Status of Data Quality in Virgo

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on behalf of the Virgo DQ team
(M. Bizouard , L. Bosi , S. Chatterji , E. Cuoco, G. Guidi, P. Hello, G. Hemming , N. Leroy , F. Marion, D. Verkindt)

- *DQ flags currently available*

- *DQ lists for data analysis*

- *Current tools (to download and combine DQ flags)*

- *Ongoing activities and next steps*

Virgo Data Base

Main repository of the DQ flags: **VDB** (a MySQL database developed by L. Bosi)

Virgo Data Base documentation

Overview

The Virgo Data Base (VDB) aims at storing different kind of information that are important for the analysis of the Virgo data:

- bookeeping: Virgo frame files geographical position (SITE, PATHNAME, FILENAME, …)
- metadata information: data about frame data (science mode, data quality and ITF status)
- segments information: ITF specific segments (e.g. science mode) and user defined segments
- events: inspiral, burst and others
- triggers and veto: ITF specific or user defined

The User Interface is the web VDB UI
Not all functionalities are yet implemented, this is an on-going endeavour! This web page provides information both for users and for contributors.

Segments definitions

Science Mode segments definition
Data Quality flag segments definition

Segments list documentation (lists available in VDB)

VSR1 ITF Status
VSR1 DQ Flags
VSR1 DQ deadtime

VSR1 DQ list for Burst search

Current DQ flags

LISTNAME	VERSION	STATE	CREATOR	DOCUMENTATION
V1:B5_SAT	v1	Unstable	Marie-Anne Bizouard	click here for documentation
V1:EOL_QRATE	v1	Unstable	Marie Anne Bizouard	click here for documentation
V1:LC_FAILURE	v1	Unstable	Nicolas Leroy	click here for documentation
V1:LC_FAILURE_NIWI	v1	Unstable	Nicolas Leroy	click here for documentation
V1:LC_FAILURE_PRBS	v1	Unstable	Nicolas Leroy	click here for documentation
V1:COIL_NEWE_SAT	VSR1_V1	Stable	Marie Anne Bizouard	click here for documentation
V1:DARKF_MISS	VSR1_V1	Stable	Didier Verkindt	click here for documentation
V1:EARTHQUAKE	VSR1_V1	Stable	Marie Anne Bizouard	click here for documentation
V1:FRAMEH_QUALITY12_VH1	VSR1_V1	Stable	Didier Verkindt	click here for documentation
V1:GC_MISFUNCTIONING	VSR1_V1	Stable	Marie-Anne Bizouard	click here for documentation
V1:GROUND_50HZ	VSR1_V1	Stable	Marie Anne Bizouard	click here for documentation
V1:HREC_BADQUALITY_VH1	VSR1_V1	Stable	Didier Verkindt	click here for documentation
V1:HREC_MISS_VH1	VSR1_V1	Stable	Didier Verkindt	click here for documentation
V1:INJECTIONS	VSR1_v1	Stable	Shourov K. Chatterji	click here for documentation
V1:ITF_LOCK	VSR1_v1	Stable	verkindt	click here for documentation
V1:ITF_SCIENCEMODE	VSR1_v1	Stable	verkindt	click here for documentation
V1:LOCK_UNLOCKED	VSR1_V1	Stable	Nicolas Leroy	click here for documentation
V1:MAINTENANCE	VSR1_V1	Stable	Marie-Anne Bizouard	click here for documentation
V1:MISSAMPLES	VSR1_V1	Stable	Marie Anne Bizouard	click here for documentation
V1:POWER_STAB_OFF	VSR1_V1	Stable	Marie-Anne Bizouard	click here for documentation
V1:PRE_LOCKLOSS_10S	VSR1_V1	Stable	Marie Anne Bizouard	click here for documentation
V1:RAWFRAME_MISS	VSR1_V1	Stable	Didier Verkindt	click here for documentation
V1:SSFS_CORR_SAT	VSR1_V1	Stable	Marie Anne Bizouard	click here for documentation

Stable DQ flags

- **Category 1**:
  - V1:DARKF_MISS
  - V1:HREC_MISS_VH1
  - V1:RAWFRAME_MIS
  - V1:PRE_LOCKLOSS_
  - V1:INJECTIONS
  - V1:GC_MISFUNCTIO
  - V1:LOCK_UNLOCKE
  - V1:MAINTENANCE

- **Category 2**:
  - V1:COIL_NEWE_SAT
  - V1:SSFS_CORR_SAT
  - V1:MISSAMPLES
  - V1:POWER_STAB_OI
  - V1:EARTHQUAKE
  - V1:GROUND_50HZ
  - V1:FRAMEH_QUALI
  - V1:HREC_BADQUAL

NAME	Category	Science(s)	Duration(s)	Percentage (%)
DARKF_MISS	I	9487112	5060	0.0533
GC_MISFUNCTIONING	I	9487112	8569	0.0903
HREC_MISS_VH1	I	9487112	121610	1.2818
INJECTIONS	I	9487112	47889	0.5048
LOCK_UNLOCKED	I	9487112	346	0.0036
MAINTENANCE	I	9487112	3600	0.0379
PRE_LOCKLOSS_10S	I	9487112	2898	0.0305
RAWFRAME_MISS	I	9487112	14535	0.1532
COIL_NEWE_SAT	II	9487112	36493	0.3847
EARTHQUAKE	II	9487112	59	0.0006
EOL_QRATE	II	9487112	2918	0.0308
FRAMEH_QUALITY12_VH1	II	9487112	173575	1.8296
GROUND_50HZ	II	9487112	1263	0.0133
HREC_BADQUALITY_VH1	II	9487112	73716	0.777
LC_FAILURE	II	9487112	1887	0.0199
MISSAMPLES	II	9487112	662	0.007
POWER_STAB_OFF	II	9487112	35961	0.3791
SSFS_CORR_SAT	II	9487112	24	0.0003
B5_SAT	III	9487112	393	0.0041
COMBINED_CAT1	Cat I	9487112	151209	1.5938
COMBINED_CAT2	Cat II	9487112	178721	1.8838
COMBINED	Cat I & II	9487112	306213	3.2277

Quality flags information

Data quality flags information

VSR1 DQ dead time table

CATEGORY I

- Sometimes, the dark fringe channel Pr_B1_ACp is not available, either because the needed DAQ line was stopped or because full frames of raw data were missing. Corresponding segments are flagged by DARKF_MISS which is built by looking for the presence of the Pr_B1_ACp channel in the full set of raw data.
  Remark: All RAWFRAME_MISS segments should be contained in the DARK_MISS segments.
  Flag: V1:DARKF_MISS
  Investigator: Didier Verkindt (verkindt@lapp.in2p3.fr)
  Category: I

- Usually when the Global Control looses the synchronization with the photodiodes, the ITF unlocks. It happened during VSR1 that 4 short segments have been affected by this problem. Lots of samples between Gc and the DSP are lost each 12 seconds generating lots of spikes in the dark fringe. The 5kHz line was not present during these segments (problem solved on August 22nd), so these segments are not flagged by the MISSAMPLES DQ. According to experts (F. Cavalier) these segments are not reliable for data analysis purpose. The flag is defined with respect to V1:ITF_LOCK periods.
  Flag: V1:GC_MISFUNCTIONING
  Investigator: Marie-Anne Bizouard (mabizoua_at_lal.in2p3.fr)
  Category: I

- Sometimes, h values are not computed and/or not written online, either because the needed data have not reached the online h reconstruction process or because conditions to reconstruct h were not correct. Corresponding segments are flagged by HREC_MISS_VH1 which is based on the presence or not of the channel h_20000Hz in the hrec processed data (HreconOnline.ffl). This is valid only for the online h (first processing: VH1). A new flag will be created (HREC_MISS_VH2) after the reprocessing of h.
  Flag: V1:HREC_MISS_VH1
  Investigator: Didier Verkindt (verkindt@lapp.in2p3.fr)
  Category: I

- Burst and inspiral hardware injected signals. It includes the "Automatic" injections performed during "SCIENCE" mode and "Loud" injections (Burst waveform only) done outside SCIENCE periods, during calibration periods. Note that during inspiral injections, only one signal is injected while for the burst several injections are performed randomly with a Poisson mean value of XX s.
  Flag: V1:INJECTIONS
  Investigator: Shourov Chatterji (shourov_at_ligo.caltech.edu)
  Category: I

- It happens that the server in charge of the automation of the interferometer operation has a important latency. This introduce delay in detection of an unlock in the interferometer : the interferometer is flag as lock and in science mode but it is in reality unlock. The vent is detected using a threshold on Pr_B5_DC (< 0.01 W) and

Example of DQ flag : GROUND_50Hz

- Some dark fringe glitches are in coincidence with strong glitches in magnetic probes at 50Hz simultaneoulsy in all buildings (CE, NE and WE).

  50 Hz ground issues?

- Use Q triggers on MABDCEXX, MABDNEXX, MABDWEXX   XX=01,02,03
- Set high threshold (well above the usual magnetometers glitching level)
- Coincidence between at least 2 different buildings
- OR of coincidences

  → ~100 events for VSR1
  → dead time: 0.013 %

Exemple: July 15-21th
Effect on the burst Q online triggers

2007/07 DAY: 15-21 FLAG:GROUND_50HZ

○ all triggers
● triggers suppressed by DQ
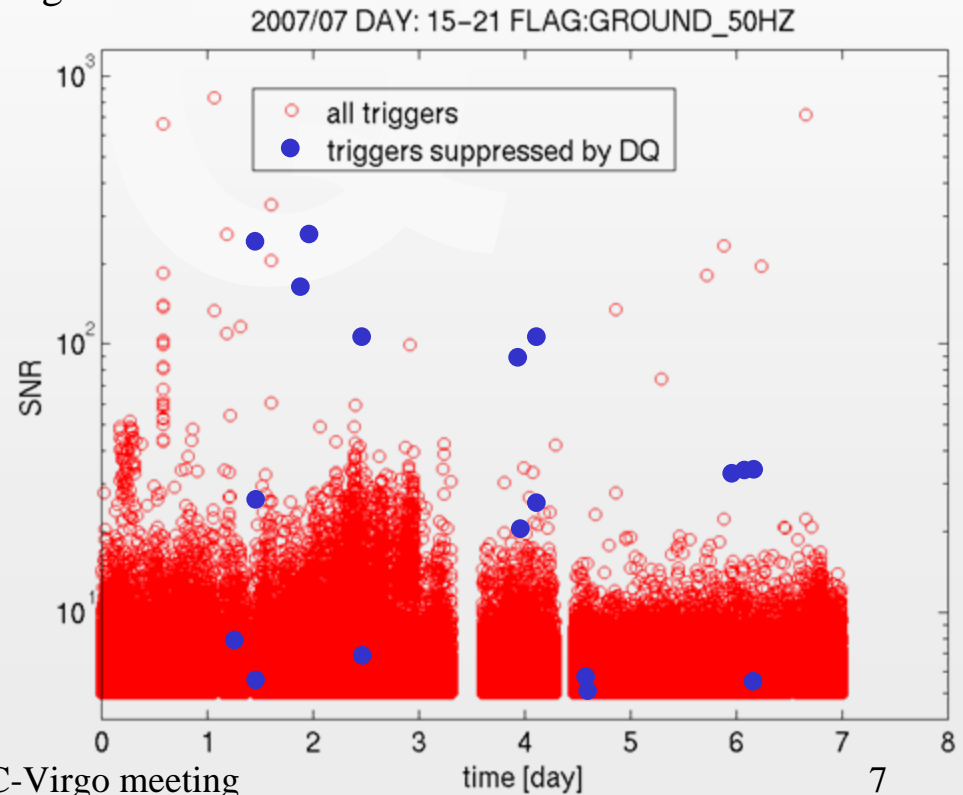
Burst and inspiral groups are studying vetos and DQ flags.
They decide which flags are interesting, which time window need to be applied around each segment and which DQ lists suit their analysis.

- For each analysis, information is provided through a web page:

- containing list of DQ flags of each category used for this analysis

- pointing to combined lists of those flags

- updated each time a stable DQ flag is added or modified in VDB

DQ lists for Bursts

VSR1 DQ lists for burst analysis

Overview

Information on the VSR1 DQ lists to be used for burst analyses is given here. All DQ segments list are stored in VDB. As soon as a new DQ has been validated ("stable" state in VDB), this page will be updated and a link to the DQ list will be provided. The DATE stamp indicate when the update has been done. The PRESCRIPTION indicates how many seconds should substracted or added to each segments stored in VDB. The LIST provided is built taking into account the presciption. Information on the DQ list is provided here

INJECTIONS

NAME	VERSION	PRESCRIPTION	DATE	LIST(VDB)	LIST(ASCII)
V1:INJECTIONS	VSR1_v1	-0s +0s	2008/03/10	link	txt

Category 1

NAME	VERSION	PRESCRIPTION	DATE	LIST(VDB)	LIST(ASCII)
V1:DARKF_MISS	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:GC_MISFUNCTIONING	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:HREC_MISS_VH1	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:LOCK_UNLOCKED	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:MAINTENANCE	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:PRE_LOCKLOSS_10S	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:RAWFRAME_MISS	VSR1_v1	-0s +0s	2008/03/10	link	txt

Category 2

NAME	VERSION	PRESCRIPTION	DATE	LIST(VDB)	LIST(ASCII)
V1:COIL_NEWE_SAT	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:EARTHQUAKE	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:FRAMEH_QUALITY12_VH1	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:GROUND_50HZ	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:HREC_BADQUALITY_VH1	VSR1_v1	-0s +0s	2008/03/10	link	txt

V1:PRE_LOCKLOSS_10S	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:RAWFRAME_MISS	VSR1_v1	-0s +0s	2008/03/10	link	txt

Category 2

NAME	VERSION	PRESCRIPTION	DATE	LIST(VDB)	LIST(ASCII)
V1:COIL_NEWE_SAT	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:EARTHQUAKE	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:FRAMEH_QUALITY12_VH1	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:GROUND_50HZ	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:HREC_BADQUALITY_VH1	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:MISSAMPLES	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:POWER_STAB_OFF	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:SSFS_CORR_SAT	VSR1_v1	-0s +0s	2008/03/10	link	txt

Combined lists (union)

DQ NAMES	LIST	DATE	VERSION	LIST(ASCII)
V1:DARKF_MISS, V1:GC_MISFUNCTIONING, V1:HREC_MISS_VH1, V1:LOCK_UNLOCKED, V1:MAINTENANCE, V1:PRE_LOCKLOSS_10S, RAWFRAME_MISS	V1:COMBINED_CAT1	2008/03/10	VSR1_v1	txt
V1:COIL_NEWE_SAT, V1:EARTHQUAKE, V1:FRAMEH_QUALITY12_VH1, V1:GROUND_50HZ V1:HREC_BADQUALITY_VH1, V1:MISSAMPLES, V1:POWER_STAB_OFF, V1:SSFS_CORR_SAT	V1:COMBINED_CAT2	2008/03/10	VSR1_v1	txt
V1:COIL_NEWE_SAT, V1:EARTHQUAKE, V1:FRAMEH_QUALITY12_VH1, V1:GROUND_50HZ V1:HREC_BADQUALITY_VH1, V1:MISSAMPLES, V1:POWER_STAB_OFF, V1:SSFS_CORR_SAT V1:INJECTIONS	V1:COMBINED_INJCAT2	2008/03/10	VSR1_v1	txt

Science segments after Cat1

TO BE DONE

Scripts

The script download_list.sh downloads DQ lists. The input of the script is a file containing the DQ flag names. The altering window applied to each DQ is given at the end of the fkag name following ":" signe. Example: V1:MISSAMPLES[VSR1_v1]:-1:2 for a [-1; 2] window
The script combine_list.sh makes an union of the DQ lists. The input of the script is a file containing the DQ flag names as previously described.

Last modified: Mon Mar 10 22:22:46 CDT 2008 by mab

DQ combined list from web UI

DQ list for Bursts

V1:RAWFRAME_MISS	VSR1_v1	-0s +0s	2008/03/10	link	txt

Category 2

NAME	VERSION	PRESCRIPTION	DATE	LIST(VDB)	LIST(ASCII)
V1:COIL_NEWE_SAT	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:EARTHQUAKE	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:FRAMEH_QUALITY12_VH1	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:GROUND_50HZ	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:HREC_BADQUALITY_VH1	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:MISSAMPLES	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:POWER_STAB_OFF	VSR1_v1	-0s +0s	2008/03/10	link	txt
V1:SSFS_CORR_SAT	VSR1_v1	-0s +0s	2008/03/10	link	txt

Combined lists (union)

DQ NAMES	LIST	DATE	VERSION	LIST(ASCII)
V1:DARKF_MISS, V1:GC_MISFUNCTIONING, V1:HREC_MISS_VH1, V1:LOCK_UNLOCKED, V1:MAINTENANCE, V1:PRE_LOCKLOSS_10S, RAWFRAME_MISS	V1:COMBINED_CAT1	2008/03/10	VSR1_v1	txt
V1:COIL_NEWE_SAT, V1:EARTHQUAKE, V1:FRAMEH_QUALITY12_VH1, V1:GROUND_50HZ V1:HREC_BADQUALITY_VH1, V1:MISSAMPLES, V1:POWER_STAB_OFF, V1:SSFS_CORR_SAT	V1:COMBINED_CAT2	2008/03/10	VSR1_v1	txt
V1:COIL_NEWE_SAT, V1:EARTHQUAKE, V1:FRAMEH_QUALITY12_VH1, V1:GROUND_50HZ V1:HREC_BADQUALITY_VH1, V1:MISSAMPLES, V1:POWER_STAB_OFF, V1:SSFS_CORR_SAT V1:INJECTIONS	V1:COMBINED_INJCAT2	2008/03/10	VSR1_v1	txt

Science segments after Cat1

TO BE DONE

Scripts

The script download_list.sh downloads DQ lists. The input of the script is a file containing the DQ flag names. The altering window applied to each DQ is given at the end of the fkag name following ":" signe. Example: V1:MISSAMPLES[VSR1_v1]:-1:2 for a [-1; 2] window
The script combine_list.sh makes an union of the DQ lists. The input of the script is a file containing the DQ flag names as previously described.

Last modified: Mon Mar 10 22:22:46 CDT 2008 by mab

```
# Veto file created  Mon Mar 10 16:50:03 CDT 2008 by mab on antigone.Physics.Carleton.edu
# DQ segments info stored in VDB https://pub7.virgo.infn.it/VDB/main.php
##################################################################################
## Dead time:3.124%
##################################################################################
## NAME:        COMBINED LIST: V1:DARKF_MISS{0,0}+V1:GC_MISFUNCTIONING{0,0}+V1:HREC_MISS_VH1{0,0}+V1:LOCK_UNLOCKED{0,0}+V1:MAINTENA
## COVERAGE:    2236536.00
##################################################################################
#INDEX   TIMESTART       TIMESTOP        DURATION #
1        863562047       863566352       4305
2        863593263       863593315       52
3        863593418       863593470       52
4        863593472       863593554       82
5        863593575       863593627       52
6        863594128       863594220       92
7        863595488       863595568       80
8        863596848       863596934       86
9        863598016       863598096       80
10       863598592       863598654       62
11       863599840       863599905       65
12       863601920       863601978       58
13       863602688       863602763       75
14       863603744       863603803       59
15       863604000       863609091       5091
16       863644034       863644086       52
17       863647674       863651120       3446
18       863656144       863656196       52
19       863656292       863657840       1548
20       863664731       863666240       1509
21       863666241       863666245       4
22       863666251       863666255       4
23       863666261       863666265       4
24       863666271       863666288       17
25       863666291       863666295       4
```

Studies on burst Q online triggers *(M. Bizouard)*

- Generate Cat 1 + Cat 2 combined DQ list and apply it to burst Q triggers
  to see what remains at high SNR
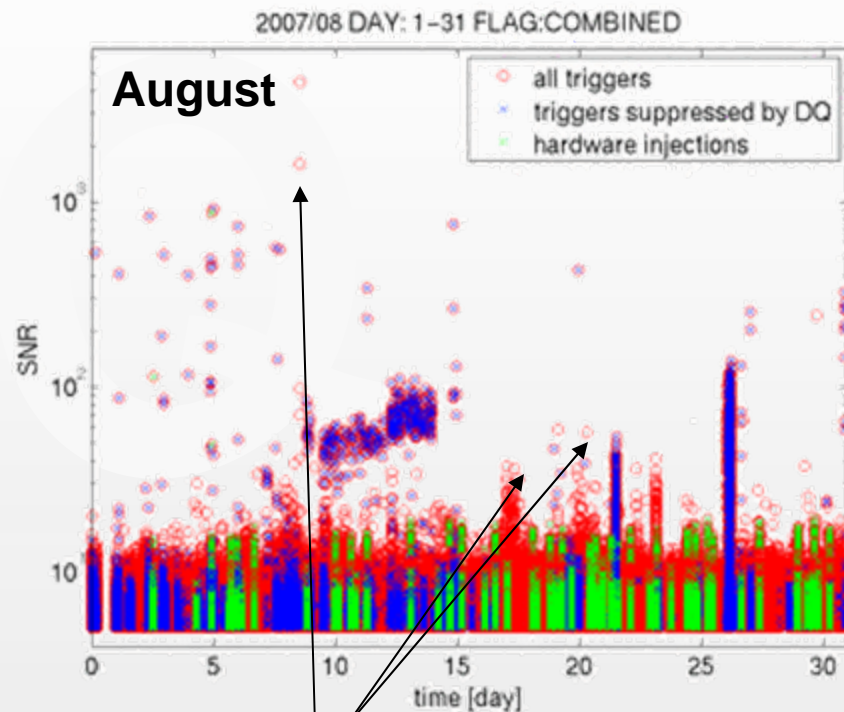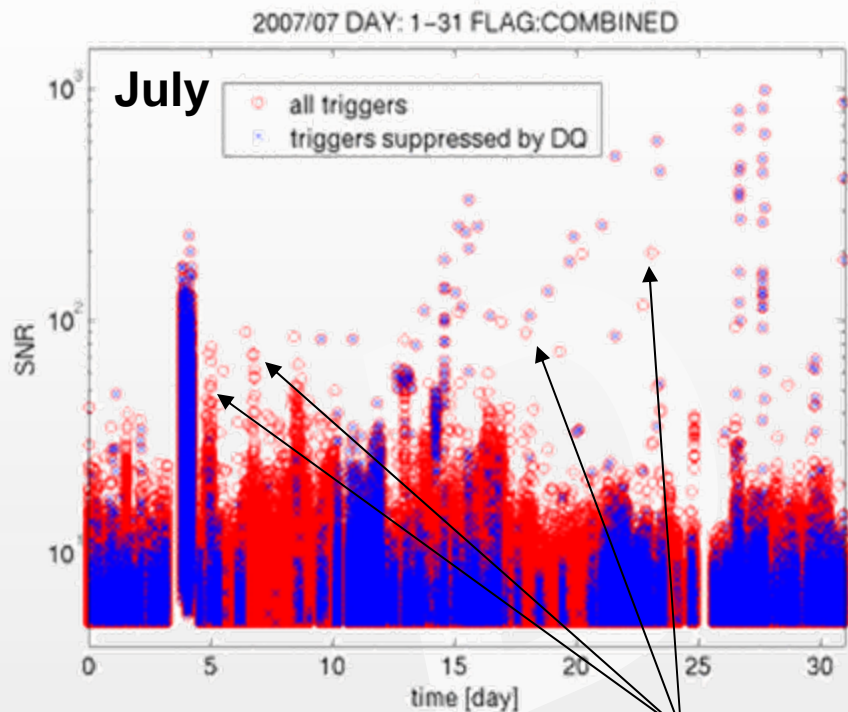
few remaining very high SNR …. under study

Same thing done with PC and inspiral triggers …

Current DQ tools

A web interface to VDB : **https://vdb.virgo.infn.it/VDB/main.php**

Current DQ tools

A nice feature of this web interface : **list of DQ flags concerned by a given time period**

A C++ toolkit : **VDBtk_segments**   (package VDB v0r4p2 can be retrieved from Virgo CVS repository)

  - To download or upload DQ segments lists

  - To combine DQ segments lists

  - To compute deadtimes

Example: to download a combined list of segments

VDBtk_segments -expr 'V1:DARKF_MISS{0,0}+V1:MAINTENANCE{0,0}' -omode idlTC

```
################################################################################
## Dead time:0.0912817%
################################################################################
## NAME:         COMBINED LIST: V1:DARKF_MISS{0,0}+V1:MAINTENANCE{0,0}
## COVERAGE:     9479.00
################################################################################
#INDEX  TIMESTART       TIMESTOP        DURATION #
1       863593263       863593315       52
2       863593418       863593470       52
3       863593575       863593627       52
4       863644034       863644086       52
5       863656144       863656196       52
6       863656292       863656344       52
7       863666113       863666114       1
8       863666163       863666164       1
9       863666173       863666174       1
10      863666193       863666194       1
11      863666203       863666204       1
12      863666213       863666214       1
```
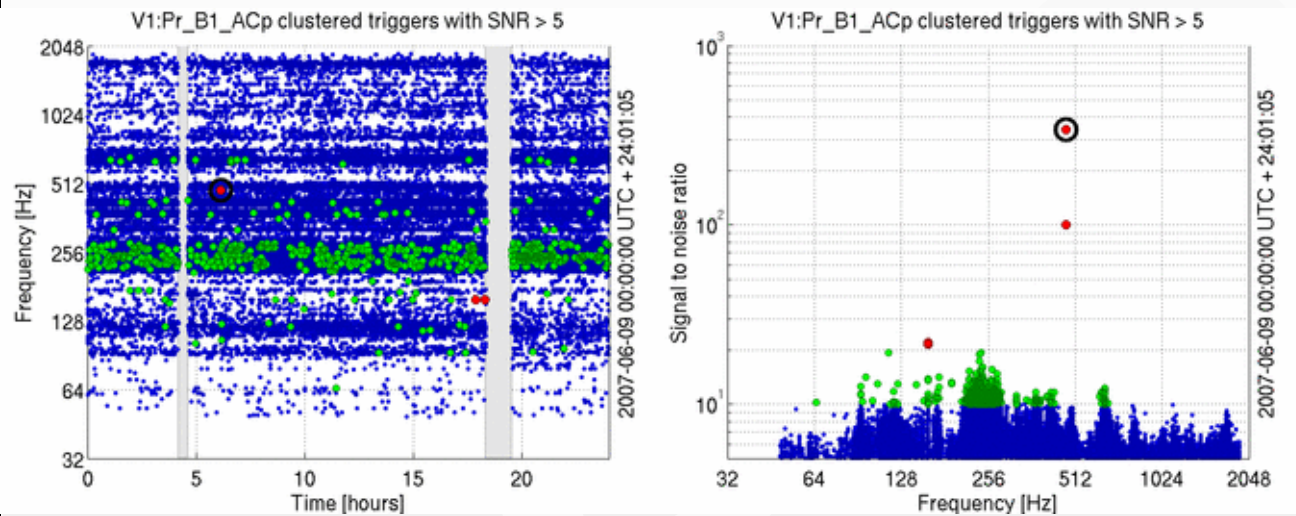
On going activities

- Turn into DQ flag the "BMS" event by event vetoes developed for burst & inspiral

- Understand periods with a higher events rate at high SNR
  (environmental disturbance? low frequency noise upconversion?)

- Turn into a DQ flag the vetos on "dust events" developed using the quadrature signal (Pr_B1_ACq) ?
- Turn into DQ flag seismic events (glitches < 1s) seen in the seismic probes?
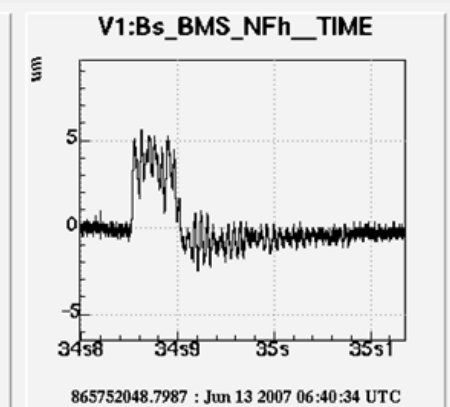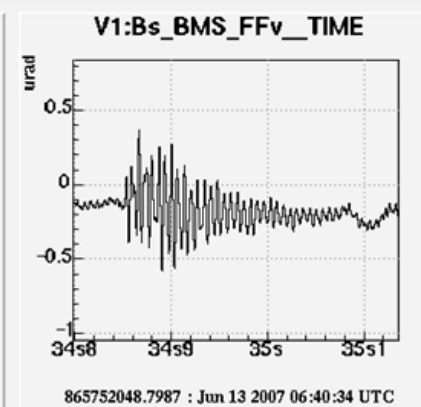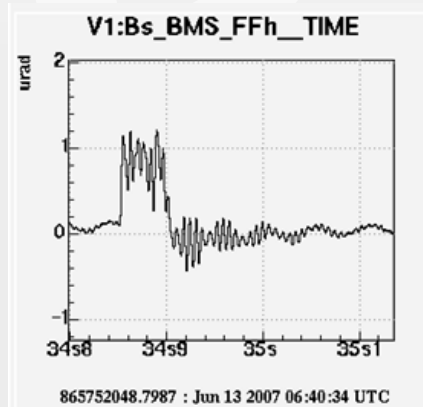- Produce DQ flags using the information provided by the Online Detector Monitoring system

BMS events

- BMS = Beam Monitoring system
- Misfunctioning of one of the 4 piezos →input beam jitters and glitches on the dark fringe signal **around ~200Hz**
- Problem discovered in June and fixed in July 18th. Beginning of VSR1 is strongly affected

- Short events <100 ms
- Event by event vetoes developed by P. Hello (burst) and G. Guidi (inspiral)
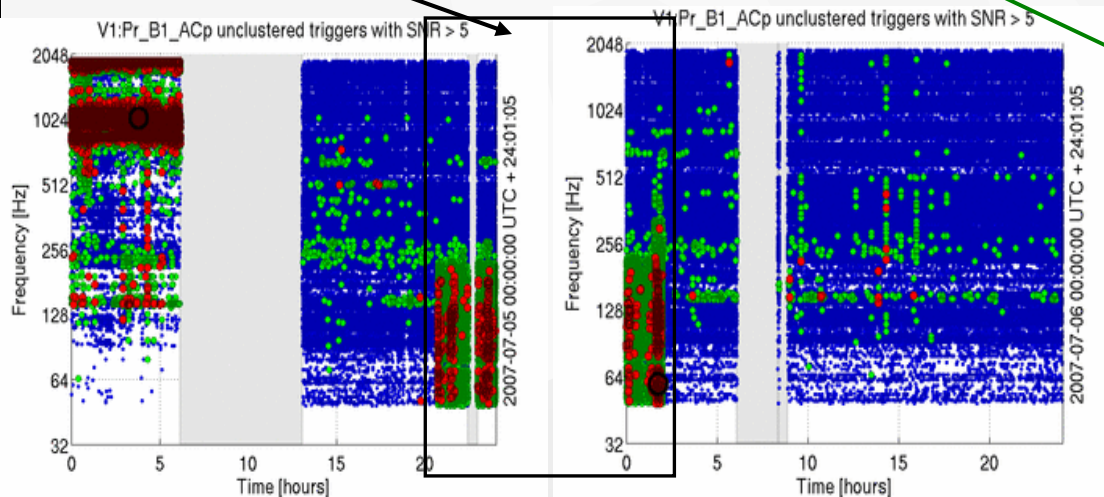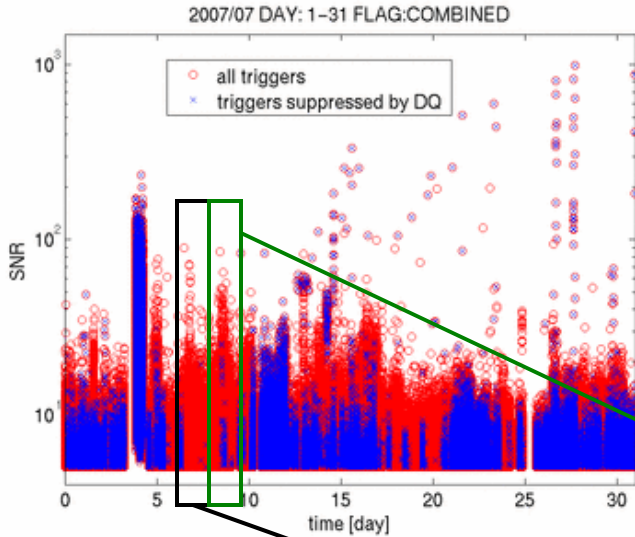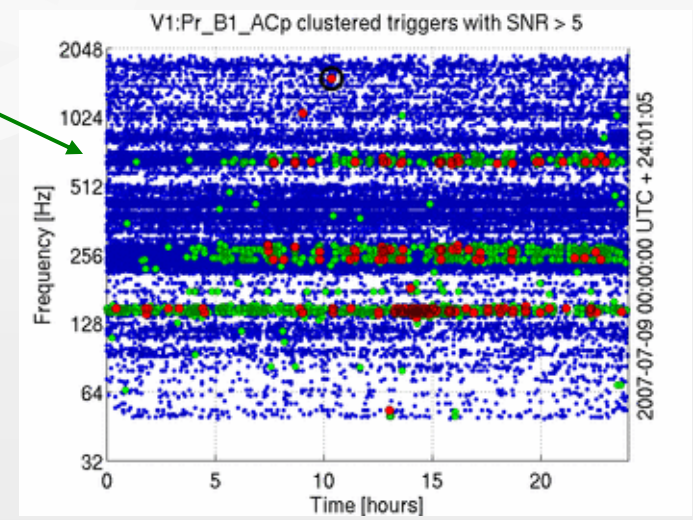
- May turn them into a DQ flag

19 March. 2008

Noisy periods to be understood

Triggers from Q online

5 -6 july 2007

9 july 2007

On going activities

- Turn into DQ flag the "BMS" event by event vetoes developed for burst & inspiral

- Understand periods with a higher events rate at high SNR
  (environmental disturbance? low frequency noise upconversion?)

- Turn into a DQ flag the vetos on "dust events" developed using the quadrature signal (Pr_B1_ACq) ?
- Turn into DQ flag seismic events (glitches < 1s) seen in the seismic probes?
- Produce DQ flags using the information provided by the Online Detector Monitoring system

Next steps

- Official release of stable DQ flags (this week)

- Continue to improve the access tools (VDB web interface and VDBtk_segments)

- Check of "unstable" DQ flags

  - EOL_QRATE , LC_FAILURE , LC_FAILURE_NI , LC_FAILURE_WI , B5_SAT

- Investigate new DQ flags for category 2 and 3

- Finalize the "Burst DQ list" and "Inspiral DQ list" web pages

- Continue to exchange information with LSC about DQ flags repositories and tools
  (already help from S. Chatterji and discussions between L. Bosi and D. Brown)

- Finalize automatization (real time upload of some segments lists like ScienceMode, Injections…)

More information – More people

- Weekly telecon on Thursday at 4pm (CET).

- **Need to increase the DQ team**:
  people from data analysis groups and from Virgo commissioning are welcome!

- Expertise from LSC is also very welcome!

For more information:

https://vdb.virgo.infn.it/VDB/main.php

http://wwwcascina/virgo.infn.it/DataAnalysis/VDBdoc

http://wwwcascina.virgo.infn.it/DataAnalysis/VDBdoc/VSR1_dqinfo.html

http://wwwcascina.virgo.infn.it/DataAnalysis/VDBdoc/VSR1_DQ_BURST_LIST.html