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S3 Glitch Updates

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for the burst/inspiral glitch working group
LSC meeting – Hanford, August 17 2004

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Lessons learned from S2 moving on to S3

- pursuing loudest event candidates, interesting discoveries for detector characterization
  - » example: AS_Q gain dips (See Gabi's talk)
- PEM vetos matter
  - » focus on H1-H2 correlations
- Except for outliers, different algorithms see different glitches
  - » need to explore use of time-frequency methods on auxiliary channels
- Veto figure of merit
  - » which one is used is not critical, as long as we choose one

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Strategies for S3 veto search

UPPER LIMIT MODE

- Continuing “old fashioned” veto searches: statistical correlations between transients on auxiliary channels and burst/inspiral candidates on AS_Q → “upper limit mode”

- Identify selected features in the playground, using loudest events, to be extended to the full dataset
  - » H1-H2 correlations and PEM channels

How fast a response can we provide? Can we train for an online analysis for S4?

DETECTION MODE

- After-the-fact veto for candidate events
  - » checklist for event candidates

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Auxiliary Channel Glitch Search

- Archive for S3 glitches (A. Di Credico)
  - » Production is done by authors/users
  - » More than data: links to documentation, results based on those data and records of choices made
  - » Fruitful collaboration between burst and inspiral group

http://lancelot.mit.edu/ldas/dc/S3GlitchRuns.html

- Glitches produced on S3 PG data by:
  - » glitchMon (Author: M. Ito Production: N. Christensen, A. Di Credico)
    - – several triggers available, used in inspiral search (burst so far used online triggers)
    - – looking for optimal parameter settings?
  - » PTmon (Author & Production: N. Zotov)
    - – ready for prime time
  - » kleineWelle (Authors: L. Blackburn, E. Katsavounidis Production: P. Richerme)
    - – used in burst search
  - » waveMon (Author:S. Klimenko Production: K. Franzen)
    - – used in burst search

How the S3 online triggers have been used

- completed scan of glitchMon and PSLmon triggers on AS_Q vs auxiliary channels (P. Richerme)
  - » completed as of June LSC
  - » in particular:
    - H1: AS_I, POB_I
    - H2: AS_I, POB_Q, MICH_CTRL
    - L1: AS_I Anomaly in online triggers on REFL_Q
- Inspiral triggers from online production used with offline glitch production to start playground search (although a more comprehensive offline production is used now) (H. Bantilan, N. Christensen, G. Gonzalez)
- No Burst ETG triggers were produced online

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Status of offline S3 glitch production/analysis

- glitchMon triggers
  - » validation with software injections using DMTgen (A. Di Credico)
  - » existing production (A. Di Credico, N. Christensen) is being used for:
    - – S3 inspiral veto search (H. Bantilan, N. Christensen, G. Gonzalez)
    - – rate comparison/stability studies in the S3 playground (A. Dawson)
- WaveMon triggers
  - » validated with software injections, addressed open question on effective deadtime of WaveMon triggers (K, Franzen, S. Klimenko)
  - » currently in production mode (K. Franzen)
- kleineWelle triggers
  - » run on AS_Q and various aux channel (L . Blackburn, P. Richerme)
  - » existing production used for burst veto studies (P. Richerme)

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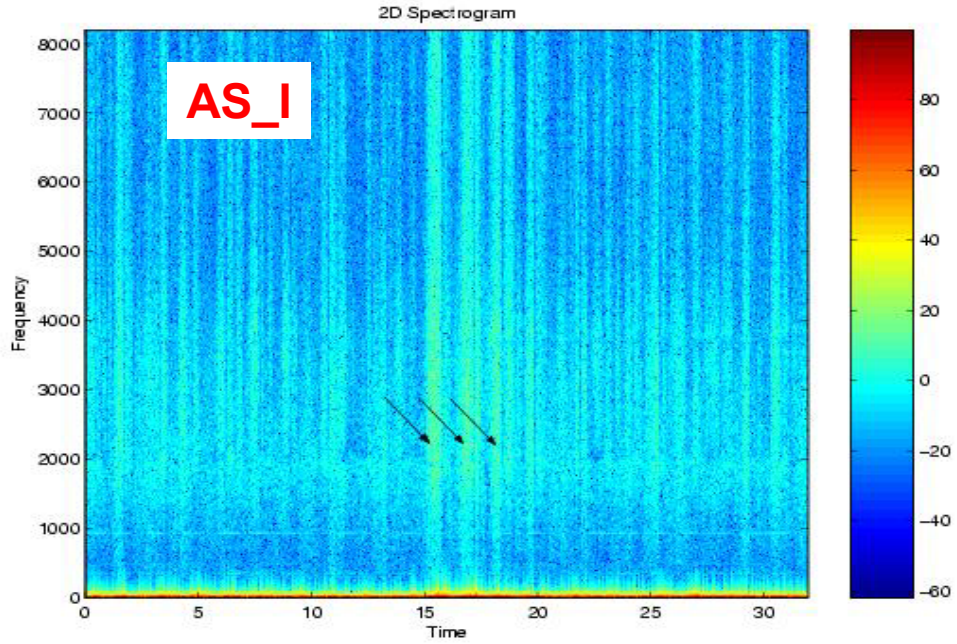
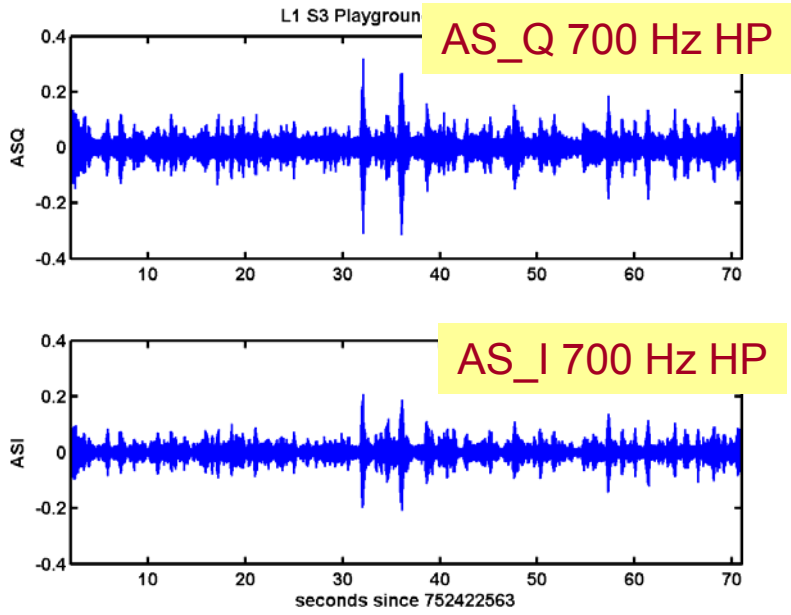
Interferometric auxiliary channels

L1 burst/inspiral veto search: AS_Q/AS_I correlations

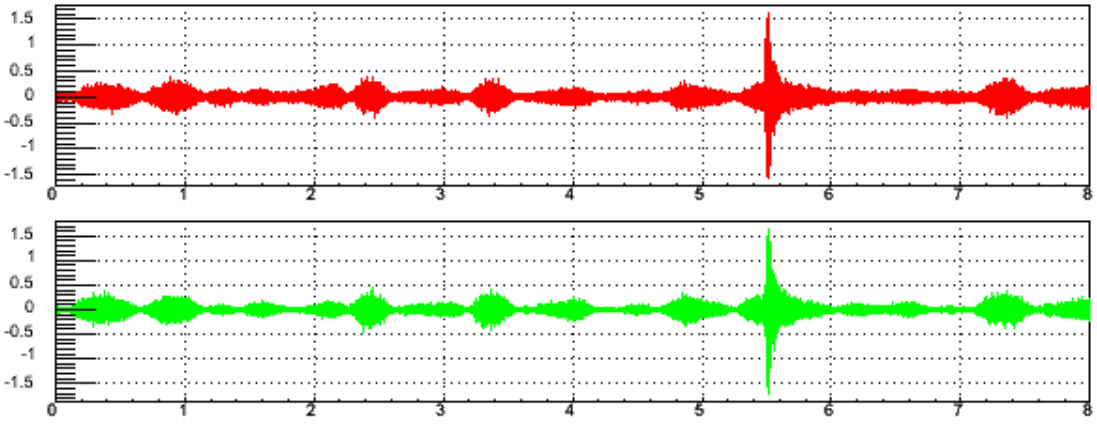




AS_Q 700 Hz HP

AS_I 700 Hz HP

December 3 2003, 9:46:53 UTC = 754480026 sec 0 nanosec



AS_Q 70 Hz HP

AS_I 70 Hz HP

L1 burst/inspiral veto search: AS_Q/AS_I correlations

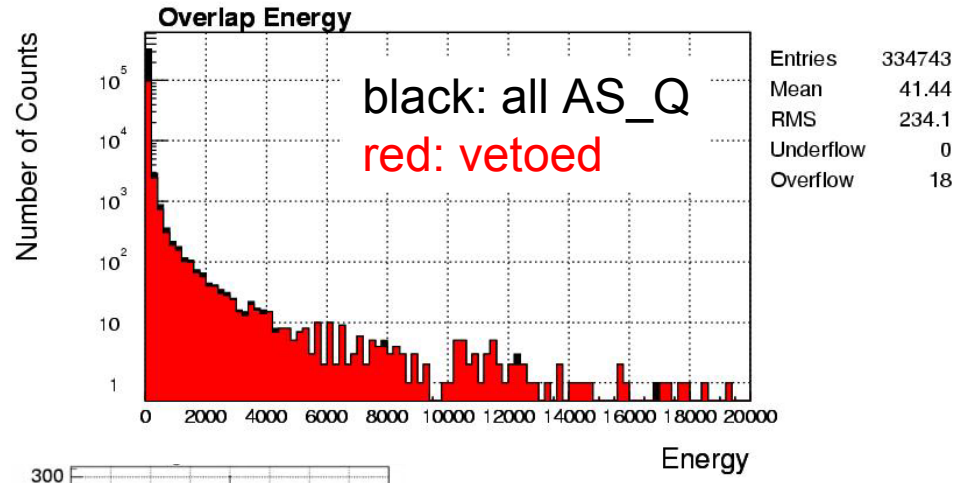
What is it? oscillator phase noise -> see Gaby's talk

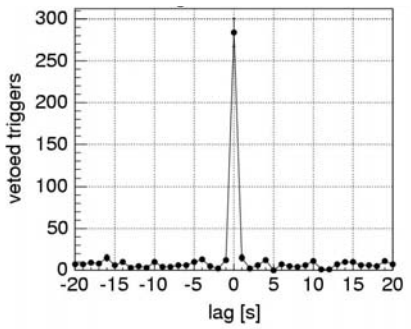
Possible inspiral veto (conditional on AS_I/AS_Q coincidence and amplitude ratio above 700Hz) → Gaby's talk

Seen in burst investigation too.
e.g.: kleineWelle studies:

all events >4σ
veto efficiency =31%
use percentage = 91%

AS_I and AS_Q energy>2000
veto efficiency =61%
use percentage = 76%





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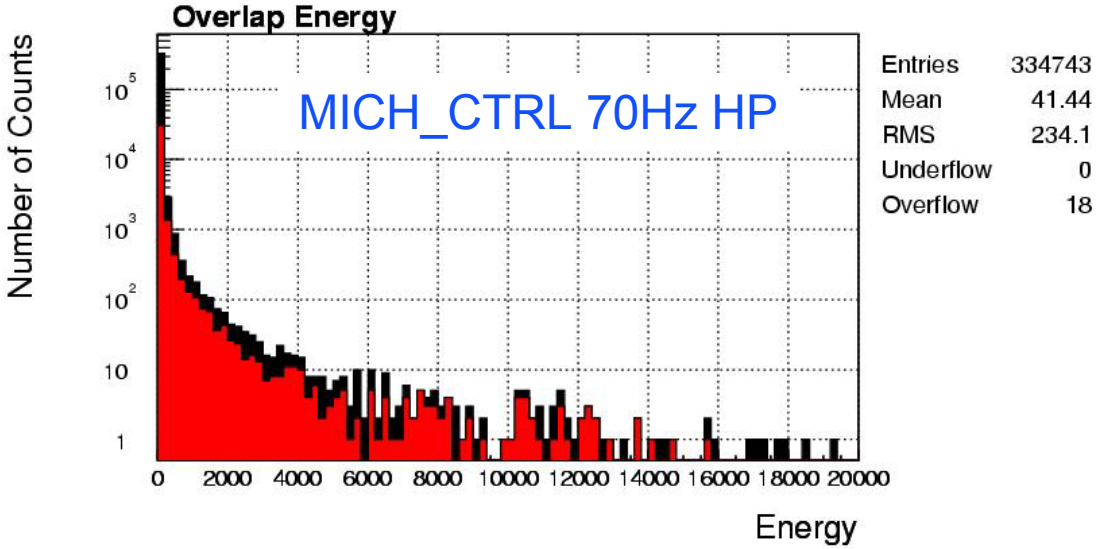
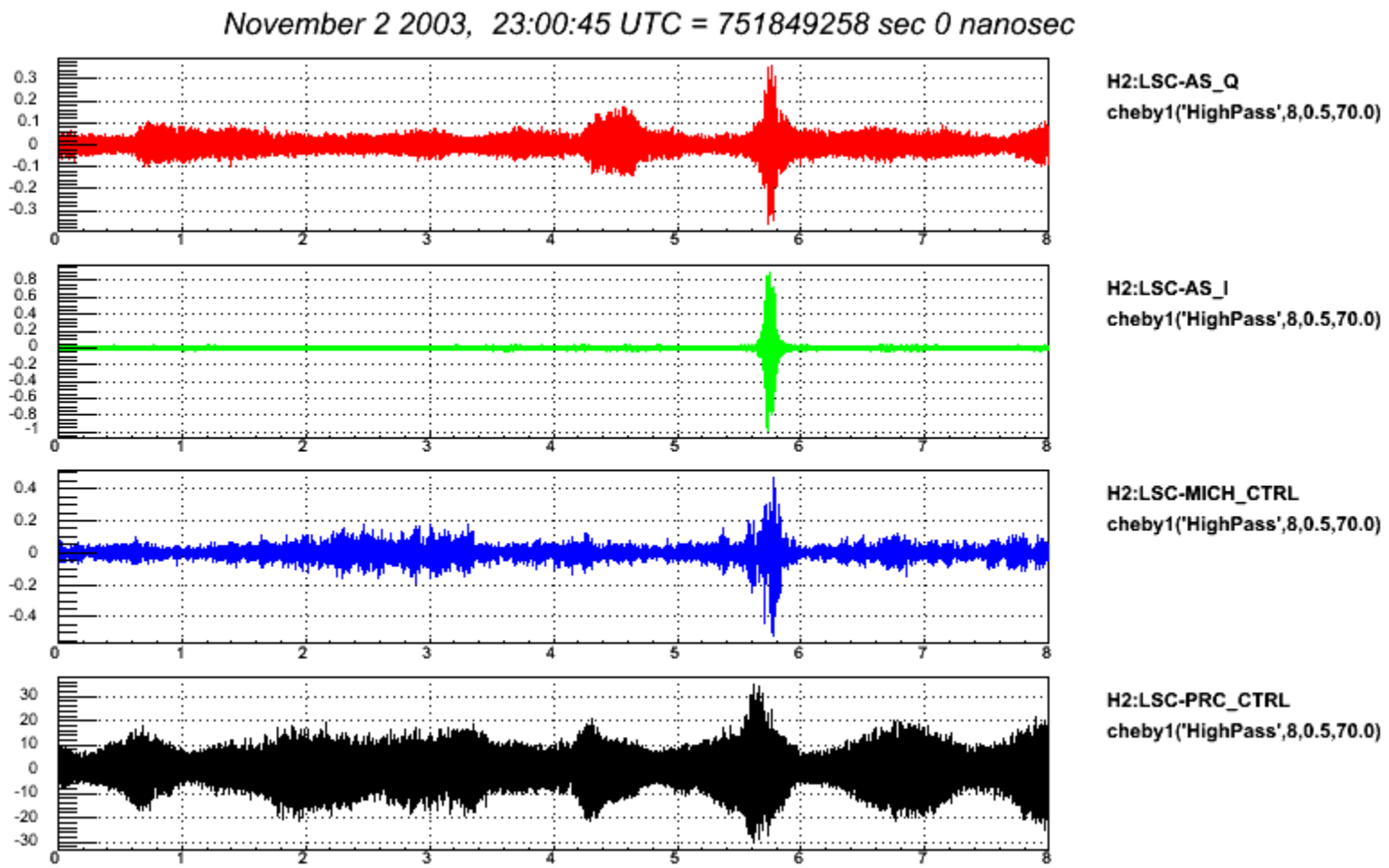
more L1 results from KleineWelle

Channel	all events >4s	energy>2000
L1 LSC-MICH_CTRL	use percentage: 49.48% veto efficiency: 10.13%	use percentage: 75.76% veto efficiency : 45.26%
L1 LSC-PRC_CTRL	use percentage: 53.06% veto efficiency: 13.71%	use percentage: 66.47% veto efficiency: 46.77%



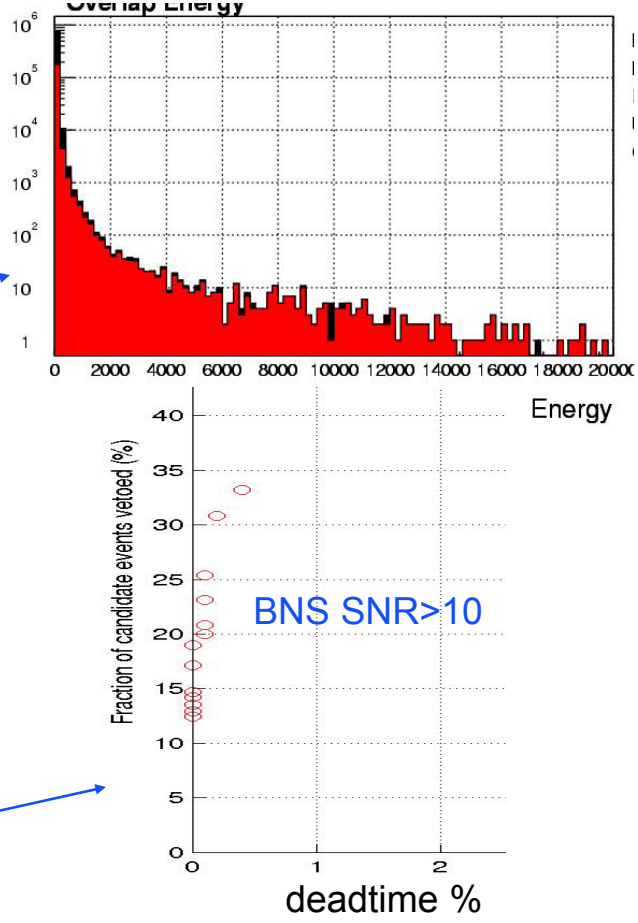
H2 burst/inspiral veto search: AS_I/POB_Q/MICH_CTRL/PRC_CTRL



H2 burst/inspiral veto search: AS_I/POB_Q/MICH_CTRL/PRC_CTRL

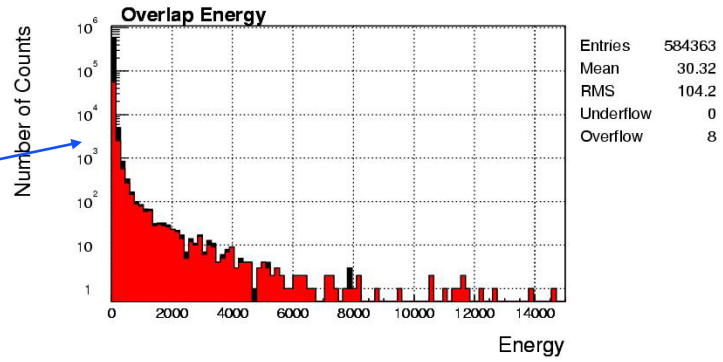
Channel	BURST KW all events >4σ	BURST KW outliers	Inspiral BNS
AS_I	use: 59% eff : 71%	use: 61% eff : 79%	
PRC_CTRL	use: 75% eff : 29%	use: 60% eff : 42%	
MICH_CTRL	use: 37% eff : 24%	use: 32% eff : 83%	looks good
POB_Q	use: 39% eff : 7%		use: 10% eff : 30%
POB_I	use: 94% eff : 4%		
REFL_Q	use: 45% eff : 5%		use: 37% eff :31%

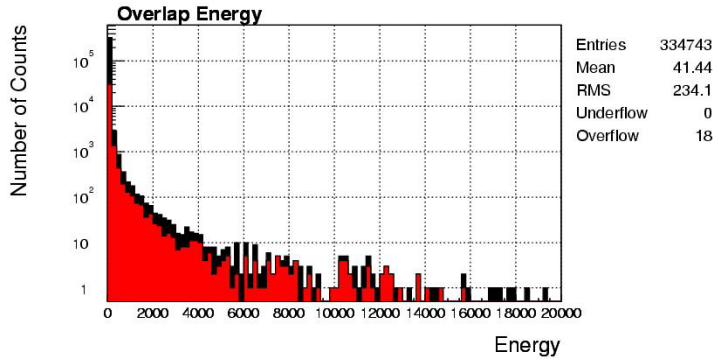
AS_AC AS_DC REFL_DC SPOB_MON for some loud events



H1 burst/inspiral veto search: AS_I/POB_Q/MICH_CTRL/PRC_CTRL

Channel	BURST KW all events >4σ	BURST KW outliers	Inspiral BNS
AS_I	use: 15% eff : 10%	use: 19% eff : 30%	
PRC_CTRL	use: 6% eff : 1%	use: 35% eff : 49%	
MICH_CTRL	use: 8% eff : 1%	use: 33% eff : 52%	nothing

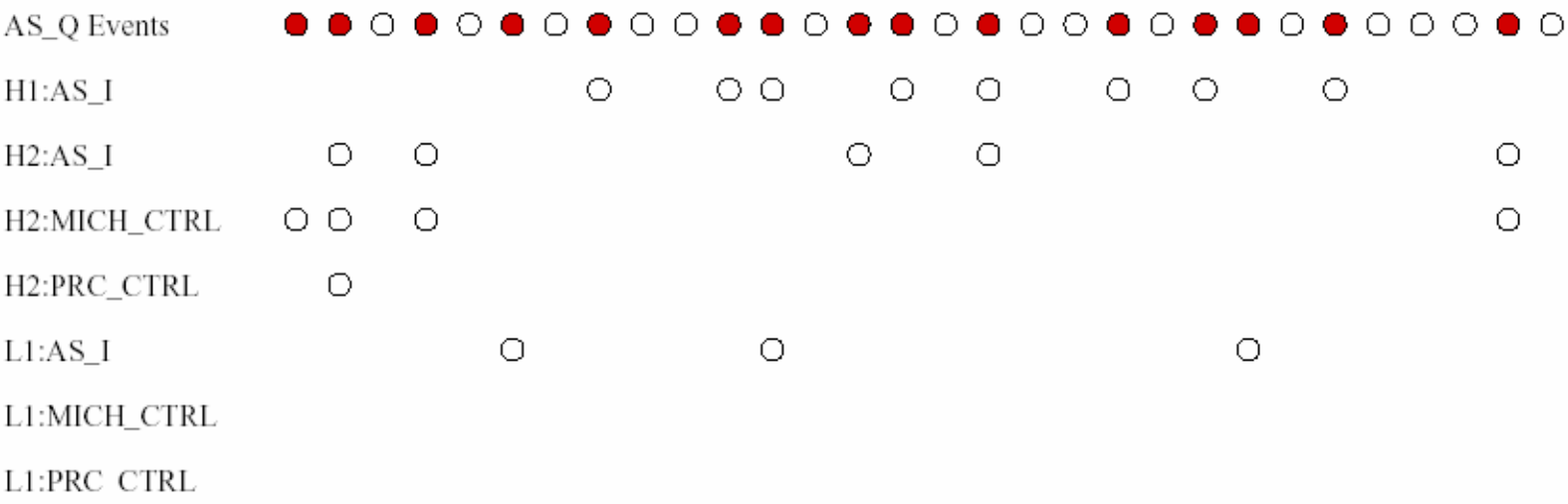




AS_AC, AS_I, MICH_CTRL, POB_I, POB_Q, REFL_Q

AS_AC AS_DC REFL_DC for some loud events

Are these types of veto going to be used this time?



hopefully yes

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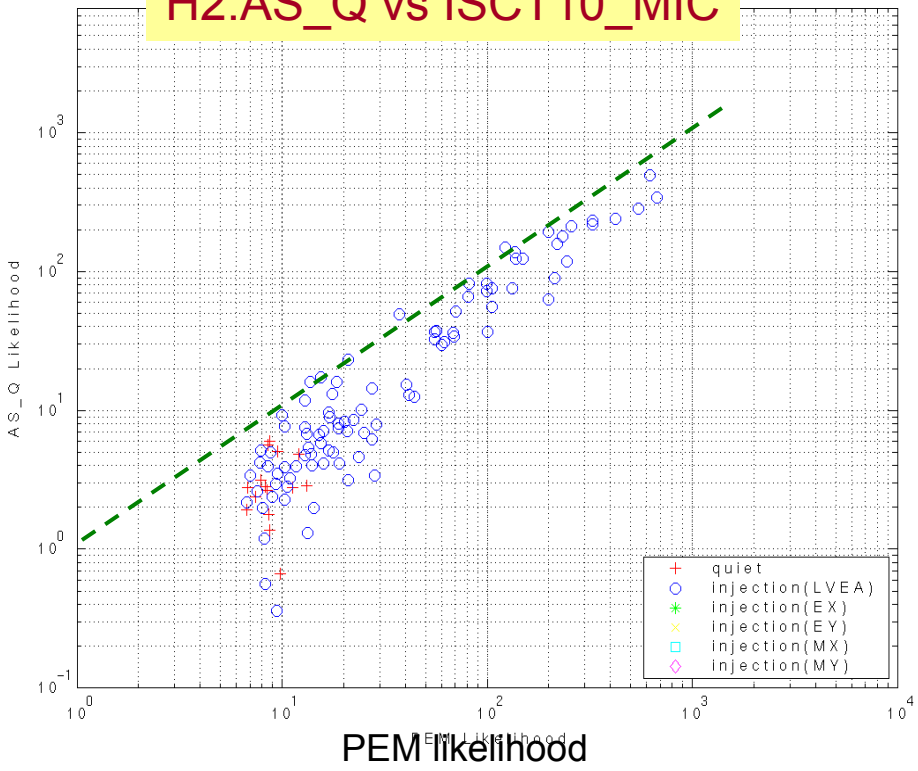
PEM vetos

H1-H2 PEM injections

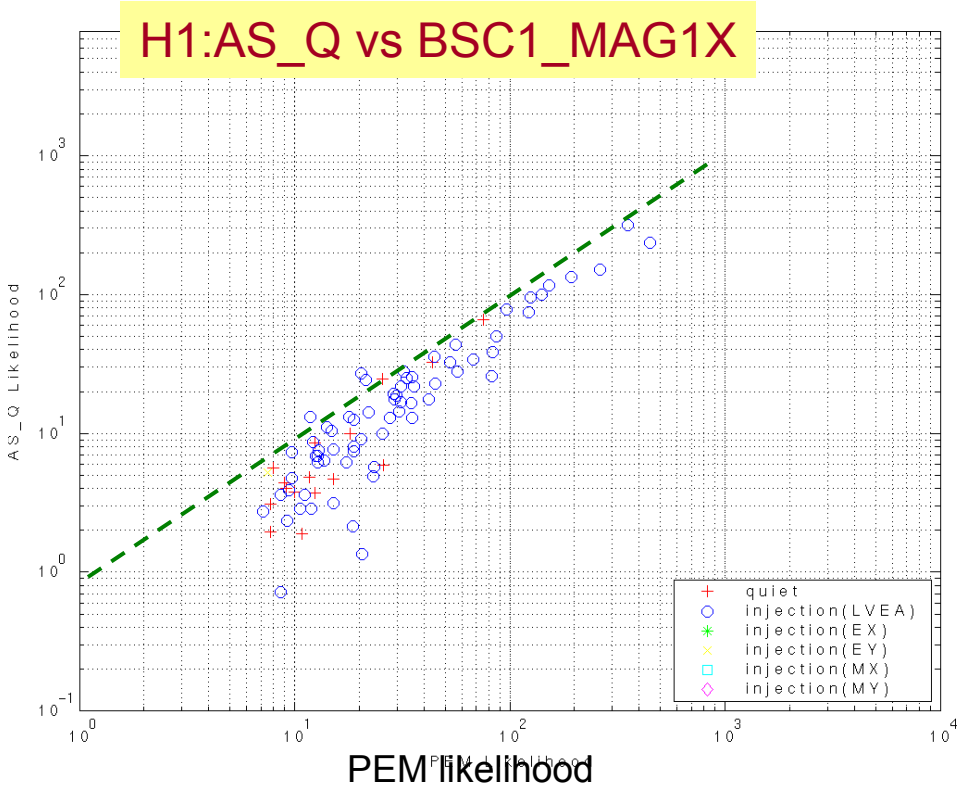
using waveMon around the time of PEM injections to establish coupling (Harstad, Ito, Schofield)

H2:AS_Q vs ISCT10_MIC



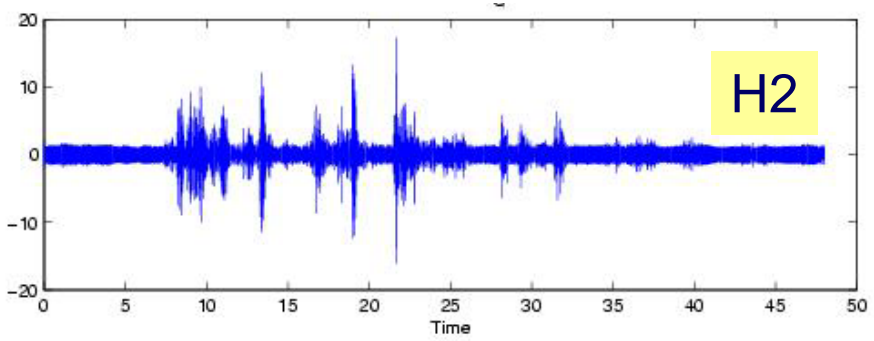
acoustic coupling

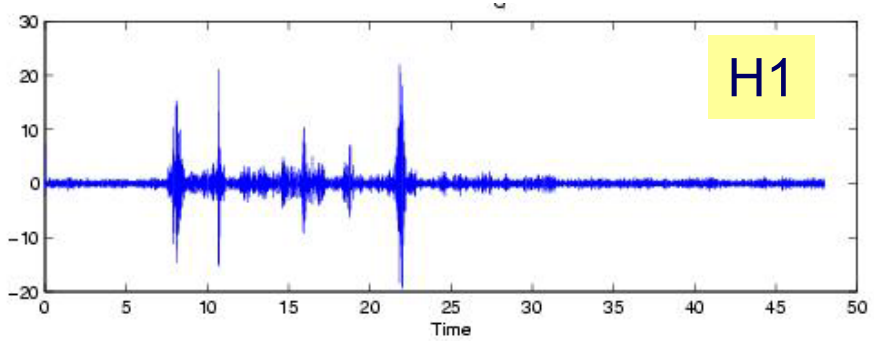
H1:AS_Q vs BSC1_MAG1X



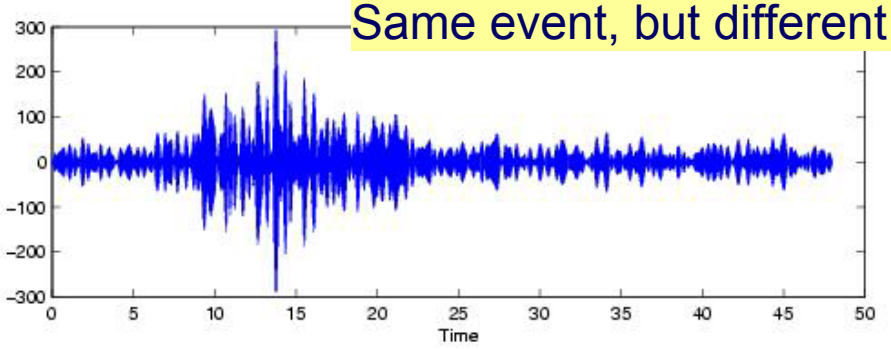
magnetic coupling

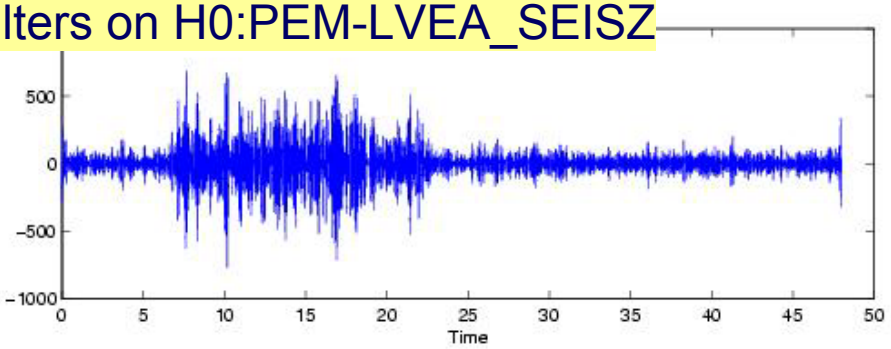
Inspiral H1 and H2 S3 Veto H0:PEM-LVEA_SEISZ





Same event, but different filters on H0:PEM-LVEA_SEISZ



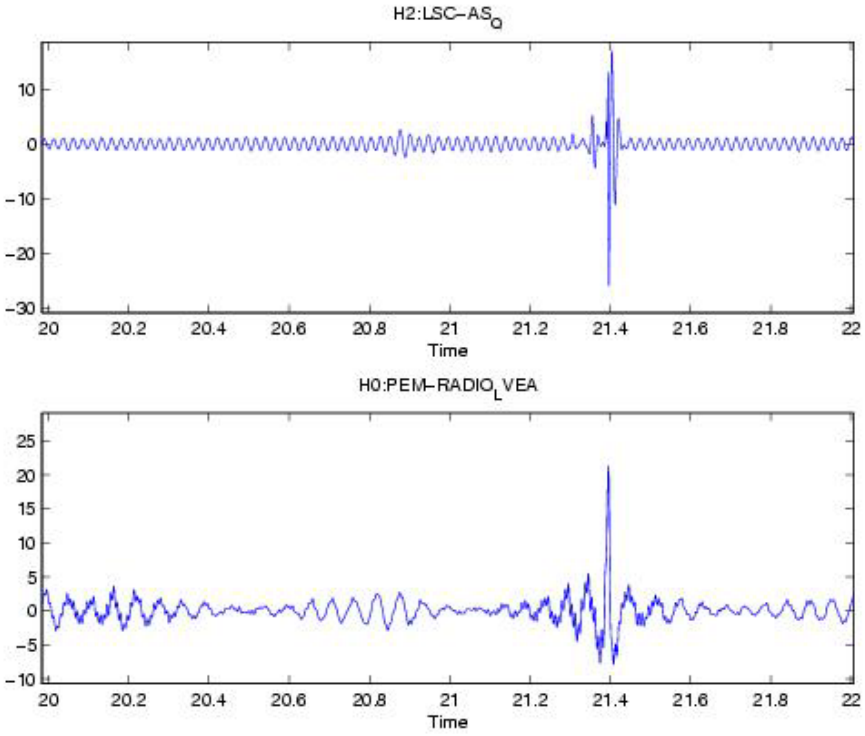


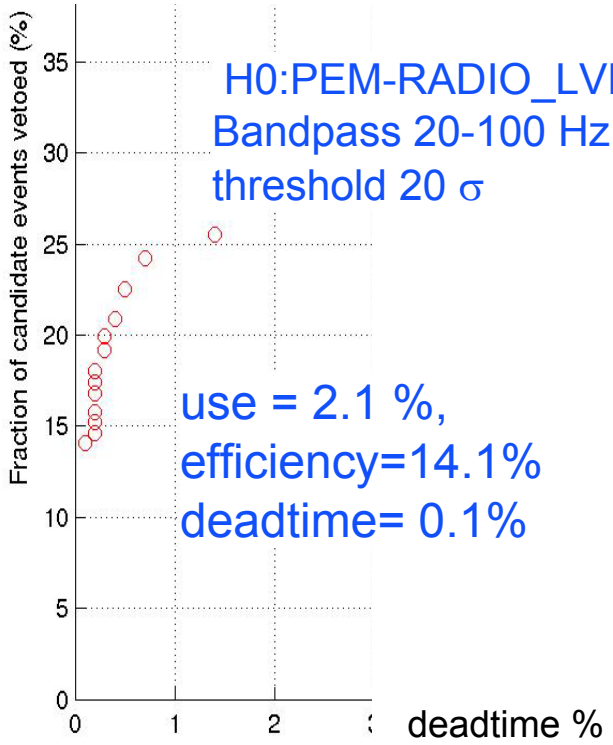
H2: Band Pass 2-20 Hz, threshold 9σ
LVEA_SEISZ Events in H2 playground
37.5% use for +/- 5 s or 10 s windows
16 events; 6 of these events are at the same time as H1 and H2 inspiral triggers.

H1: Band Pass 2-20 Hz, threshold=9σ
LVEA_SEISZ Events in H1 playground
77% use for +/- 10 s windows
13 events, negligible deadtime

Bantilan, Christensen

H2 S3 BNS Veto: H0:PEM-RADIO_LVEA





H0:PEM-RADIO_LVEA,
Bandpass 20-100 Hz
threshold 20 σ

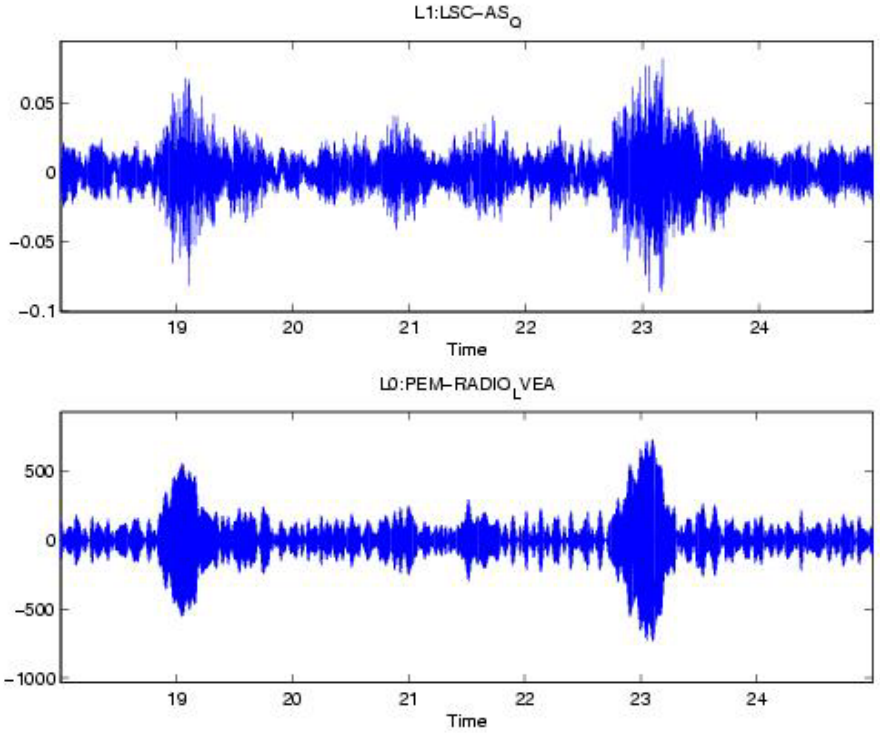
use = 2.1 %,
efficiency=14.1%
deadtime= 0.1%

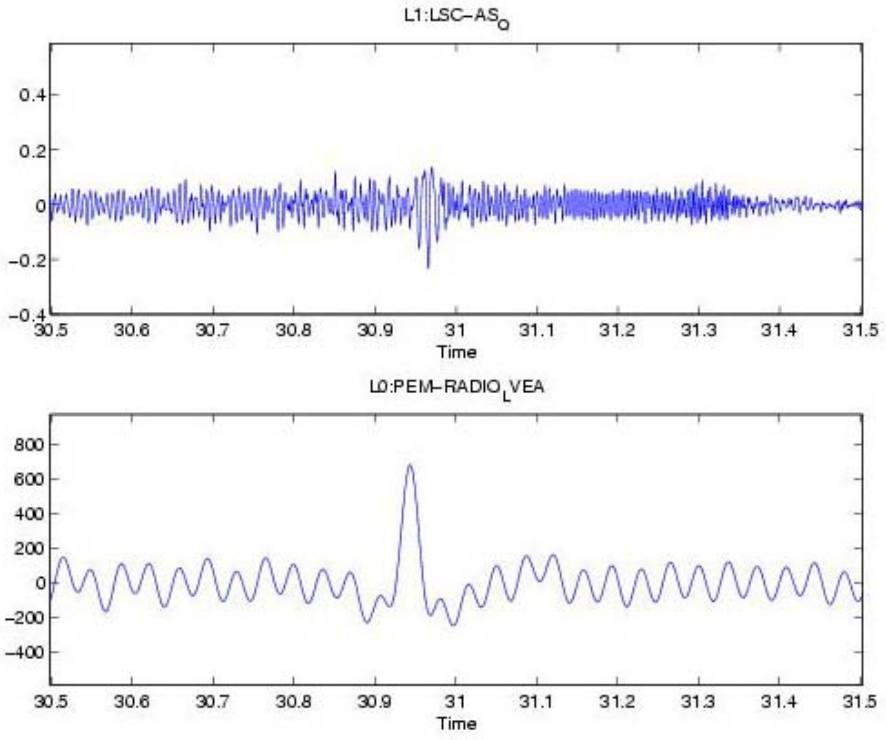
For all of the hardware injections inspected
no obvious simultaneous event in RADIO_LVEA

Bantilan, Christensen

L1 S3 Veto L0:PEM-RADIO_LVEA

Many glitches in L1:LSC-AS_Q simultaneous with glitches
in L0:PEM-RADIO_LVEA Power in RADIO goes in 60Hz harmonics





Potential problem seen with only one hardware injection.
AS_Q and RADIO passed through a 5 Hz to 25 Hz Elliptic filter.
This injection had an effective distance of 250 kpc; there were injections
up to 20 times larger.

Bantilan, Christensen

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Summary

- S3 glitch investigation is active
  - » veto strategy
  - » glitch trigger archival and distribution
  - » parallel investigative efforts
- Good potential vetos
  - » interferometer channels particularly effective at detecting loudest events
  - » veto safety checked with hardware injections
- PEM playing stronger role
  - » will especially explore H1-H2 correlations
- Approaching a regime where vetos affect the astrophysical results in burst and inspiral searches