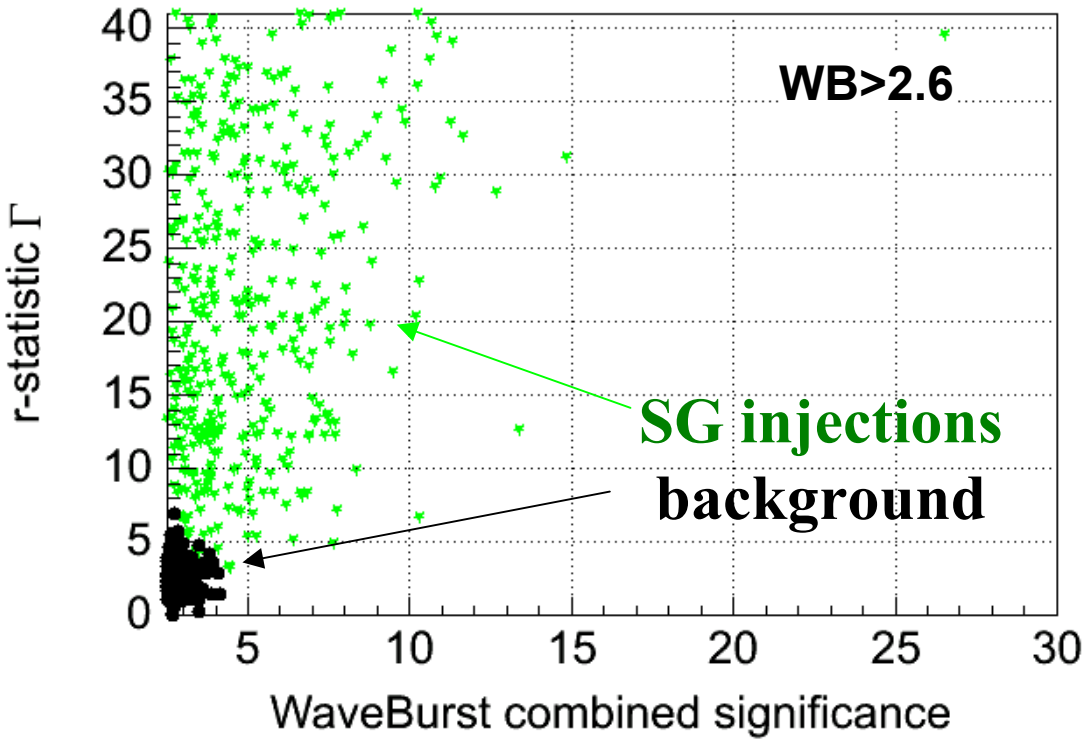
L.Cadonati, Class.Quantum Grav. 21 (2004) S1695

R-statistic test is applied only to H1-H2 pair

Expect background reduction after r-statistics test down to <0.2 Hz

Detection with H1-H2 only

H1-H2 waveform consistency



excess power in H1,H2,GEO

Affected by difference in Hanford and GEO antenna patterns

Summary

- analysed 53326 seconds of playground data from GEO600, Hanford 2km and 4km detectors
- Preliminary results
  - Expected background rate is <20 μHz for WB significance>3
  - Expected sensitivity 3.5-7.0 x 10^{-20} $Hz^{-1/2}$ at 50% detection efficiency and frequency band 768-2048 Hz.
- R-statistic test on H1-H2 pair will further reduce background with minimal reduction in detection efficiency
- Expected false alarm rate after all cuts <0.2 μHz
- Plan more detailed simulation studies with different waveform morphologies and analysis of the quadruple H1xH2xL1xGEO data.