

Burst group summary and plans

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for the LSC-Virgo Burst Group

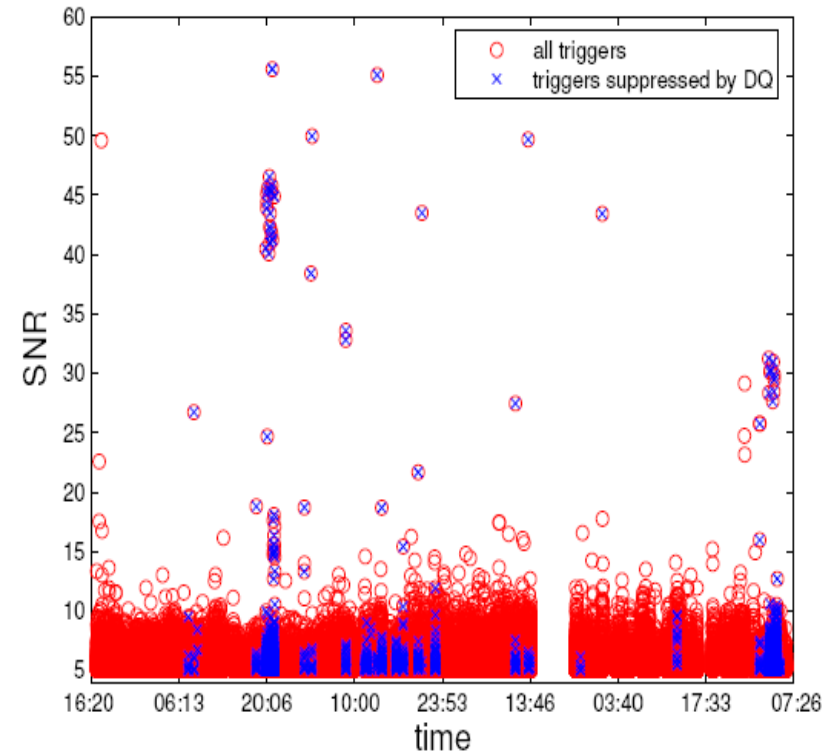
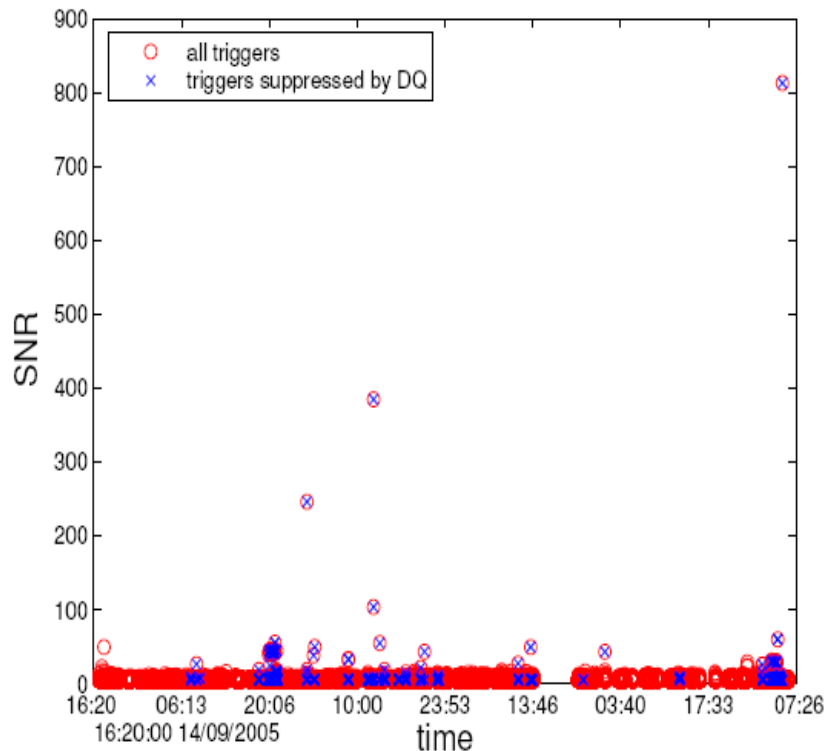
March 20, 2007
LSC-Virgo meeting
Baton Rouge, LA

- Officially started operating jointly, holding full-length joint weekly telecons (on all burst group matters) in February 2007
- Telecons specific to the LSC-Virgo joint bursts analysis started in November 2006
- Group co-chairs: Patrice Hello (Orsay), Erik Katsavounidis (MIT), Peter Shawhan (Maryland)
- Group web page/e-notebook/wiki:
 - » <http://www.lsc-group.phys.uwm.edu/bursts/>
 - » <https://workarea.ego-gw.it/ego2/virgo/data-analysis>

- **Virgo part** of the group emphasizes on the analysis of commissioning and weekend-science-run data of the Virgo detector
- **LSC part** of the group emphasizes on the analysis of science data collected by the LSC detectors
- **All** are involved in the group's current joint analysis: a high-frequency (800-2000Hz) search with data in coincidence among LSC and Virgo detectors (Sep 8th 9:00 UTC 2006 - Sep 11th 5:00 UTC 2006)
 - » End-to-end analysis using fully coherent and incoherent methods (talks by Sergey Klimenko, Peter Shawhan)
 - » An exercise of what we would like to do when data exchange commences

- Burst f2f talks by Fabien Cavalier, Nicolas Leroy and Gianluca Guidi
- As we are doing analysis on single detector, Data Quality and veto definition are important

C7 data using MF

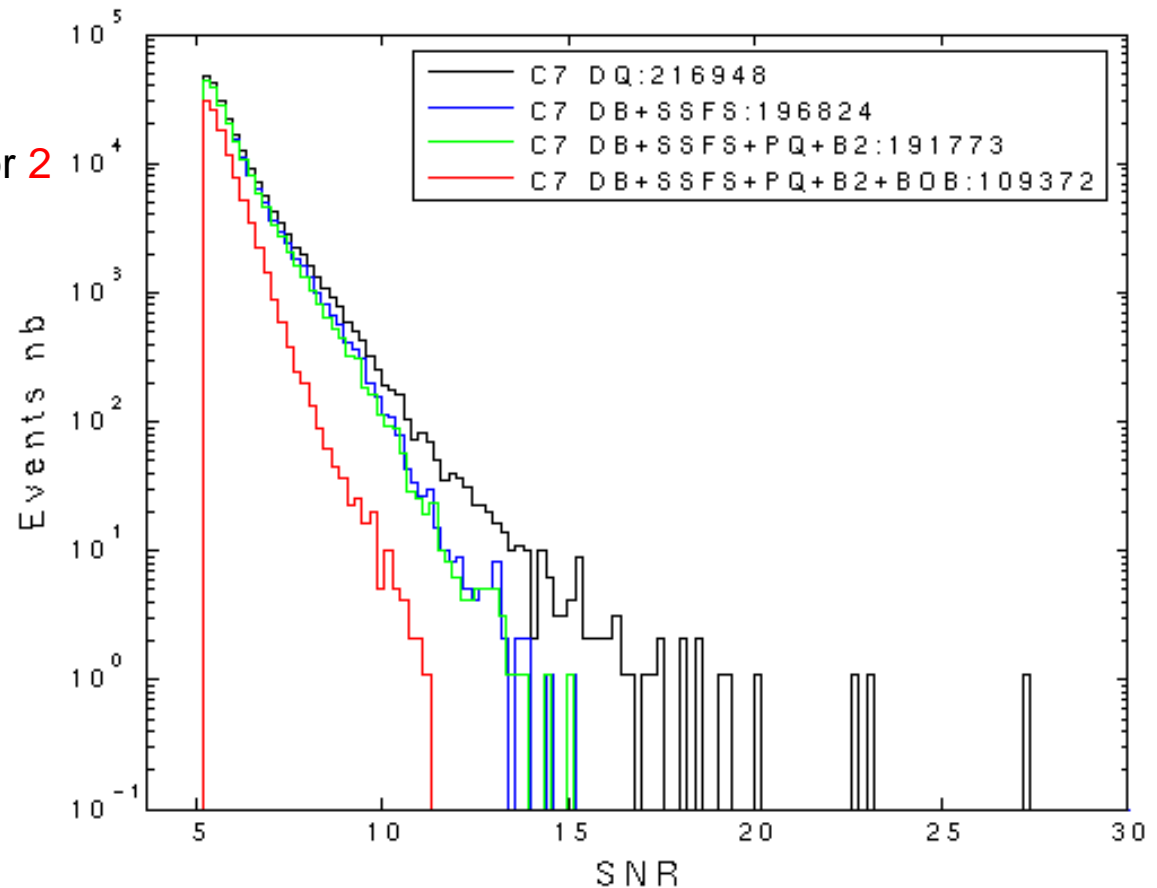


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C7 data :

max SNR 11.3

Reduction of events by a factor 2

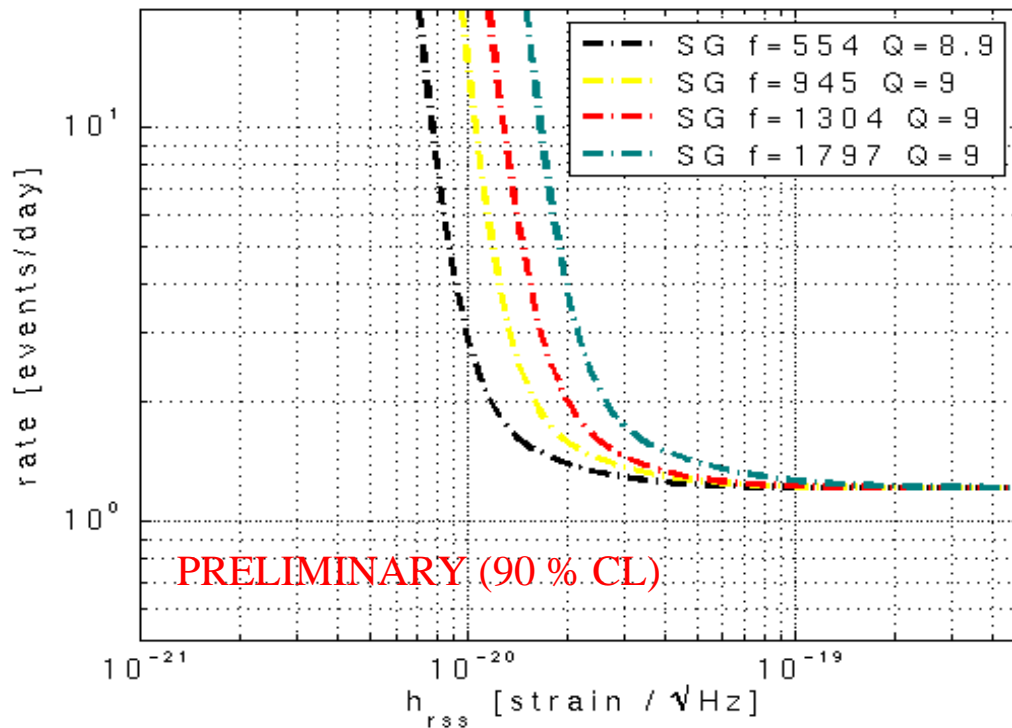


- As we are doing analysis on single detector, Data Quality and veto definition are important
- Determine all-sky upper limit

C7 data using EGC

- SG signals
- UL using no background
- Effective duration 1.9 days
- Similar S2 sensitivity

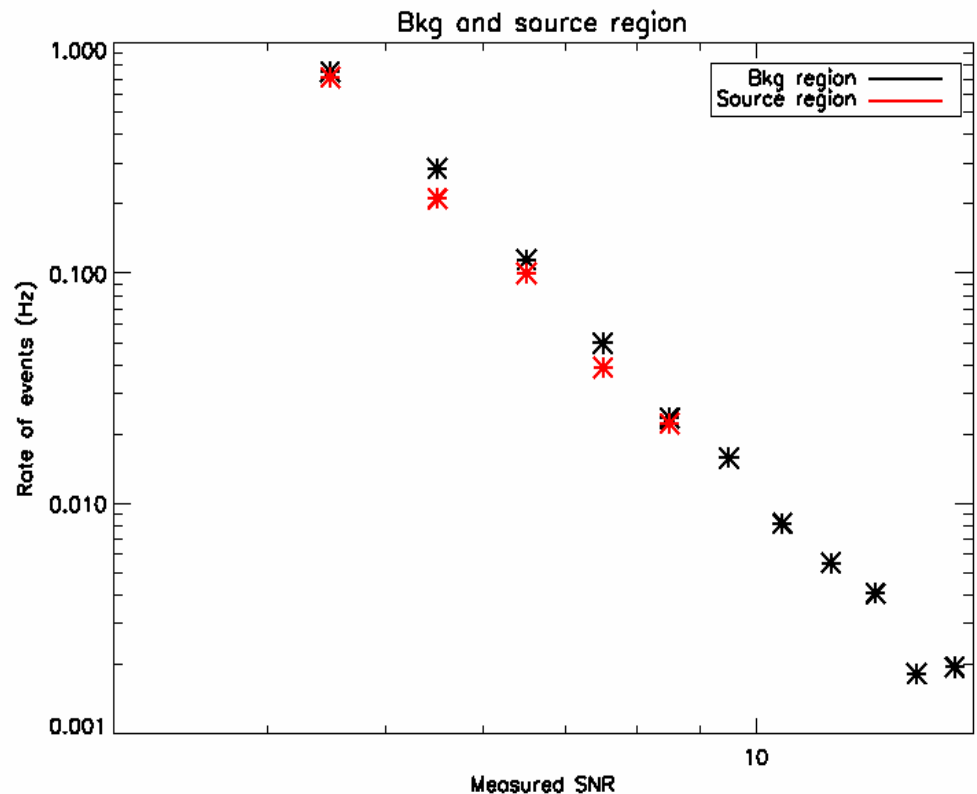
UL on the rate of events/day:
1.2 event/day



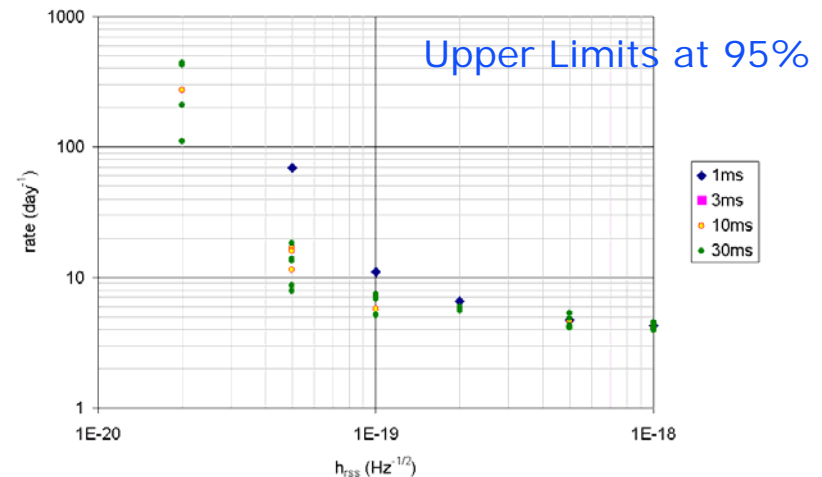
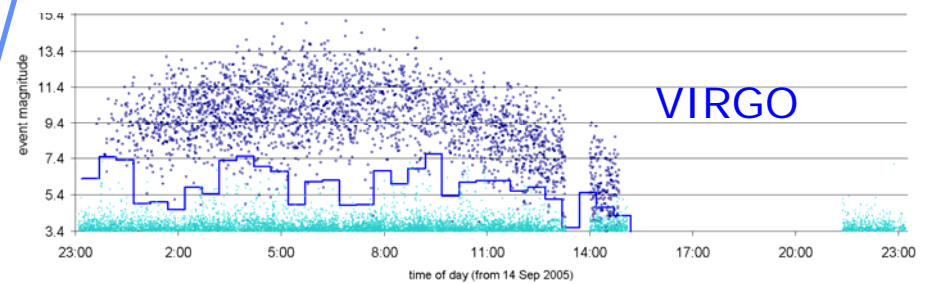
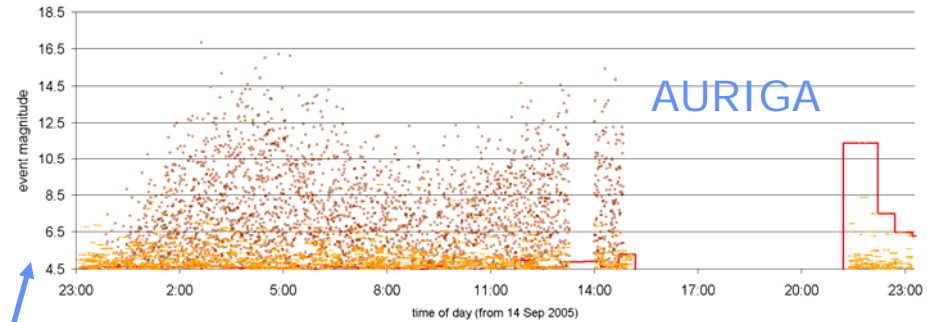
- As we are doing analysis on single detector, Data Quality and veto definition are important
- Determine all-sky upper limit
- Follow-up on GRB

Using GRB 050915a (C7) and
SG signals

UL (hrss Hz^{-0.5}) 4.2 – 6.9 10⁻²⁰



- **Period:** 24 hours of data taking during C7.
- **Coincidence search** on trigger lists provided by each detector.
- **Goal:** assess confidence intervals for signals coming from the *galactic center* and taken from the template class of *damped sinusoids*.
- **Optimization of thresholds:** for each template and each given target amplitude, the best compromise between efficiency and FAR is searched, using variable threshold for each detector with $\frac{1}{2}$ hour bins.
- **Blind analysis:** in order not to bias results by feedbacks on methods from looking at results, a “secret” time offset has been added to detector times.
- **Mainly a methodological work**





Virgo burst searches: the near future (up to May)



- Analysis our 2007 WSRs data
 - » All of them are different (commissioning changes status of detector) and need important work on veto
 - » All-sky analysis with others signal types- also using a galactic distribution on simulated injections
 - » Continue the follow up on GRBs

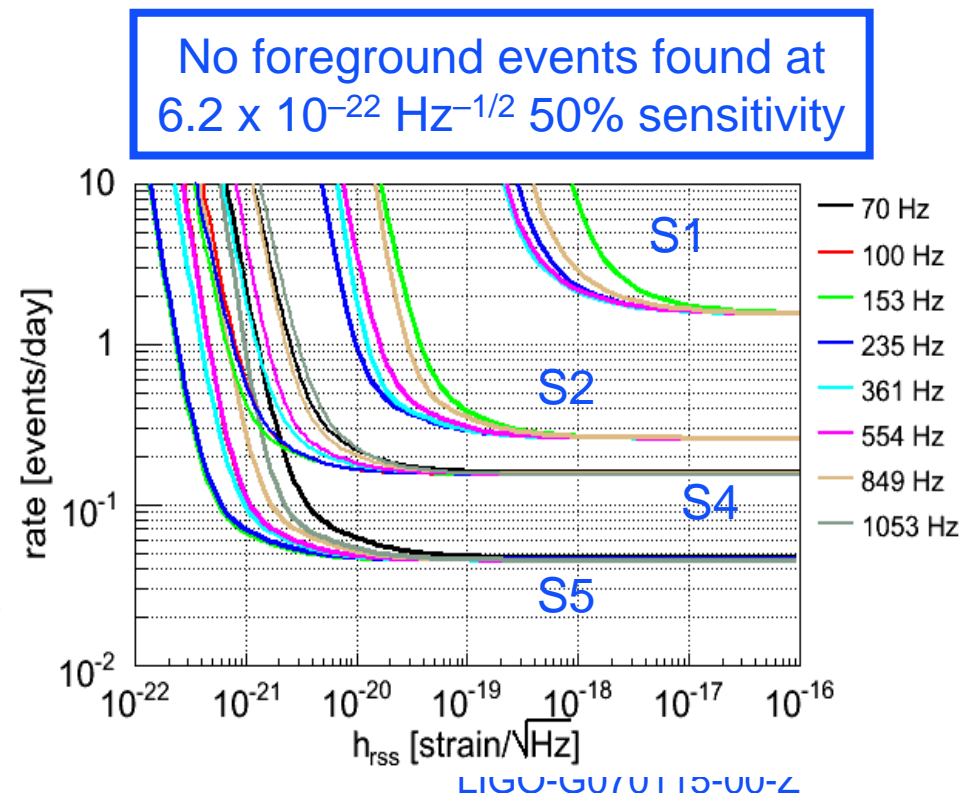
- S4 all-sky untriggered burst search
 - » 15.5 days of triple coincidence LIGO data
 - » WaveBurst+CorrPower methodology developed in S2/S3
 - » Search for signals with frequency content in the 100-1600Hz frequency range
 - » Instrument-based interpretation (local flux of gravitational wave transients)
 - » UL at 0.15 events per day
 - » For a sine-Gaussian of 153 Hz, $Q=8.9$, h_{rss} at 50% efficiency is $1.3 \times 10^{-21} \text{ Hz}^{-1/2}$
 - » Few minor last minute comments and insertion of final author list are pending before paper is placed on arxiv.org

- Oscillation search associated with SGR1806-20 (talk by S. Marka)
 - » Astrowatch data (pre-S4)
 - » Analysis of the most significant QPOs is complete and 90% strain-limits of GW strength at the detector placed
 - » Paper has appeared on arxiv.org (astro-ph/0703419)

- S2/S3/S4 GRB-triggered burst search (39 GRBs)
(talk by S. Marka)
 - » Association of transient gravitational wave emission on a single- and multi-GRB basis
 - » Show how to use multi-GRBs to set constraints on population models

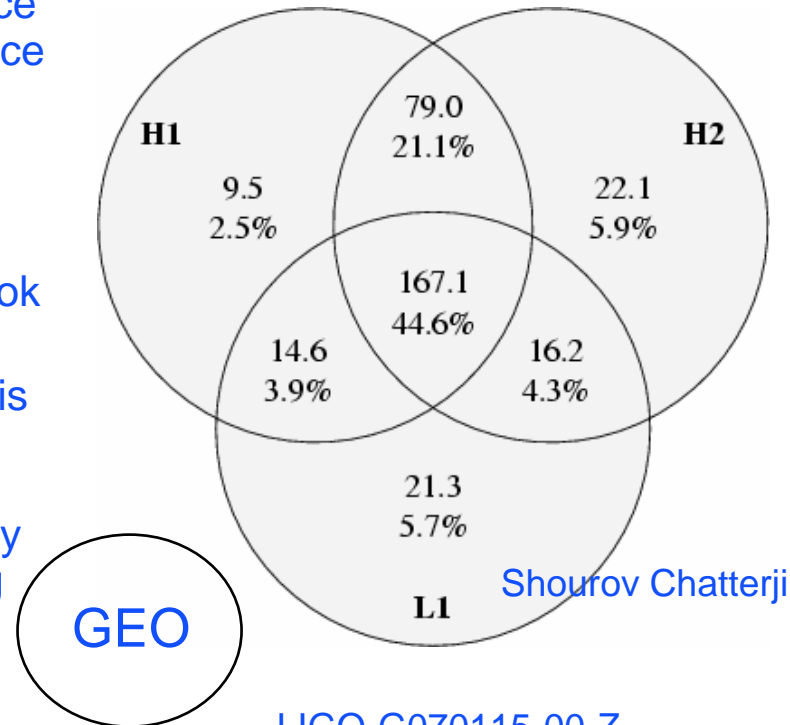
- S3 LIGO-AURIGA search (talk by L. Cadonati)
 - » Demonstrate methods using 2 weeks of S3 data
 - » Paper draft circulated within the Burst group
 - » Currently being reviewed by the Burst Review Committee
- S4 Cosmic strings burst search
 - » Demonstrate how to search for such bursts using data from S4
 - » Loudest event search complete
 - » First paper draft circulated within the Burst group
 - » Next on Burst Review Committee's list of papers/analyses to look into
- S4 LIGO-GEO, all-sky burst search
 - » Application and comparison of coherent and incoherent methods
 - » Search performed in the 600-2000Hz regime (detection search covers signal region in 1600-2000Hz)
 - » Paper is being drafted -- review to commence after paper is released

- All-sky, all-times search for bursts on S5A (Nov 4, 2005-Apr 3, 2006)
 - » Extends S2->S3->S4 search methodology to first 5 months of S5
 - » Triple coincidence livetime analyzed: ~54 days
 - » Waveburst and CorrPower used as the main search methods
 - » Data Quality and event-by-event vetoes tuned on single-detector triggers were also invoked
 - » End-to-end analysis complete
 - » Instrument-based interpretation (like in S1/S2/S3/S4)
 - » **Brief CQG paper describing the search is being considered**
 - » **Review is pending**
 - » Similar analysis with BlockNormal and CorrPower and over the same data set is currently being finalized



- First calendar year of S5, all-sky, all-times search

- » **NEW** Introduce fully coherent methods for the end-to-end analysis
- » **NEW** Analyze all coincidence data (two or more detectors)
- » Keep incoherent methods back-to-back for sanity
- » Coherent Waveburst analysis completed the tuning and analysis of time-shifted data corresponding to ~167 days of triple coincidence S5 data and ~83 days of LIGO-GEO coincidence data- opening of the “zero-lag box” is awaiting major analysis building blocks to be ironed out (talk by Sergey Klimenko)
- » BlockNormal: single-instrument incoherent method with coherent followup- preparing to look at the full year data
- » Q-pipeline: hierarchical approach with emphasis on the H1H2 coherent step before looking at other IFO data- also preparing to look at the same dataset (talk by Shourov Chatterji). A fully coherent follow up with X-pipeline is also being planned



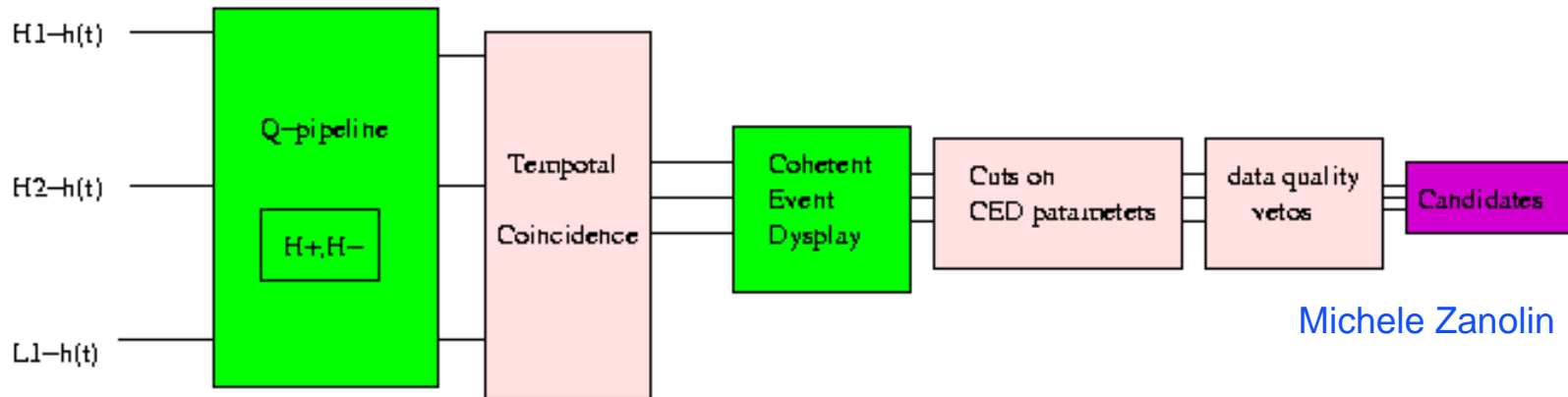
- First calendar year of S5, all-sky, all-times search (cont'd)
 - » Major analysis building blocks that are needed for an S5 first calendar year result:
 - Complete simulations for full 1-year (~1 month)
 - Investigate event-by-event vetoes (~1 month)
 - Work out UL statistics for combining results from different detector networks (with different sensitivity and background) (~2 months)
 - Finalize baseline search approach for 2-detector analysis (this is a first!) (~2 months)
 - Establish best use of GEO (follow up of LIGO coincidences vs full upfront inclusion? Still being discussed) (~1 month)
 - Availability of final S5 calibration and $h(t)$ frames
 - Open the “zero-lag box” ($\sim 0 \rightarrow \infty$)
 - » Next milestone: be ready to open the zero-lag box at the May LSC-VIRGO meeting

- First calendar year of S5, all-sky, all-times search (cont'd)
 - » Papers and interpretation of results? (assuming upper limits!)
 - » Single, long PRD writeup describing **all** analysis methods invoked in the search for gravitational waves bursts in **all** S5 detector networks: goal of having a single reference of technical aspects of any S5 forthcoming result and decouple gravitational wave analysis details from astrophysical source theory/phenomenology.
 - » Perform “standard” simulations and present instrument-based result (ala S1/2/3/4) in the same long PRD
 - » Prepare an ApJ/PRL epitome of the search detailed in companion PRD following which we elaborate on implication for astrophysics of gravitational wave burst sources (for example, present rate limits as a function of energy radiated within a source population model along the lines suggested by Sam Finn.)
 - » Separate ApJ/PRL(s) for specific astrophysical waveforms results (that use search methods detailed in the PRD)

- How/when do we publish LSC S5 data collected between Nov 2006 and until data exchange starts?
- Defer this question until we have the first year of S5 analyzed and first couple of sections of the S5 paper written ... after all, we can not have a moving target!
- What drives paper publication, after all?
 - » Improved upper limits? By xfew, x10?
 - » Need to reach non-LSC/non-VIRGO community? How often?
 - » What do we tell our astro colleagues down the corridor when we are asked, “So, did the gravitational wave detectors see anything around GRB070201?”
- How important is to have more than one methods looking at data?

- Externally triggered searches:
- Main targets in the May-summer timescale:
 - » GRB070201: rapid observational paper (letter?)
 - Rely on reviewed methods presently available results
 - Timeline is crucial as the external community is still interested
 - » GRBs:
 - Multiple method in place
 - Paper covering GRBs from the first year of S5 (PRD?)
 - Rely on reviewed methods and presently available results
 - » SGRs:
 - Paper covering all such event from the first year of S5 (PRD?)
 - Extend SGR1806-20 methodology to multiple (and more sensitive) detectors

- High frequency search (1~5KHz)



Michele Zanolin

- » Use single-IFO methods (Q-pipeline, including H1H2 coherent check) to generate triggers, form coincidences that are then followed up coherently with network techniques
- » Simulation runs and tuning of algorithm is in progress
- » High frequency search S5 paper
- Cosmic string search S5 paper (Xavi Siemens et al)
- Analysis of single LSC detector configurations jointly with IGEC2 (currently being negotiated)

- High frequency (>400Hz?) search to commence, assuming:
 - » Data not too glitchy
 - » Duty factor is 'decent'
 - » Support infrastructure comes in place as analyses ramp up
- Science pursued:
 - » All of what we are currently doing!
 - » Coincident all-sky searches
 - » External triggers follow up
 - » Relationship of Virgo and LSC projects on these topics still needs to be better defined and clarified.
- Final, joint LSC-VIRGO publications when run officially ends on all science topics pursued

