Current status of KAGRA detector characterization

Recent activities

- K-detchar group and J-detchar group had EVO meeting on 17May.
- Our current activities are mainly concentrated into three.
  - Building detchar system
    - We will use DMT for the platform.
    - Software will be developed on that system.
    - Newly developed software will be easily shared with other collaborations. eg. ANN
  - Check existing monitor software and developing new ones
  - Detchar channel selection
    - Which channels are needed for building “glitch-free interferometer”.

Application of ANNs to Glitch Identification Study using Auxiliary Channels

John J. Oh[1], Sang Hoon Oh[1], Young-Min Kim[1,2], Chang-Hwan Lee[2], Edwin J. Son[3], Ruslan Vaulin[4] , Lindy Blackburn[5]

[1] National Institute for Mathematical Sciences [2] Pusan National University
[3] Sogang University [3] MIT [4] Goddard Space Flight Center, NASA

Goals: Applying artificial neural networks (ANNs) to auxiliary channel information,

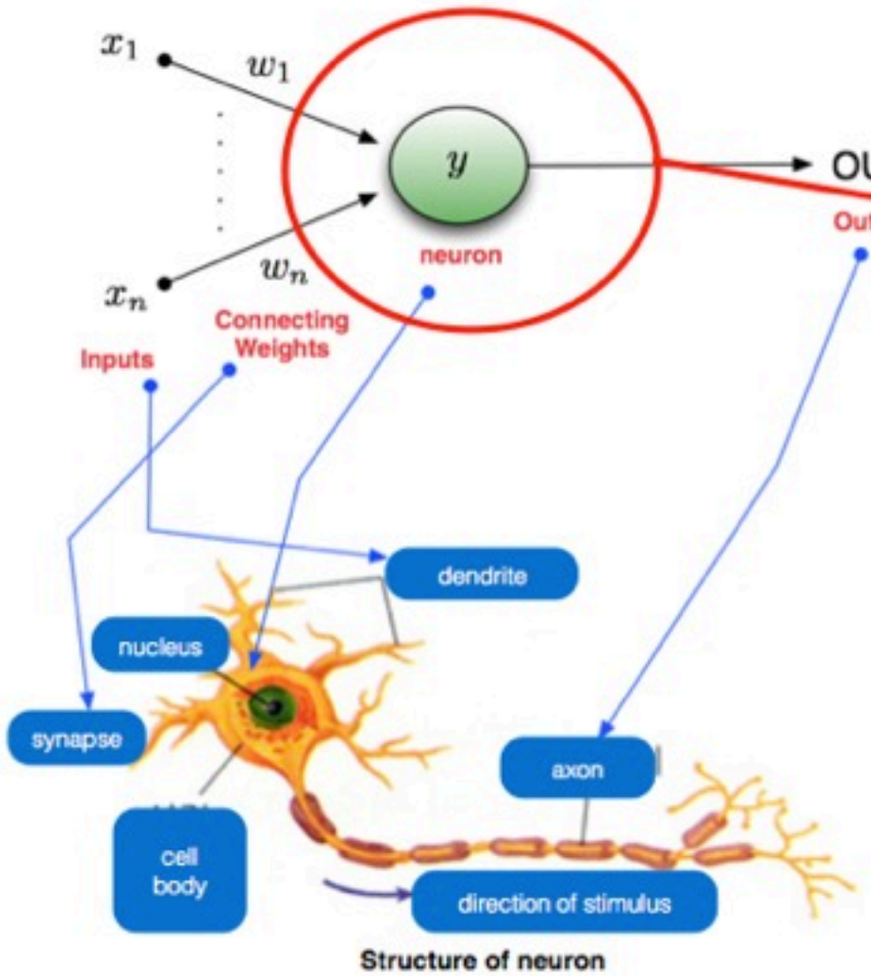
- ✦ Provide a highly efficient and reliable noise transient (glitch) identification tool
- ✦ Develop a method to trace down the culprit channel(s) causing noise transient in strain data
- ✦ Potentially establish a new ranking statistic useful for CBC search

Sang Hoon's presentation

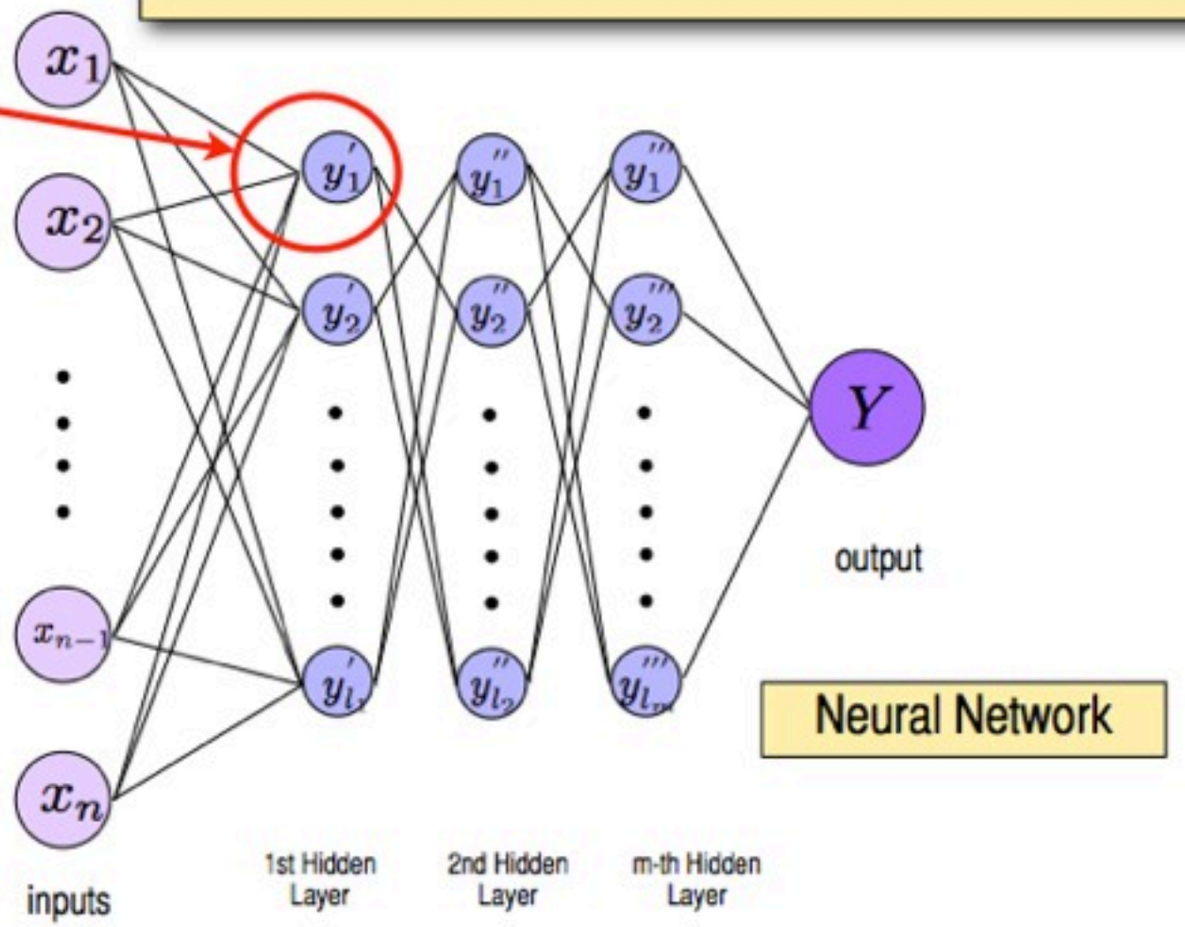
ANNs

$$y = f\left(\sum_{i}^{n}(\omega_i x_i + b_i)\right)$$

- a mathematical / computational model that is inspired by the structural and functional aspects of data processing in human brain or biological neural systems.



Structure of neuron



J. Oh's slides on 17 May 2012

Strategy of KAGRA detector characterization

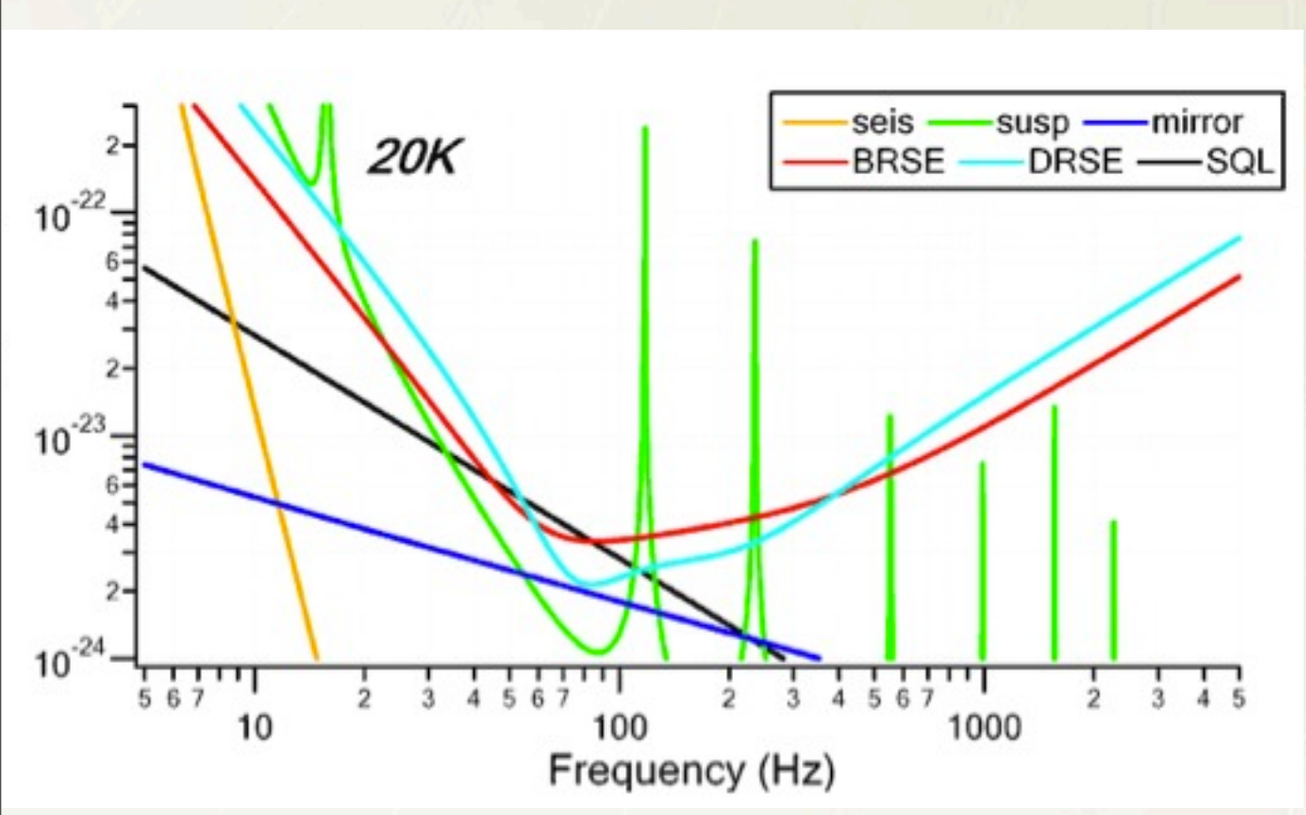
Kazuhiro Hayama

National Astronomical Observatory of Japan

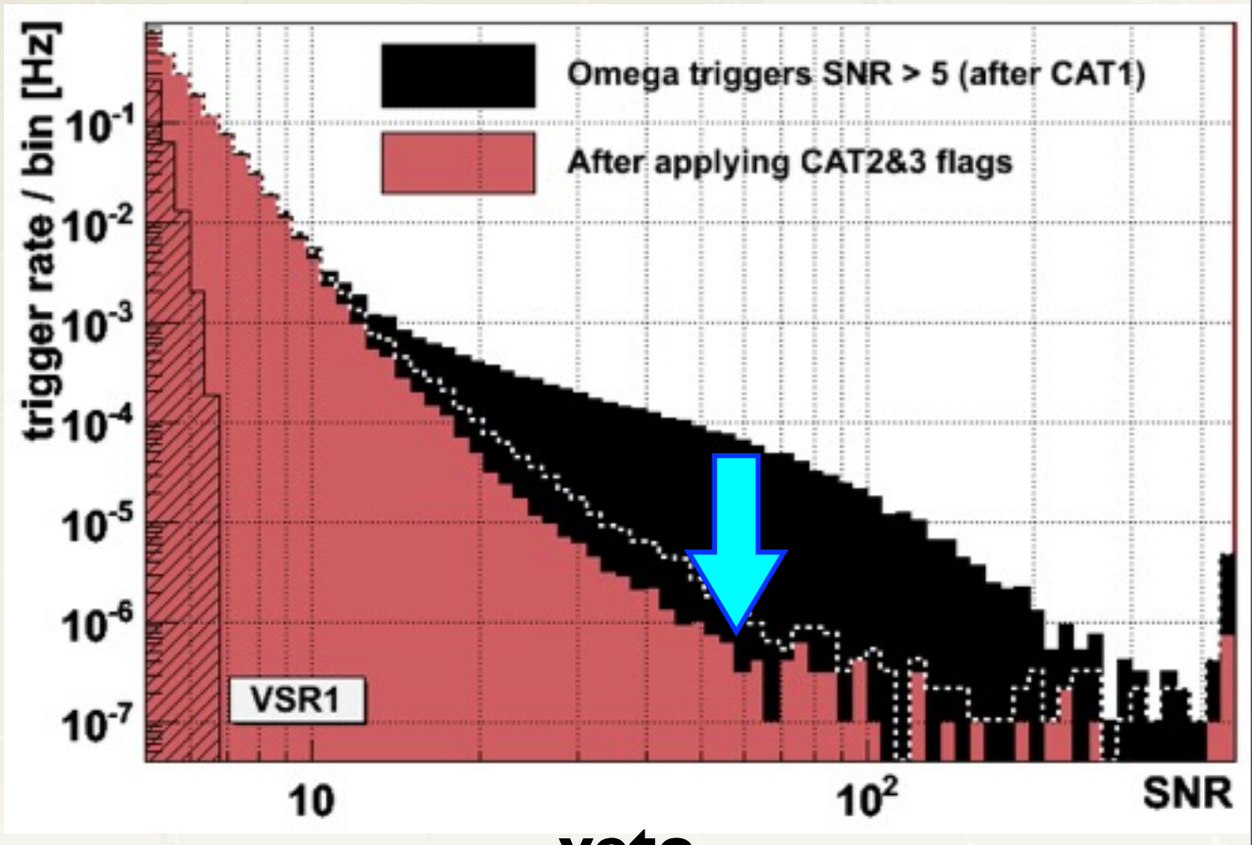
Astrophysical sensitivity

- How far a given event a detector can detect depends on
  - Design sensitivity
  - Non-stationary background noise

Detchar's main work is
o To provide tools in order to shorten commissioning period
o To perform veto analysis



Design sensitivity



veto

Interface

Data Analysis

Veto info., target veto , Data quality, calibration accu.

Detector Characterization

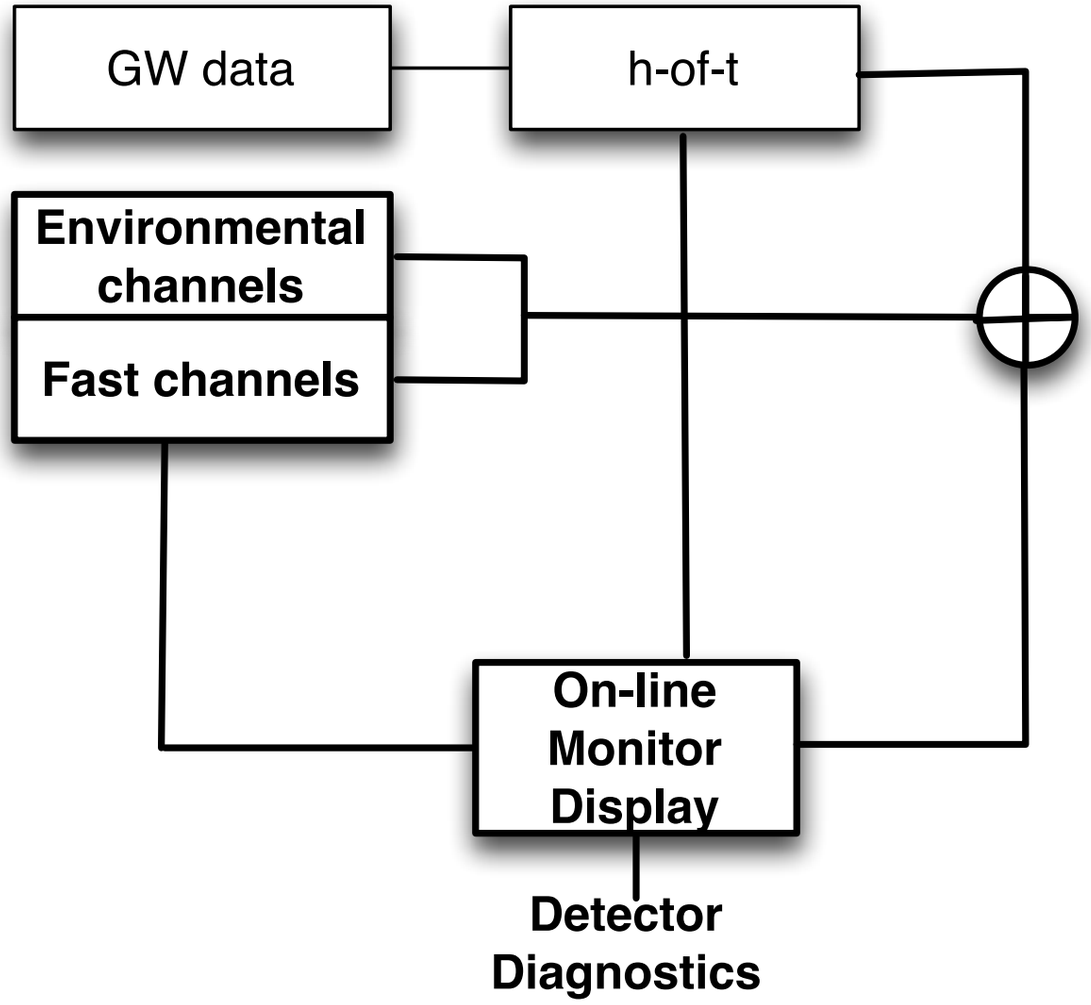
PEM, Aux. channels, Online-monitors, diagnostics

Instruments

More specifically

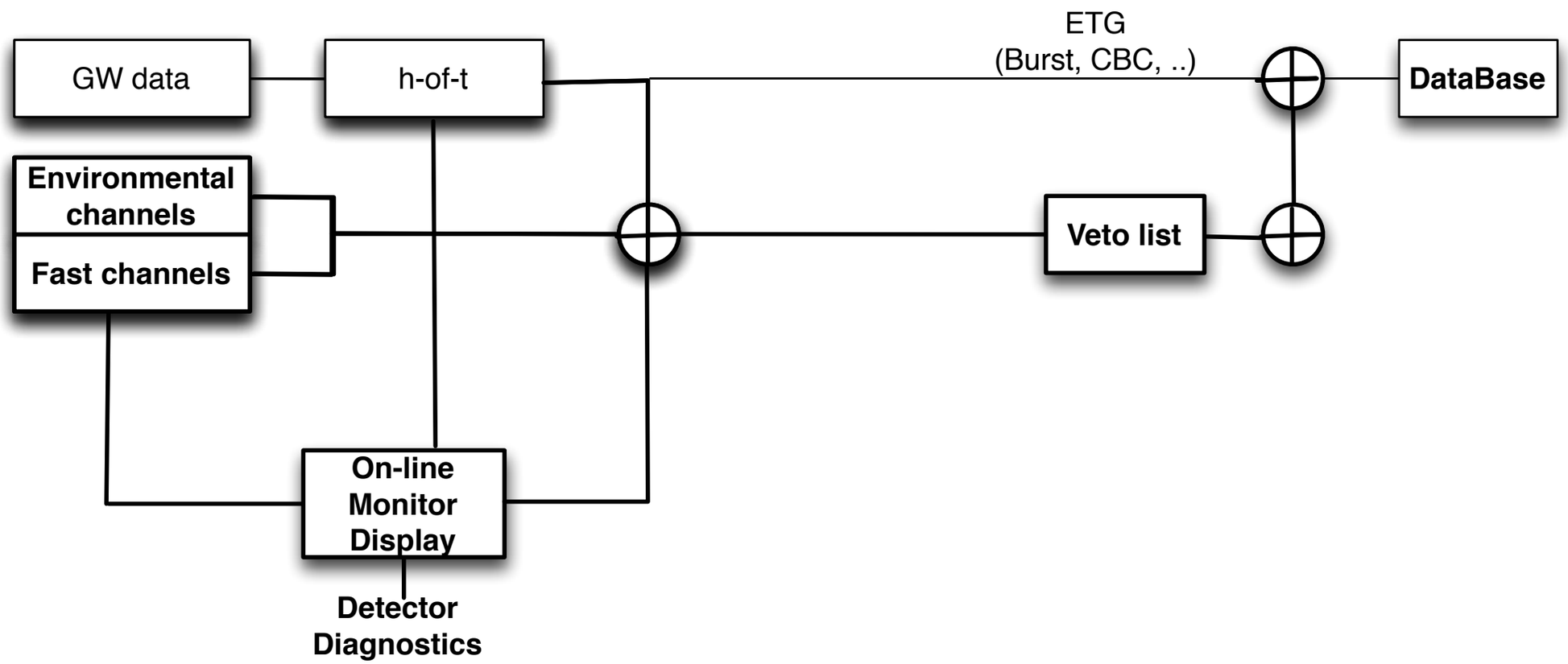
- Development of of the system to perform detector characterization in the pre-process server.
- During commissioning process, to apply detchar to important subsystems.
  - To check whether the specification of each channel is satisfied or not.
  - Long term monitoring data streams of each channel to know statistical properties of the signals, trend etc.
  - To check correlations between channels.
  - To identify lines.
  - To identify burst-line noise (glitches).
- To provide data quality information including veto list.
- To distribute the data quality information to other collaborations.
- Measurement of the accuracy of calibration of h-of-t.

Flowchart



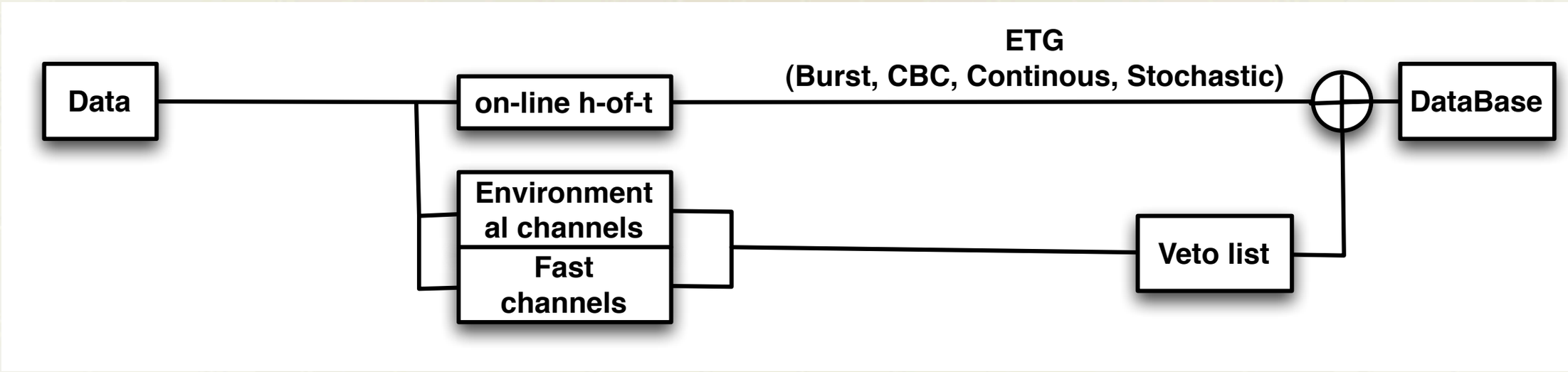
- **Data from the physical and environmental monitors(PEMs) are collected and assigned to slow and fast channels in the EPICS system by the digital control system subsystem.**
- **These channel data are analyzed and the results are displayed via the online monitor displays.**
  - **Correlation between channels**
  - **Find glitches**
  - **Find glitch family**

Flowchart



- **Both h-of, fast, slow channels are analyzed to find and reject noise artifacts.**
- **Coincidence, correlation analysis between detector, environmental channels and the h-of-t.**
- **Data quality and veto information are used in post-processing analysis of each GW search.**

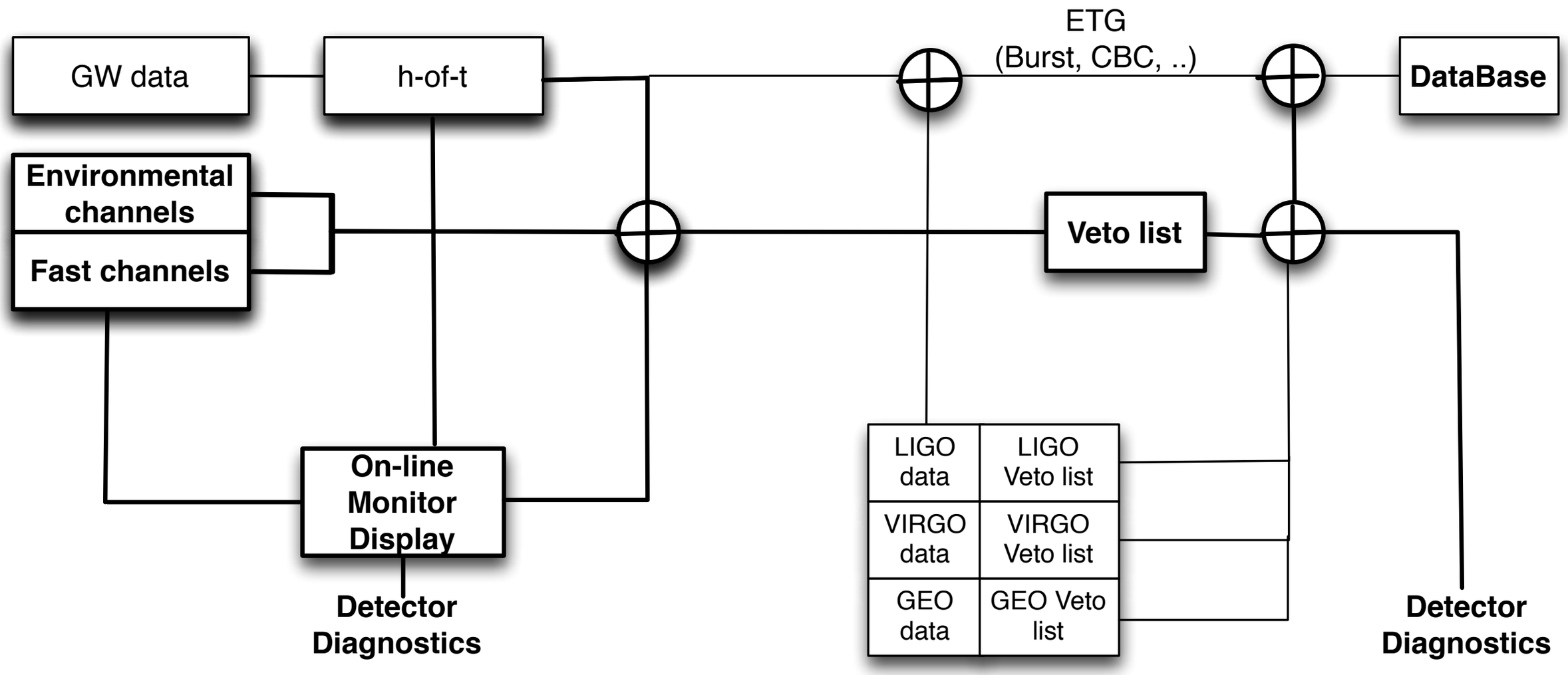
Target Veto



Veto list generation

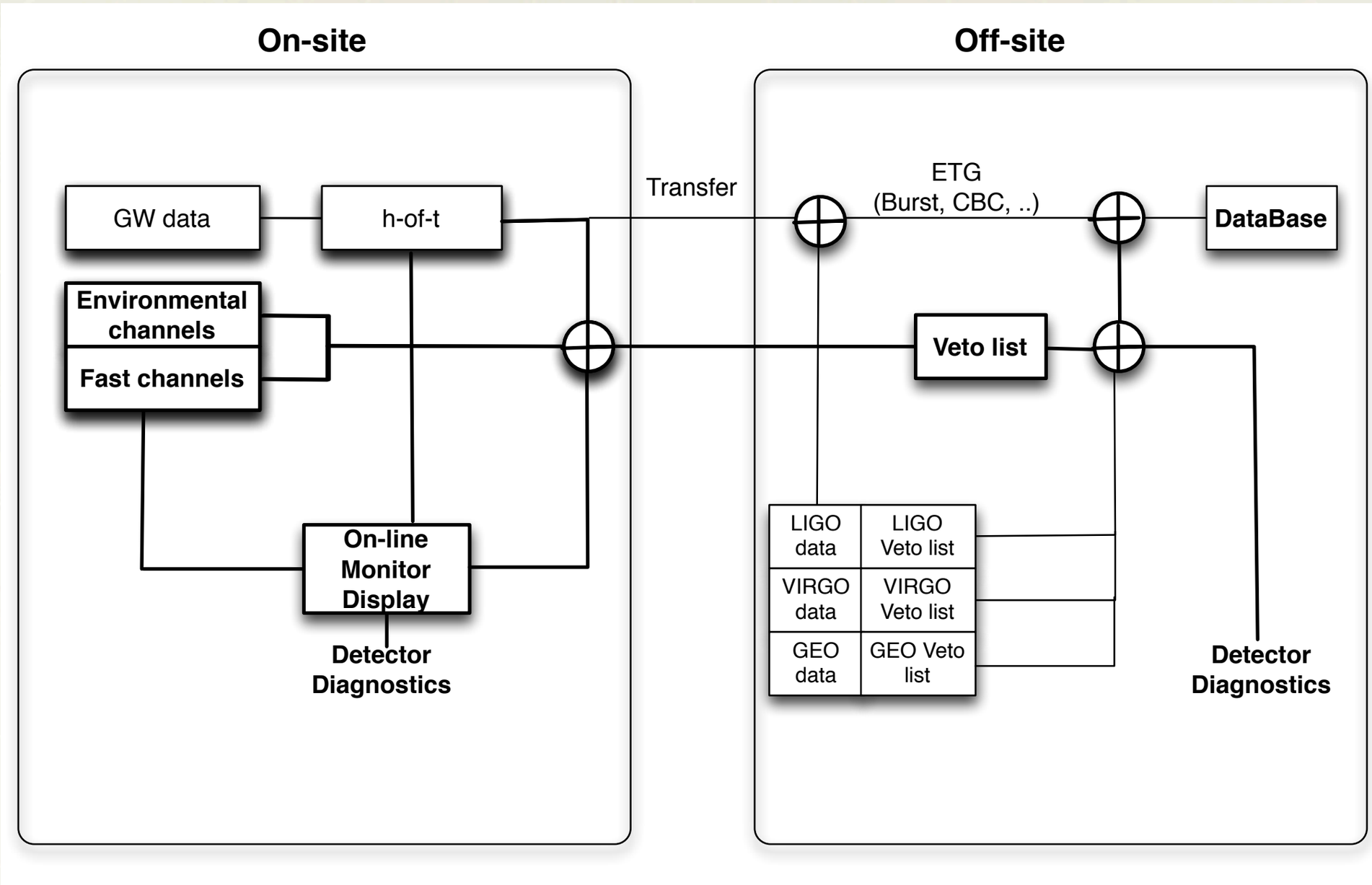
Transient GW (CBC, Burst)	Continuous GW (pulsar, LMXB, ...)	Stochastic GW (Early univ, ...)
• Real-time glitch detection • Glitch classification • Coincidence analysis between the GW channel and auxiliary sensor channels. • ...	• Line tracking • Line detection • Removal of high frequency spikes • ...	• Noise floor monitor • Non-stationary • ...

Global network detchar



- **All veto lists combined and used in the post-processing analysis of network data analysis.**
- **Environmental channels may be correlated between LIGO, Virgo, GEO, KAGRA, ...**

- **KAGRA detchar will be performed as soon as taking data on-site.**
- **Multi-messenger observation needs low false alarm rate.**



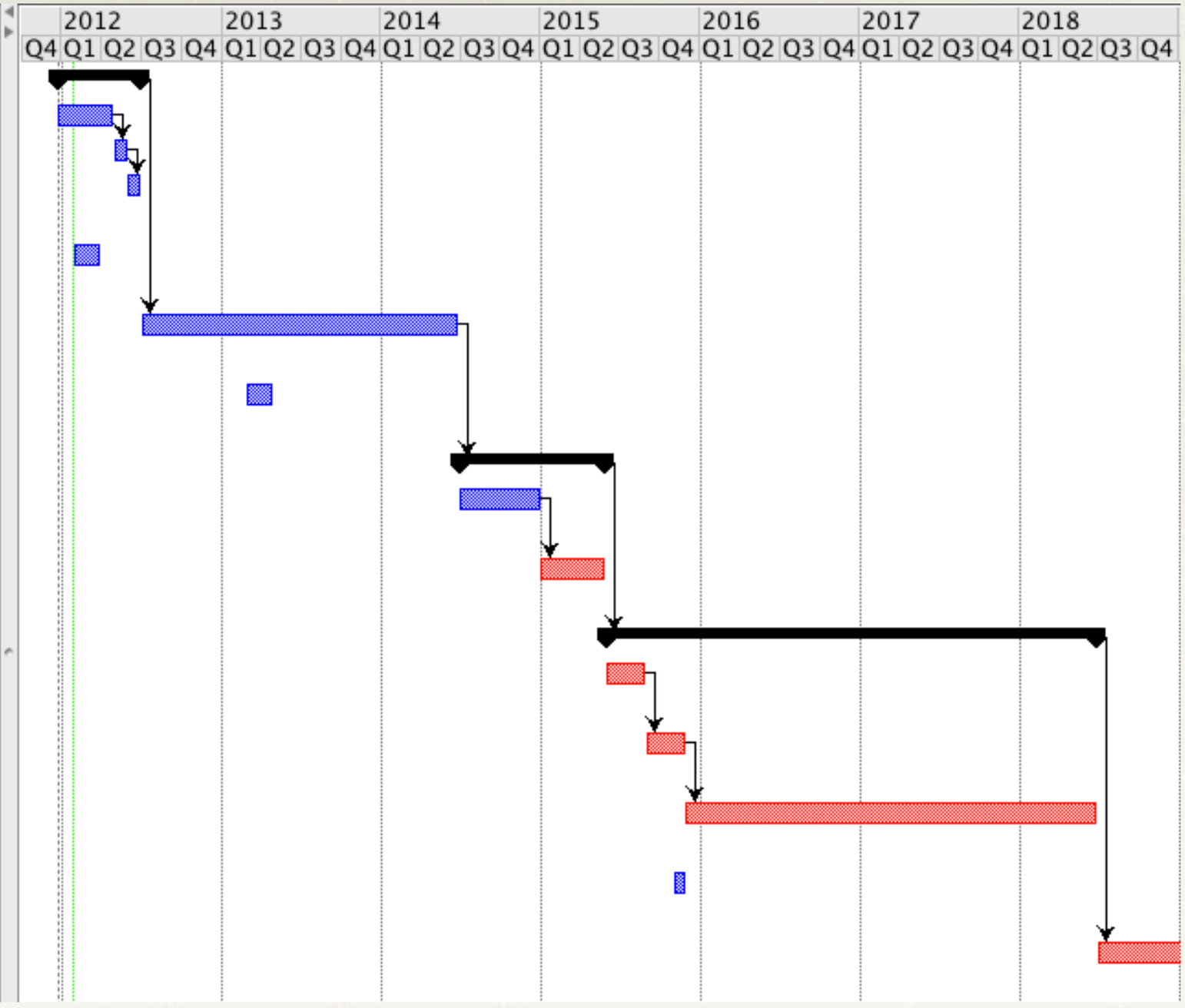
Schedule

	Name
1	⊟**Prototype test in CLIO**
	software check in NAOJ
	install software in CLIO
4	CLIO operation
5	(w GIF) EM sensor determination
6	Software development
7	(w GIF) EM sensor delivery
8	⊟**Computing platform**
9	Computing platform implementation
10	Computing-platform installation
11	⊟**Test operation**
12	(w GIF) EM-DAQ operation
13	(w GIF) detchar operation
14	(w GIF) detchar operation & update
15	bLCGT detchar operation
16	bLCGT detchar operation

Prototype Test

Computing Platform Test Operation

Operation



Schedule

- **Prototype test**
  - **Basic detchar system at NAOJ and software development.**
  - **Test operation of basic detchar system during**
  - **Software development**
- **Computation platform**
  - **2Q-4Q 2014 : Implementation of detchar system in a pre-process server.**
  - **1Q-3Q 2015 : Installation of the pre-process server to a building.**
- **Test operation**
  - **Test operation of the detchar system when the environmental monitors start working in ~March in 2015.**
  - **Operation of the detchar system during GIF operation from ~ June, 2015.**
  - **Operation during iKAGRA in ~ Nov. 2015.**

Detector characterization

- **To provide data quality and veto information**
- **To help the identification and suppression of non-stationary noise sources and to make the improvement to instruments. To do that, during the commissioning process, once a subsystem is launched, we apply detchar to the subsystem.**
- **Shorten commissioning period.**

To support detection or non-detection of GWs.