Glitch Group Report

L. Cadonati on behalf of the Glitch Working Group

LSC-Virgo meeting @ MIT, July 26, 2007

S5 Glitch Group Activities

- Goals
  - Investigate data quality issues relevant to burst and inspiral searches
  - Provide rapid feedback to operators and commissioning teams
  - Contribute to the definition of data quality flags
  - Provide guidance on the use of data quality flags and potential vetoes for the burst and inspiral searches

- Structure
  - Electronic notebook
  - Semi-weekly glitch shifts performed by group members
  - Weekly teleconference to discuss glitch shift reports in detail
  - Weekly summary reports given on S5 run call

http://www.lsc-group.phys.uwm.edu/glitch/investigations/s5index.html

Glitch shift report

- Each shift covers 3-4 days
- Collects and summarized information from a large number of resources
  - Summary of detector logs
  - Summary of science mode segments
  - BurstMon daily summaries
  - KleineWelle daily summaries
  - Sensitivity, seismic, and wind trend data
  - KleineWelle H1H2 and H1H2L1 coincident events
  - BlockNormal loudest events
  - Online inspiral search loudest events
- Template shift report automatically generated by a perl script

Continued off-site, quasi-online analysis
Since the beginning of S5

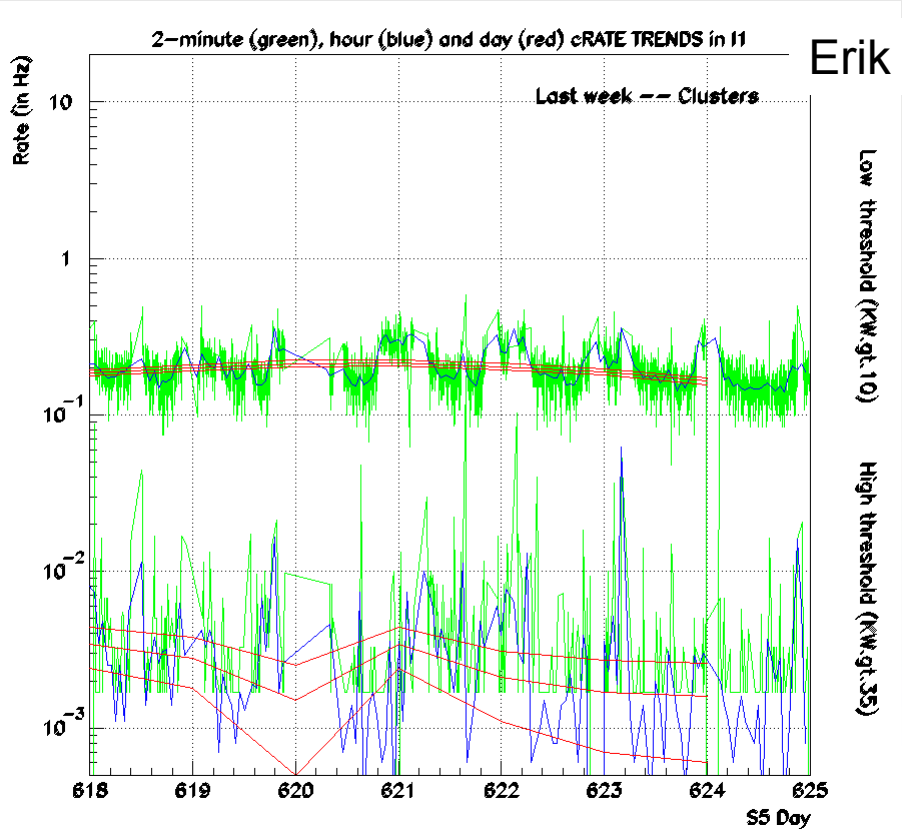
Old and New

- New glitches in Shantanu Desai's talk: G070498-00
  - Dust glitches -> PDmon (compare sign of 4 PDs)
  - TCS glitches
  - Seismic glitches
- Listening to glitches – Peter Saulson's talk: G070548-00
  - DARM_ERR glitches are surprisingly similar to one another, throughout the run (but different at different IFOs)
- New DQ flags – John Zweizig's talk: G070XXX-00
  - Periods of L1 high glitchiness for segments with high variation in SenseMon trends (Gaby Gonzalez)
  - side coil saturations, seismically induced (L.C., John Zweizig)
  - DARM_ERR upconversion (Justin Garofoli, Masahiro Ito)

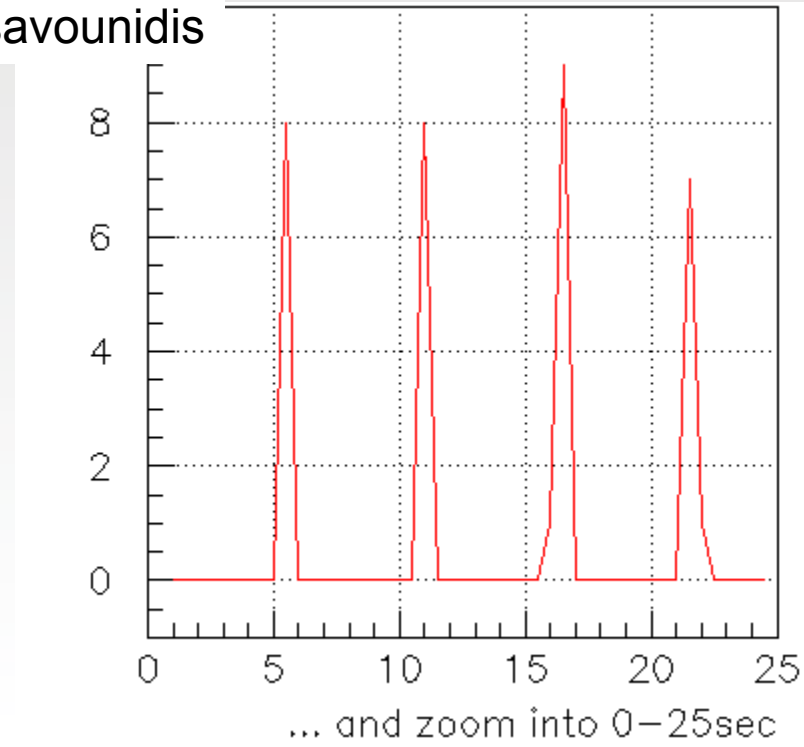
Interesting features keep coming

L1:
recent quasi-daily pattern of excess (x2-x5) rates due to logging.

H1:
5.5 s periodicities in SNR>15 glitches, coming and going in the last 2 months:



Erik Katsavounidis



Day 607 auto-correlogram of KW DARM_ERR glitches

S5 offline: Data Quality Vetoes

DetChar-wide effort: data quality flags for “bad” or “so-and-so” data, some automatically produced and inserted in the database, others we are coming up with off-line. Some are critical, others are advisory.

Many (but not all!) of these flags overlap with glitches and inspiral/burst events and will be used as vetos. We are working on which ones…

Burst and inspiral analysis have a consensus on adoption of the following flags for analysis segments:

OUT_OF_LOCK PRELOCKLOSS_xxx INJECTION
AS_TRIGGER MASTER_OVERFLOW_LSC PD_OVERFLOW
CALIB_DROPOUT_1SAMPLE CALIB_DROPOUT_BN
CALIB_DROPOUT_AWG_STUCK CALIB_GLITCH_ZG

Adoption of other flags is still under discussion, but all lik
MASTER_OVERFLOW_ASC

Presentation at the Aug 06 collaboration meeting G060407-00

We closed the circle: many of the DQ flags created w king at the remaining triggers led us to re-discover artifacts we needed to flag (ASI_CORR_OVERFLOW, H2:MMT3_OPLEVER, H2:OSEM_GLITCH ...).

Data Quality Vetoes Now

- All existing DQ flags have been tested against single-IFO KleineWelle triggers, online WB+CP triggers and online BNS triggers
  - Most recent DQ definitions still under study.
  - Still missing: L1 autoburt (October 2006)
  - If pairs with either H1 or H2 out of science mode, we need to study a flag for swinging optics
  - Seismic flag? Suspension overflow flag? (would be cat 3)

- DQ decision cross-checked by burst and inspiral group
  - Small differences due to the way the analysis is performed (some cat 1 for burst are cat 2 for inspiral, not to fragment segments too much)

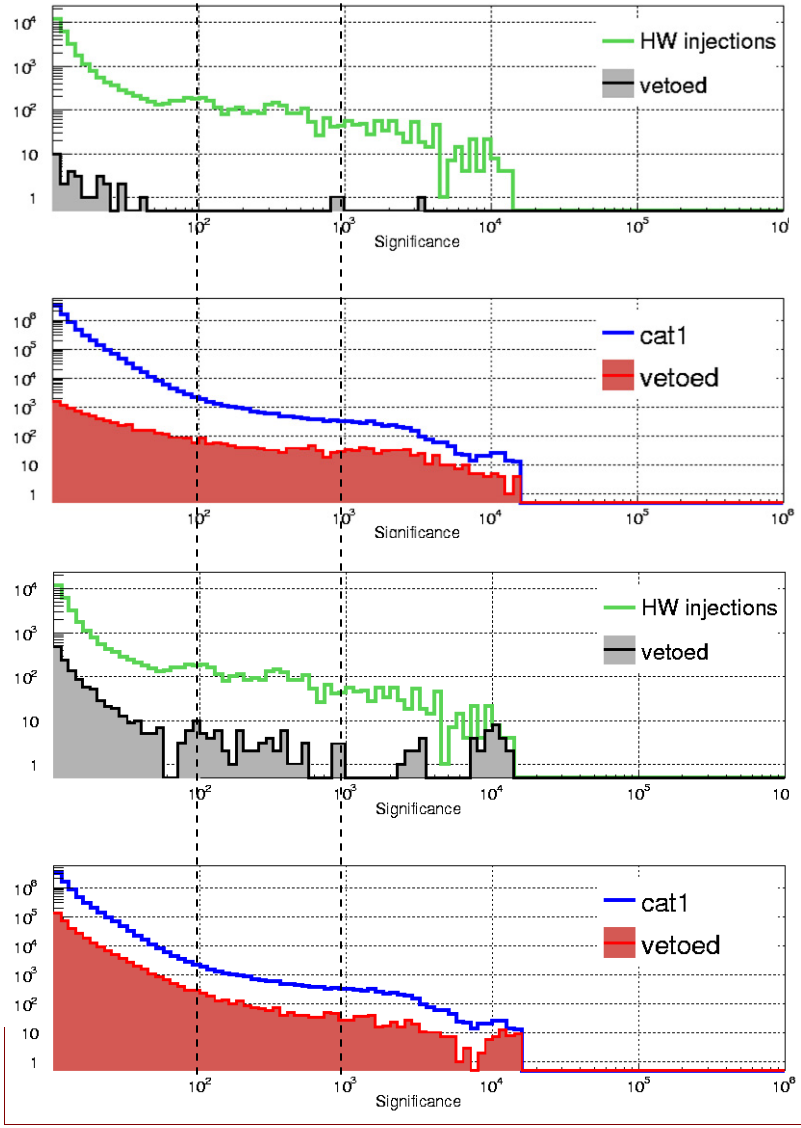
Data Quality Veto Strategy

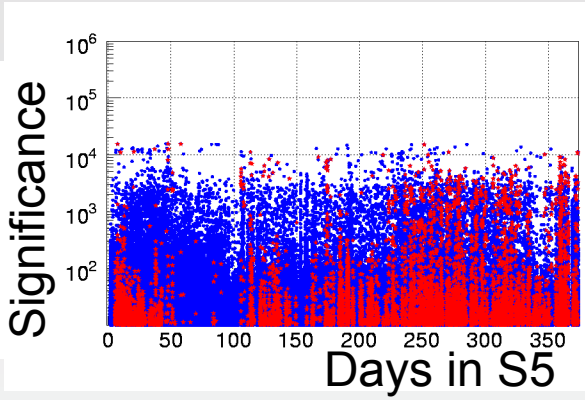
Examples are for Burst – Inspiral very similar, some difference in cat1 vs cat 2

Category 1	Minimal data quality vetoes, for the selection of data segments to be analyzed *(including calibration problems, test injections, photodiode saturations)*
Category 2	"Unconditional" post-processing vetoes: data is unreliable and there is an established one-on-one correlation with loud transients. *(e.g. saturations in the alignment control system, glitches in the power main, TCS glitches, SIDE_COIL saturations)*
Category 3	"Conditional" post-processing vetoes, for upper limit: statistical correlation to loud transients. We still look for detection candidates at those times, exerting caution when establishing detection confidence. *(e.g. train/seismic flags, 1 minute pre-lockloss, "dips" of light stored in the arm cavities, high wind)*
Category 4	Advisory flags: no clear evidence of correlation to loud transients, but if we find a detection candidate at these time, we need to exert caution *(e.g. certain data validation issues)*

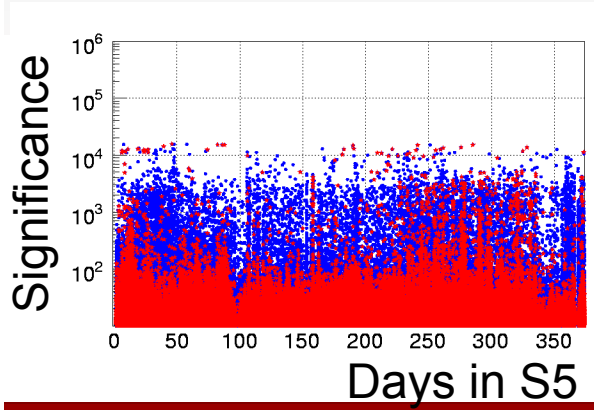
Example: H1

Data quality flags, Cat2 and Cat3notCat2 vs KleineWelle triggers (single IFO)





Cat 2 flags:
DeadTime = 0.024%
S > 100: eff = 7.1%
S >1000:eff = 14.5%



Cat3notCat2 flags:
DeadTime = 3.8%
S > 100: eff = 11.1%
S >1000:eff = 11.8%

S5 Offline: Vetoes

Glitch tools used to identify power main glitches appearing loud in site-side magnetic glitches that veto burst loudest background events.

Study of transients on auxiliary channels (KleineWelle-burst)

- Extensive analysis of
  - » LLO: 57 environmental and 59 interferometric channels
  - » LHO: 98 environmental and 63 (H1) / 71 (H2) interferometric ch
- New veto logic:
  - » was: veto if overlap trigger durations
  - » now veto if glitch peak times are within a fixed windo
- Proposed F.O.M.:
  - » σ=number of vetos/Poisson prediction
- We have several options, to be wrapped up after safety studies are concluded.

Presentation at the Aug 06 collaboration meeting G060407-00

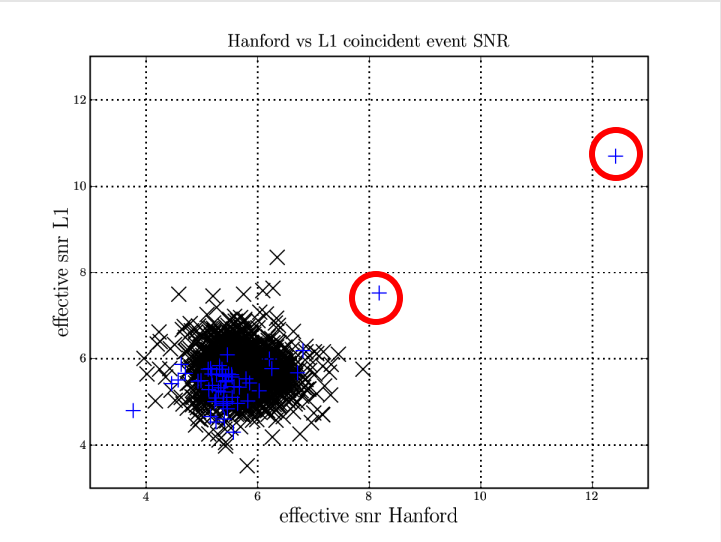
More burst-specific for now, but closely followed by inspiral

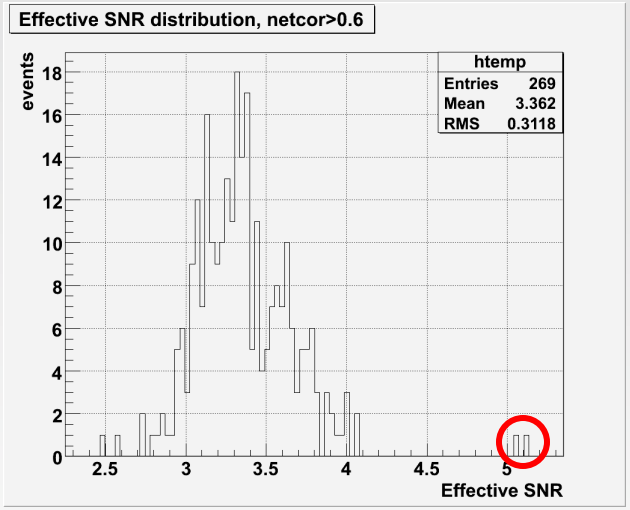
Vetoes Now

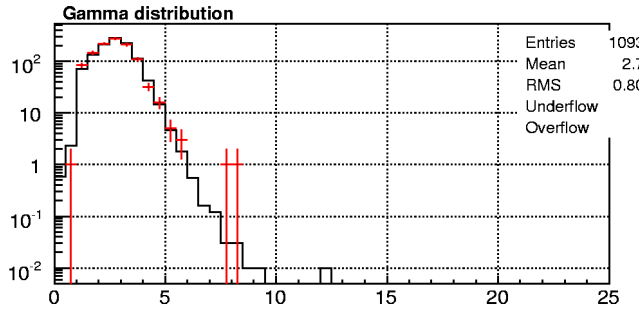
- BURST: (E. Katsavounidis)
  - Analysis of correlations between KleineWelle triggers from 300+ detector channels and the gravitational-wave channel (single-IFO)
  - First 380 days of S5 processed, first look at analysis results suggest they are consistent with S5A findings
  - Veto-yield on single-IFO glitches is at the 10% level (for outliers, ~10^{-21} sqrt(Hz) and above), with resulting dead-time at the 0.5% level
- INSPIRAL:
  - Similar work in progress at Carleton (N. Christensen)

Follow-up of Candidates

- Example from the blind injection test:

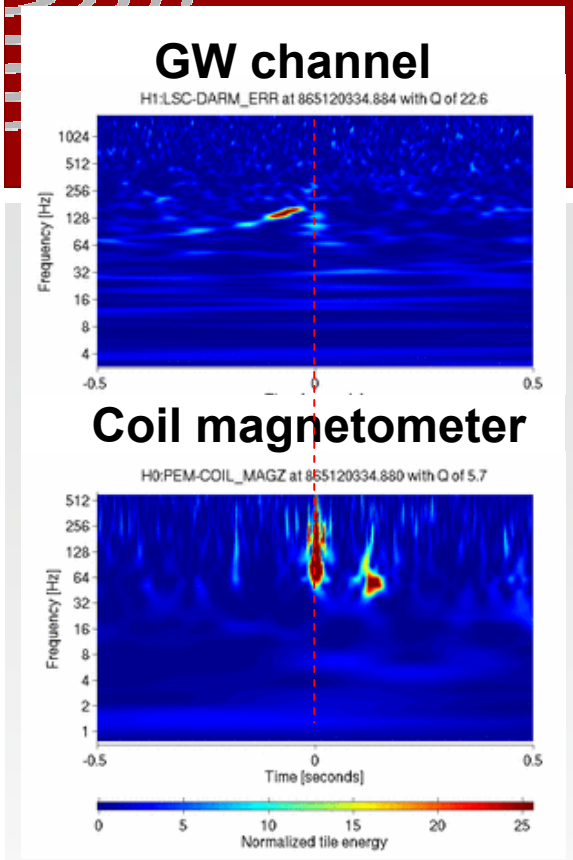






Qscan can give information overload…
Lesson learned: we need to improve online followup of candidates

Follow-up of Candidates



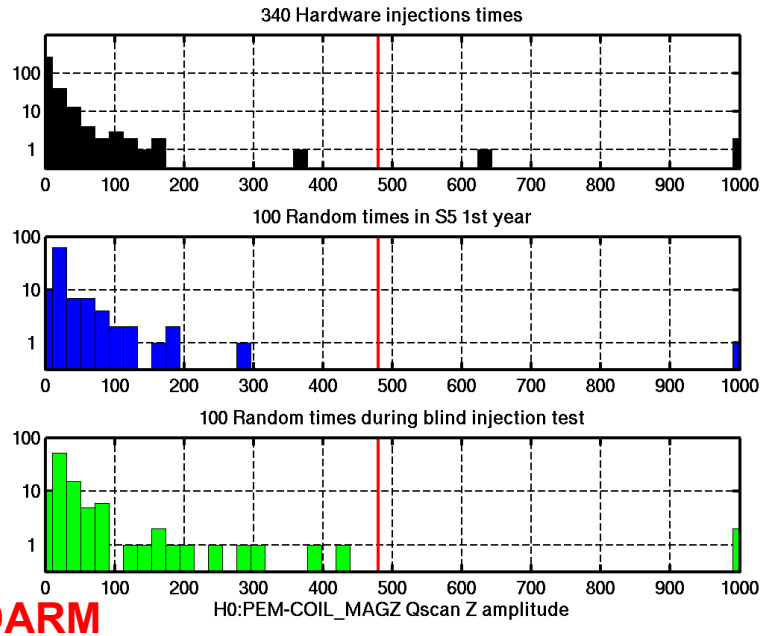
Can this magnetic glitch be related to the HW injection ?

⇒ Analyze qscans at random times:

provides a list of magnetic glitch accidentally found in coincidence with the GW channel

⇒ Analyze qscans at HW injections times: for safety checks

Romain Gouaty
Gaby Gonzalez



A few magnetic glitches found at random times with comparable amplitude:

⇒ upper limit on the coupling

- **The magnetic glitch did not cause the chirp in DARM**
- **No evidence that HW injections might produce such magnetic glitches**

http://www.lsc-group.phys.uwm.edu/cgi-bin/glitch-enote.pl?nb=glis5misc&action=view&page=13

Plans

- Priorities between now and end of S5:
  - Continue monitoring “glitchiness”
  - Fine-tune follow-up: blind injections!
- Continued work:
  - Finalization of veto (data quality and event-by-event) and exploration of outliers, to support burst and inspiral searches
- Post S5?
  - Shift resources can be freed up
  - Possible reduced effort during AstroWatch?
  - Follow-up remains high priority