All-Sky Burst Searches for Gravitational Waves at High Frequencies

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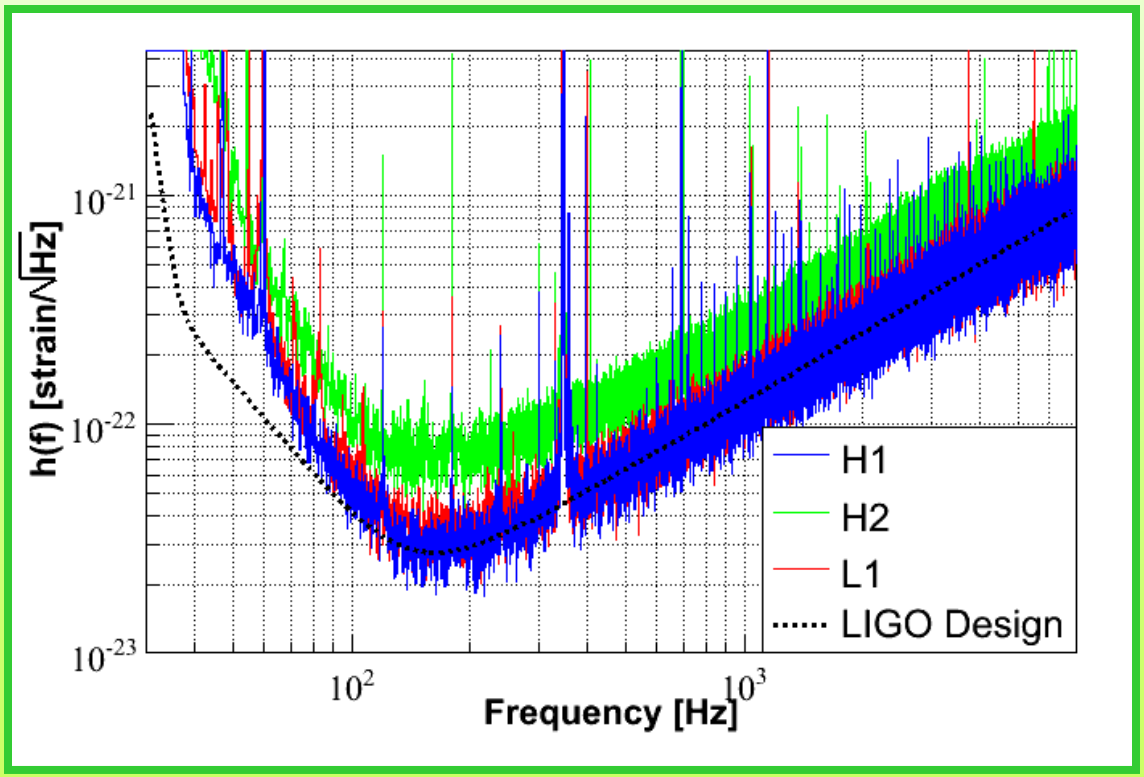
“High Frequency” Gravitational Waves

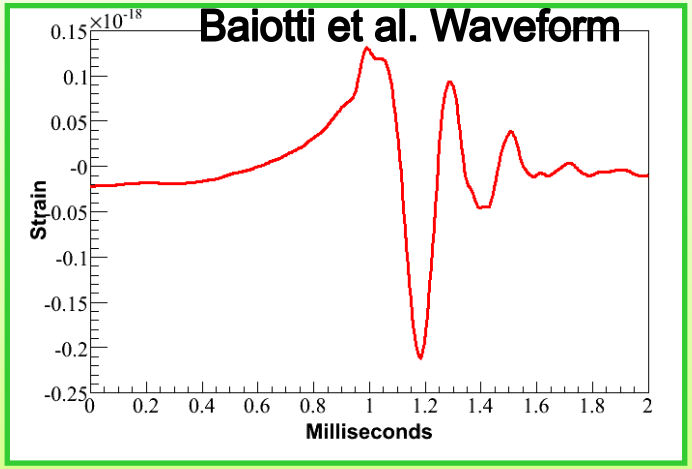
- In S5 we have conducted all-sky burst searches extending the frequency range up to 6 kHz
- Use similar approach to low frequency analyses, adapt where needed
- Not in optimal sensitivity range of detectors, but:
  - with the exception of narrow band detectors, nobody else covers this region
  - shot noise-dominated data is less glitchy (fewer outliers)
  - the literature points to a large number of potential sources…..



Transient Sources at a few kHz

Neutron star collapse scenarios resulting in rotating black holes
L. Baiotti *et al*. Phys Rev. Lett. **99**, 141101 (2007).
L. Baiotti *et al*. Class. Quant. Grav. **24**, S187 (2007).

Nonaxisymmetric hypermassive neutron stars resulting from neutron star-neutron star mergers
R. Oechslin and H.-T. Janka, Phys. Rev. Lett. **99**, 121102 (2007).



Neutron star f-modes
B.F. Schutz, Class. Quant. Grav. **16**, A131 (1999).

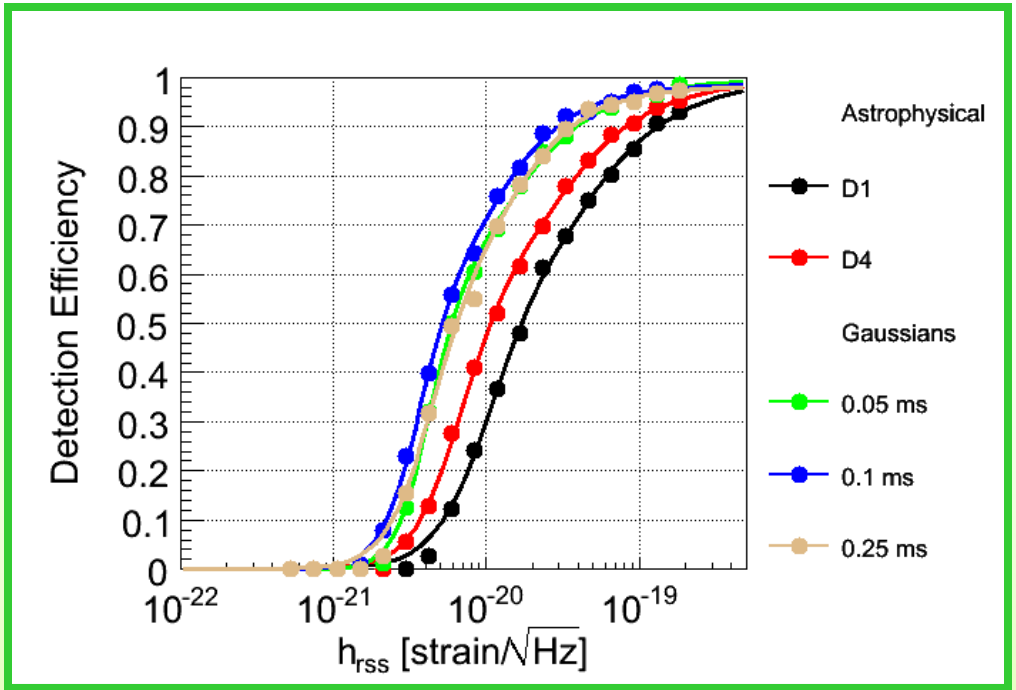
Neutron stars undergoing torque-free precession
J.G. Jernigan, AIP Conf. Proc. **586**, 805 (2001).

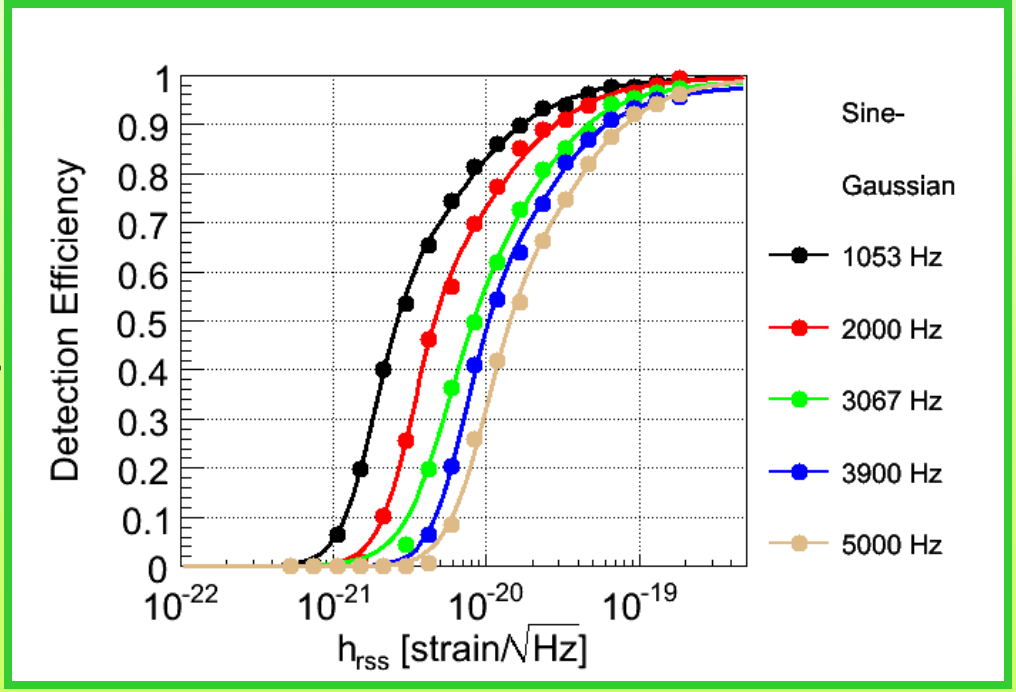
Low-mass black hole mergers
K.T. Inoue and T. Tanaka, Phys. Rev. Lett. **91**, 021101 (2003).

SGRs
J.E. Horvath, Modern Physics Lett. A **20**, 2799 (2005).

1st Year S5 Analysis

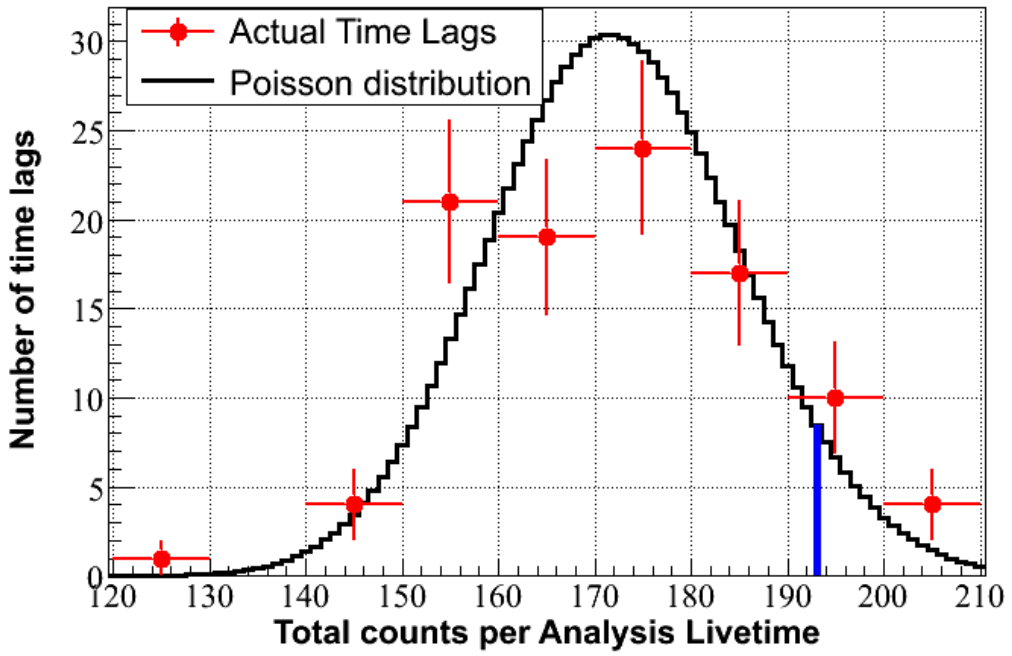
- Based on QPipeline, with cross-correlation followup
- Run on triple-coincident H1, H2 and L1 data
- Also check for loud events in H1H2 only time
- Tuned on background sets from 100 lags of L1 w.r.t. H1H2
- Cuts on single site energy, cross-correlation factor Γ
- Used similar data quality/vetoes as low frequency, empirically determined which apply





Results

	Background Count	Normalized Background	Unshifted Count
Coincident Triggers	23361	242.9	265
Data Quality Cuts	18831	195.8	223
Auxiliary Channel Vetoes	16547	172.0	193
Cut on Cross-Correlation	11	0.115	0



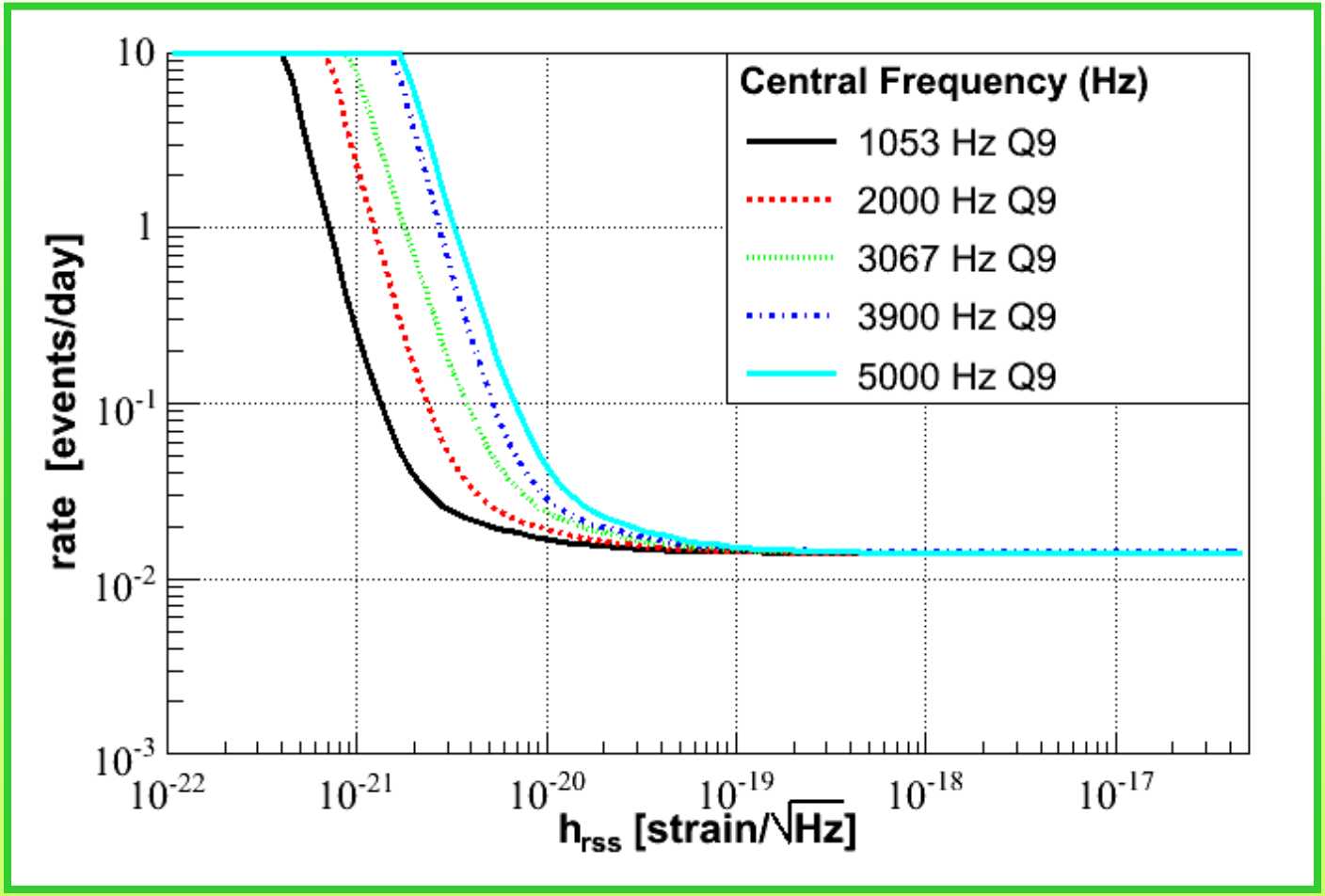
Null Result

Distribution of sub-threshold Events in time-lags consistent with expectation

Zero-lag subthreshold counts less Than 2-sigma deviation from mean

Upper Limits

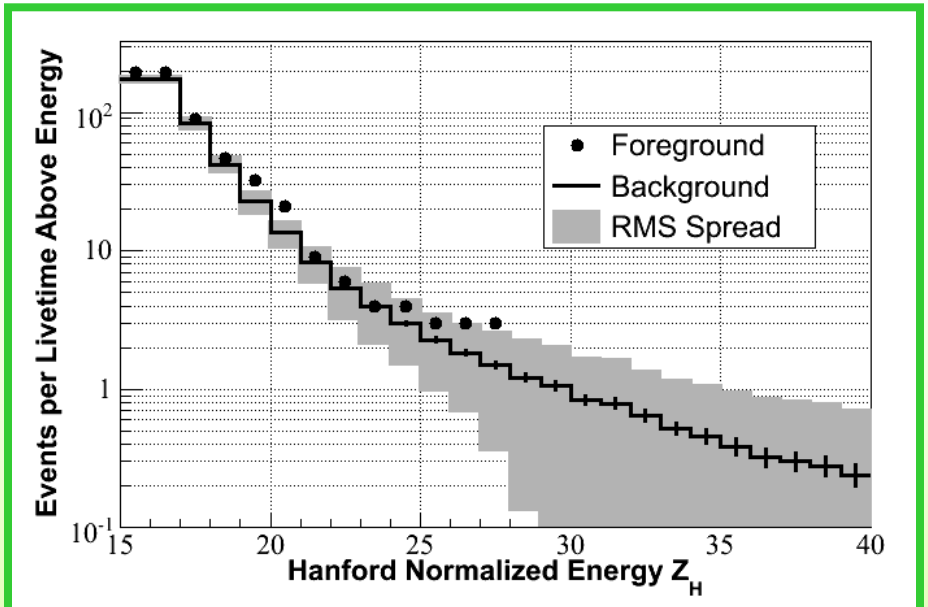
90% Confidence Level Upper limit curves for some waveform types (adjusted for uncertainties)

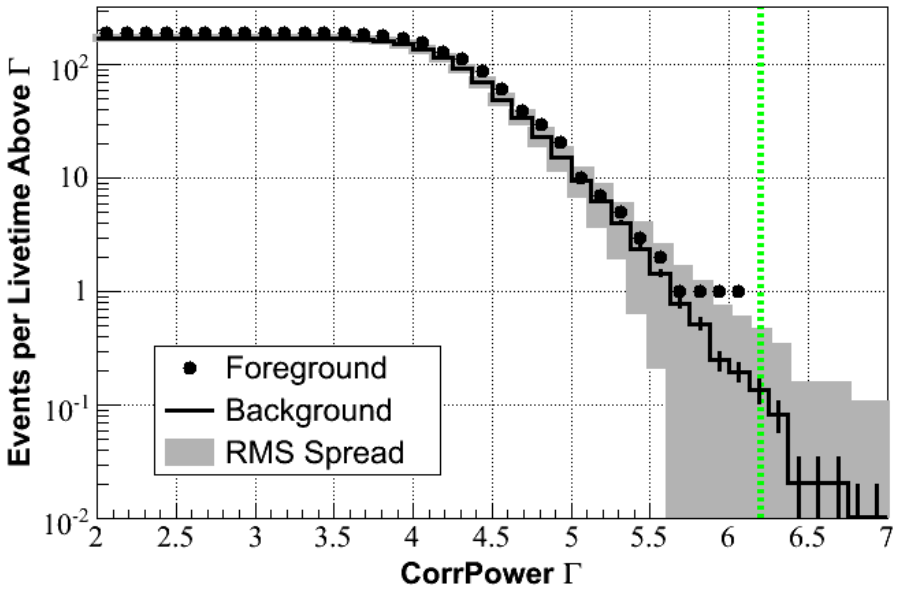


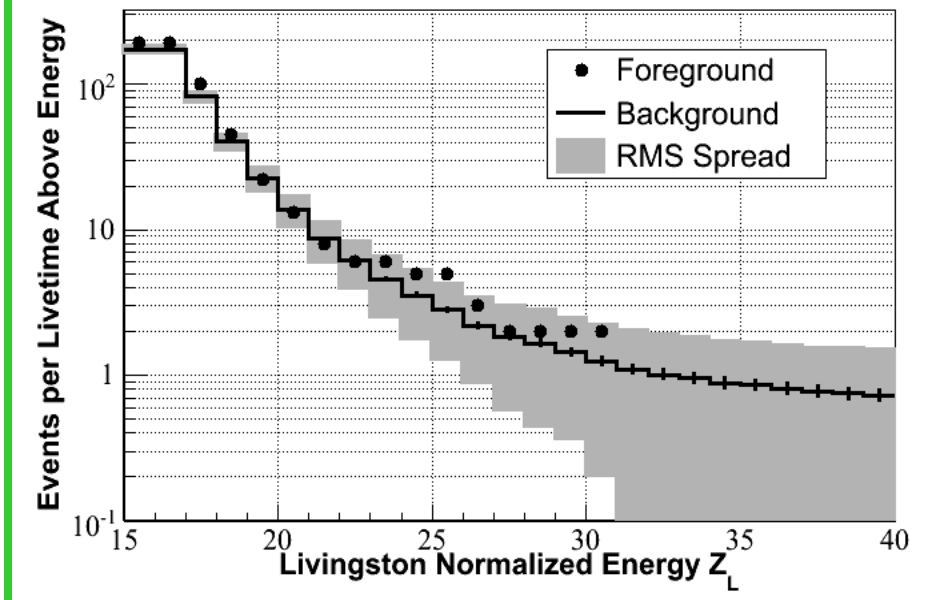
Trigger Distributions

Cumulative distributions of subthreshold events for

- Cross-correlation measure CorrPower
- Hanford energy distribution
- Livingston energy distribution







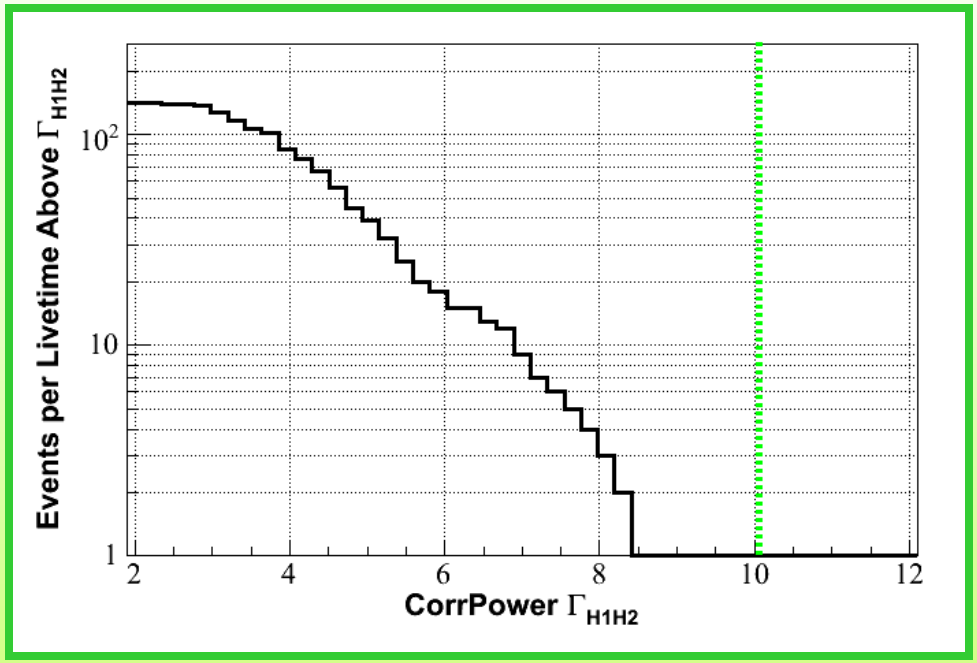
H1H2 only analysis

Lack of two sites increases background due to lack of multi-site coincidence, but still worth checking for interesting events

About half as much livetime as H1H2 – L1 coincident search

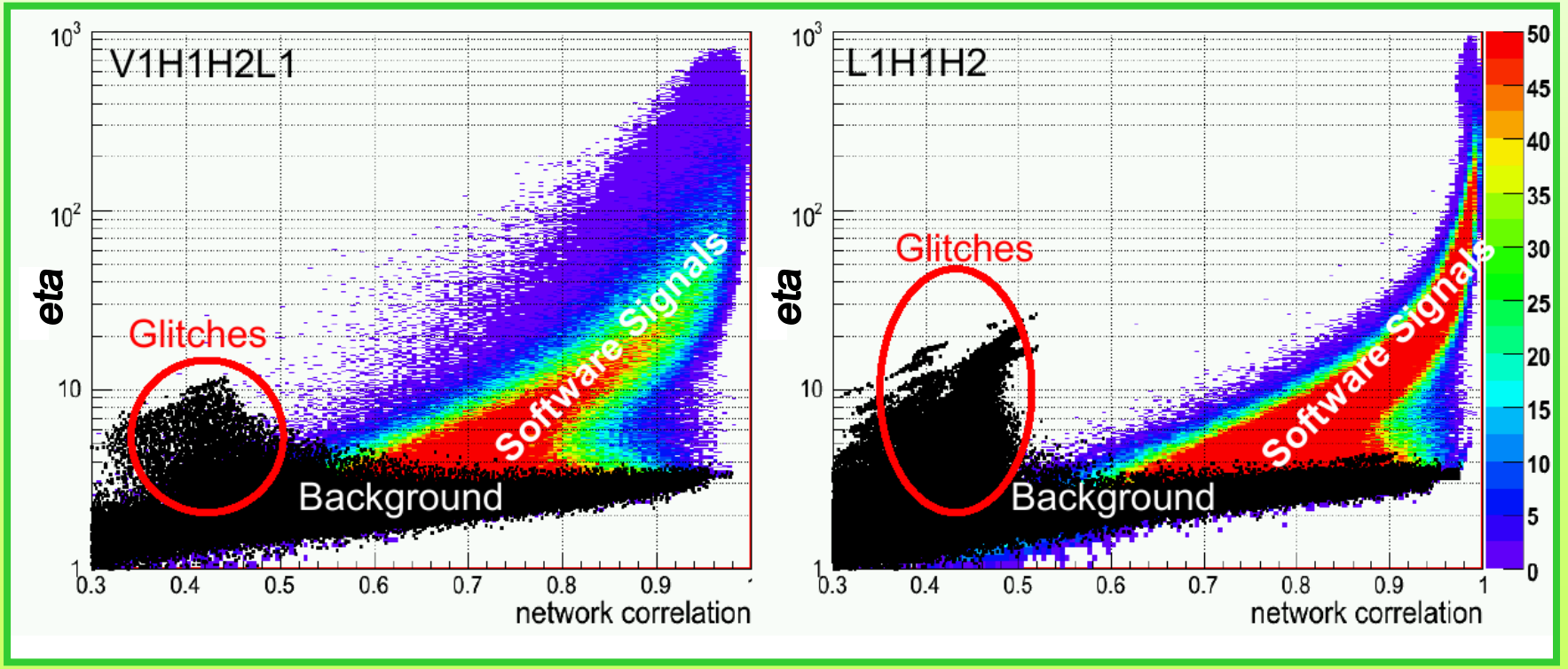
Tuned independently after triple coincident analysis was completed using triple-coincidence time as background

Also a null result

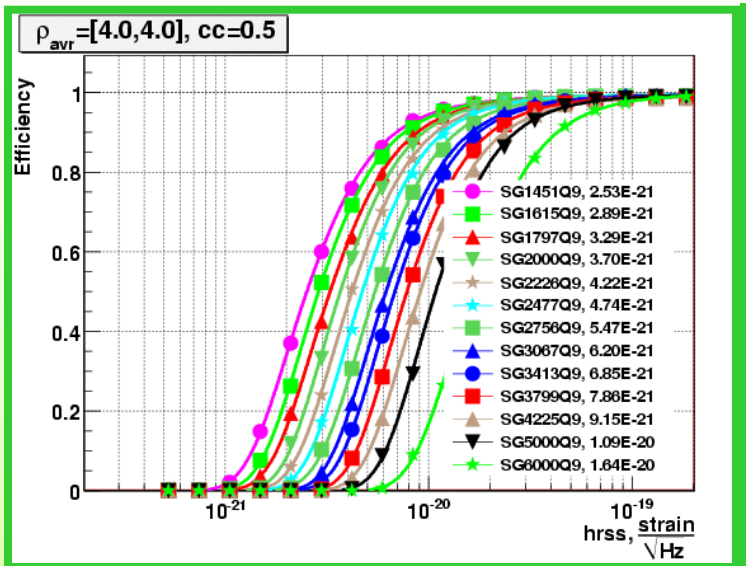


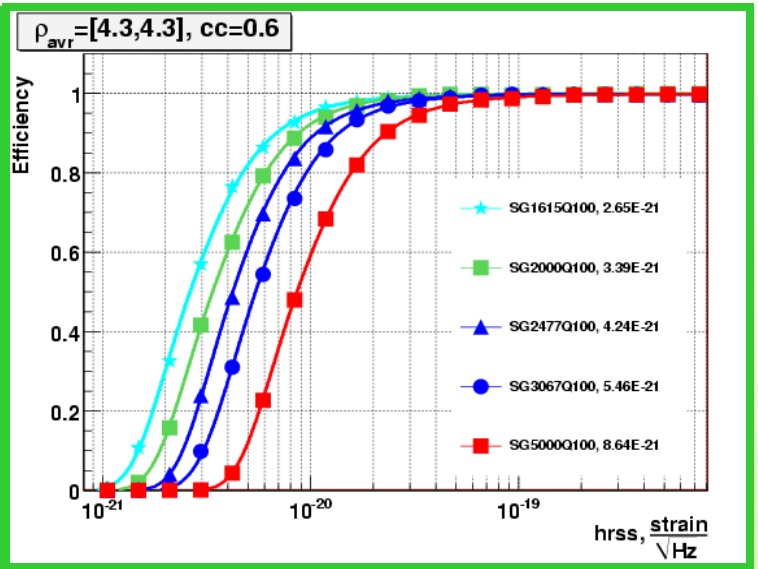
2nd Year S5/ VSR1 Analysis

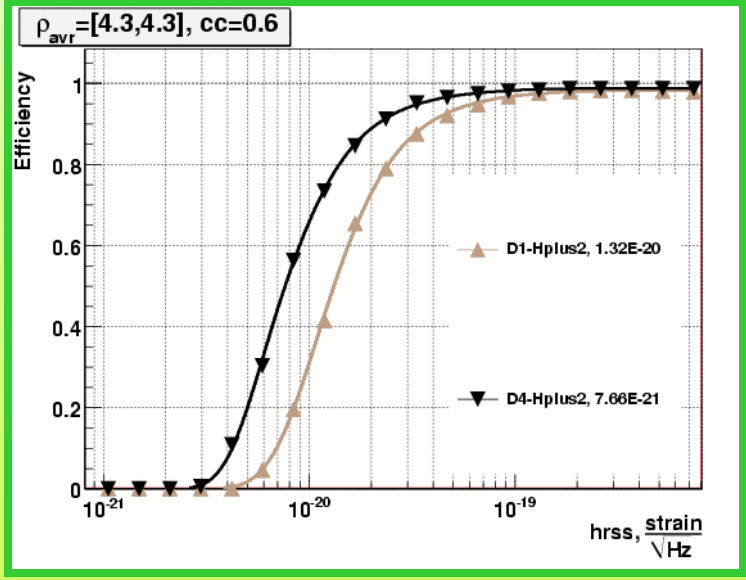
- Joint analysis of LIGO and Virgo data
  - Virgo sensitivity on par with LIGO's in this band
- Uses coherent WaveBurst (1st year methods can't utilize Virgo)
- Employs coherent network correlation coefficient (cc) and network correlated amplitude (eta) see S. Kilimenko et al. Class Quant Grav 25 1140209 (2008)
- Analysis complete, review underway

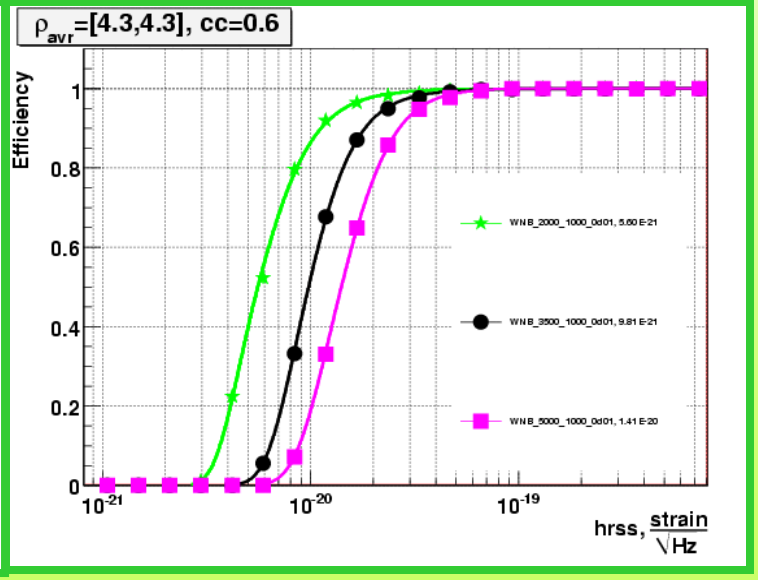


2nd Year S5/ VSR1 Efficiencies









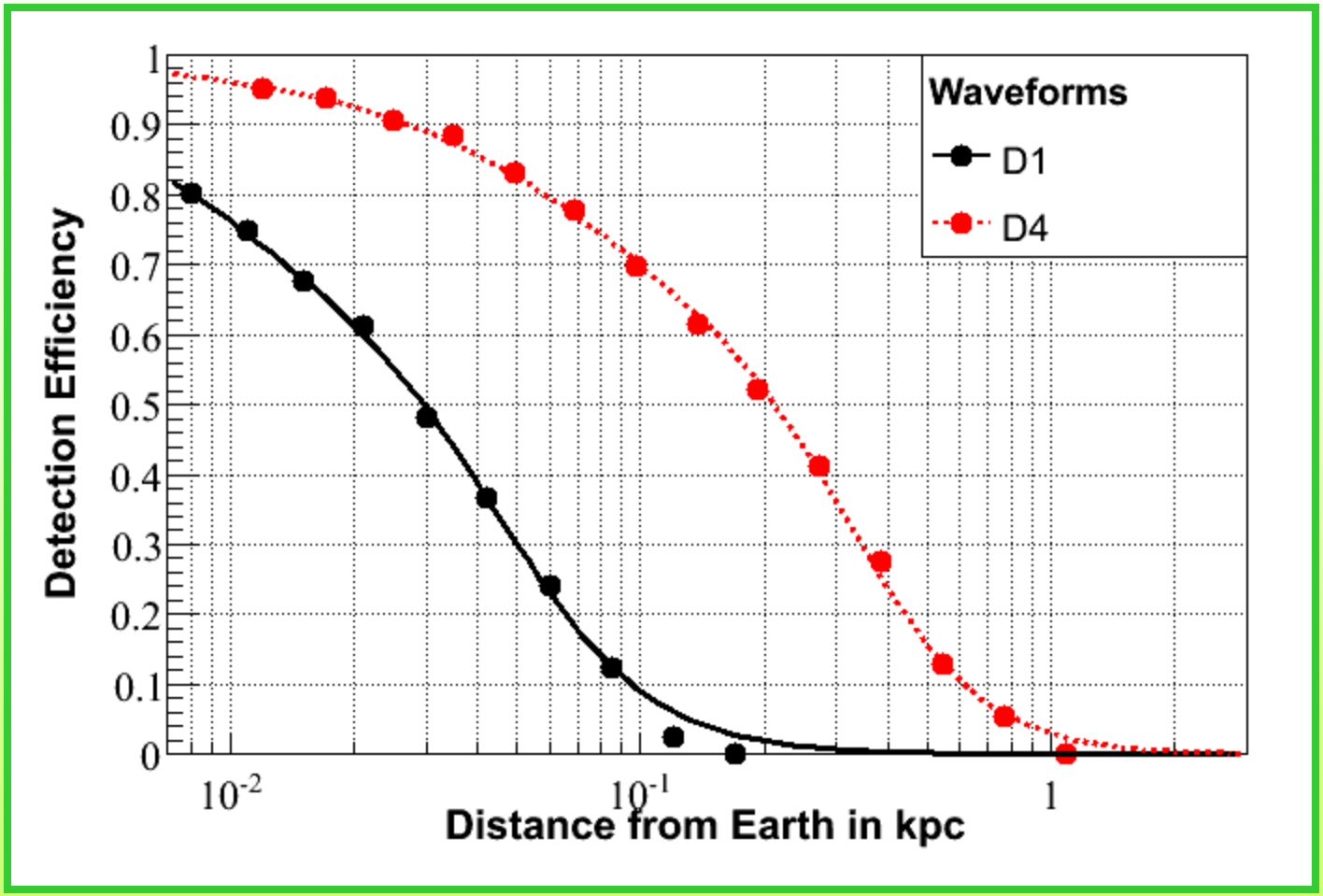
Summary

- LIGO burst analysis extended up to 6 kHz for first time
- 1st year results available on arXiv:
  gr-qc/0904.4910
- 2nd year + Virgo results forthcoming soon
- We will continue to look for signals
  in this regime in S6

Emergency Backup

Efficiency vs. Distance

Tested efficiency as function of range for neutron star collapse simulations by Baiotti et al.



Background Distribution

Distribution of sub-threshold events in time-lags consistent with expectation