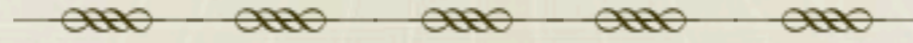


# **Current status of collaboration research on detector characterization**

**KAGRA & KGWG  
detector characterization team**



- **Commissioning stage**  
**With each subsystem,**

- **Subsystem diagnostics**

- **Kill sources of glitches**

- **Speed-up commissioning**

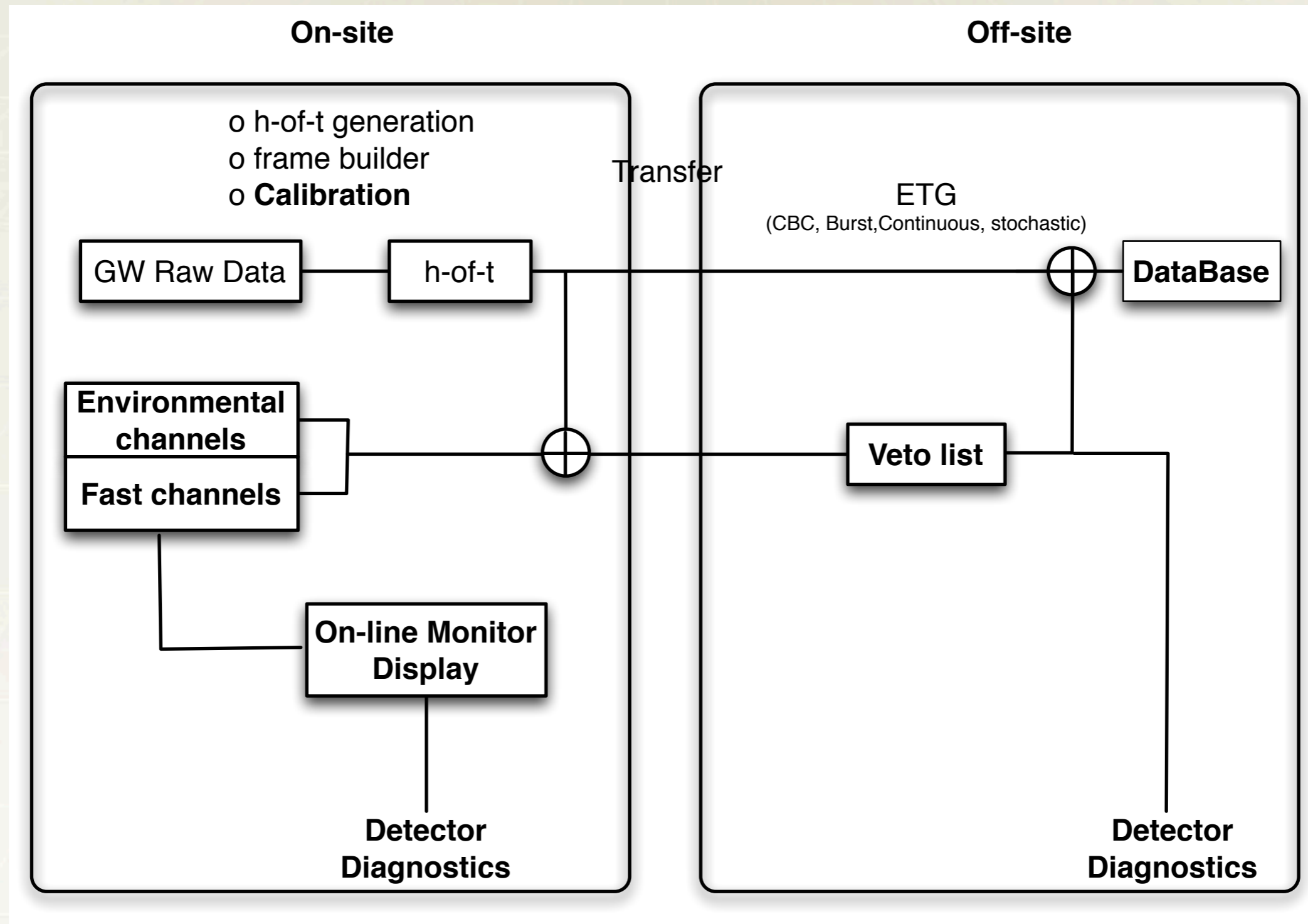
- **Calibration (with MIF, DGS, DMG etc)**

- **Observation stage**

- **Veto analysis (rejection of glitches)**

- **To improve false alarm rate**

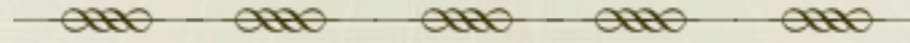
- **Multimessenger observation**







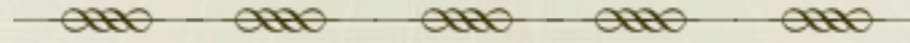




- **Simple standalone system** (RT PC + ADC, Client WS, router) has been **delivered to NAOJ** on 12/6/2011.
- 3days work for installation, lecture and training
- **Online analysis software** will be developed by DAS group.





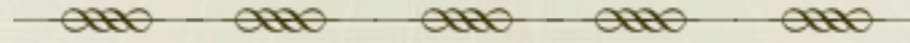


- **CLIO test operation in 15-19, Oct. 2012.**  
(Hayama, Miyakawa, Miyoki, Ohashi, Tanaka, Uchiyama, Yamamoto, Yuzurihara)
- **End-to-end test of prototype detchar system during the operation.**
- **Time domain calibration**
- **Hardware injection of correlated glitches in GW and acceleration monitor.**

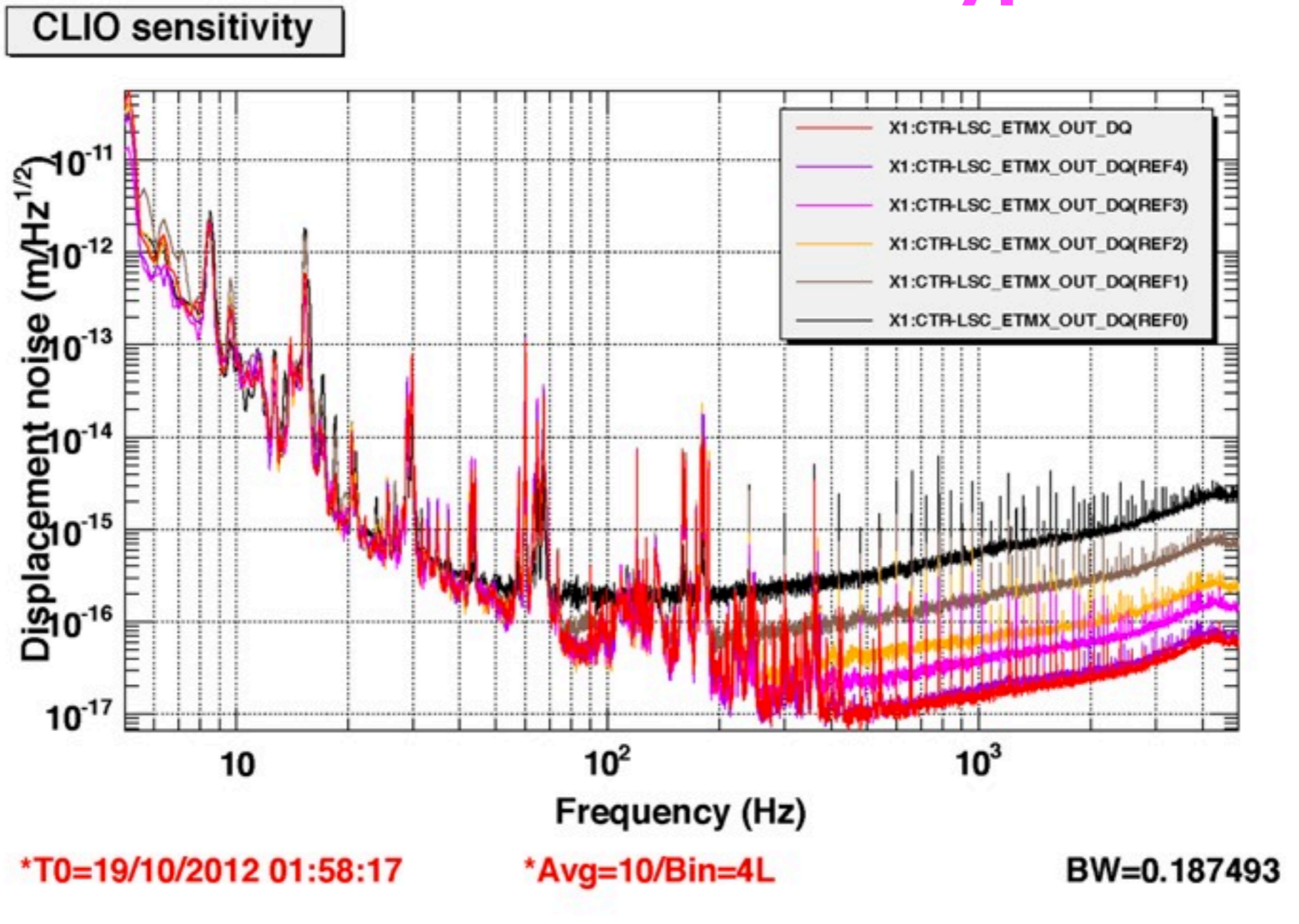


**Taken by  
Yuzurihara**





**Test operation**  
**~x10 worse than typical sensitivity**



**O. Miyakawa**

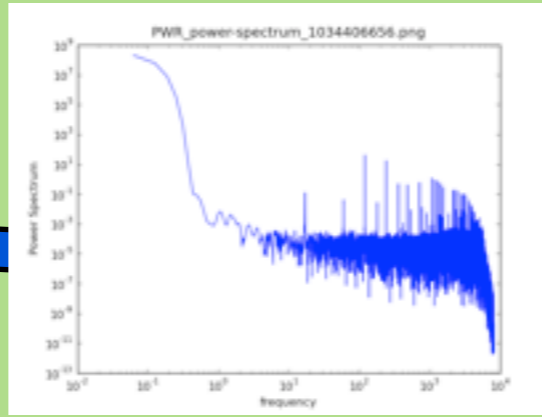
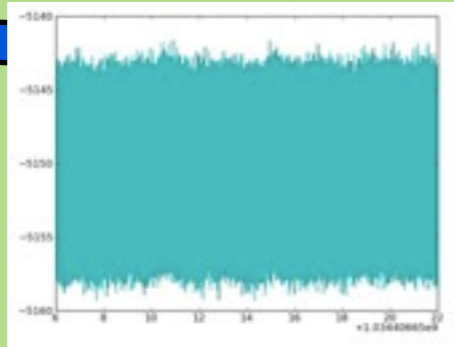
# Detector Characterization

**Inst. Mon**



Laser Intensity

16s

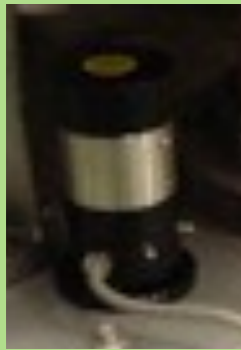


RT WS



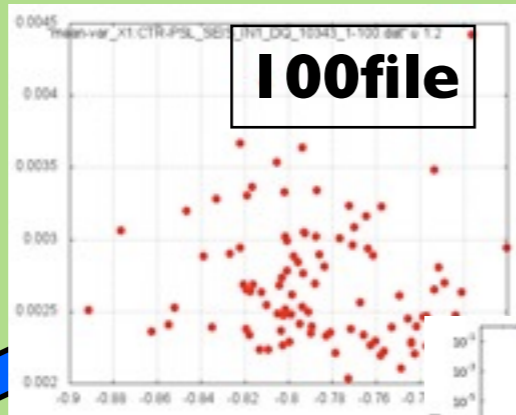
RealTime update @16s

**Env. Mon**

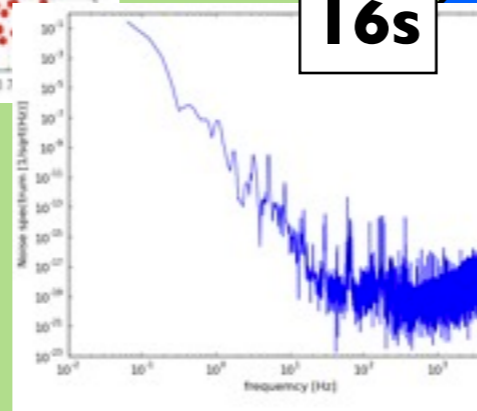


acce.

100file



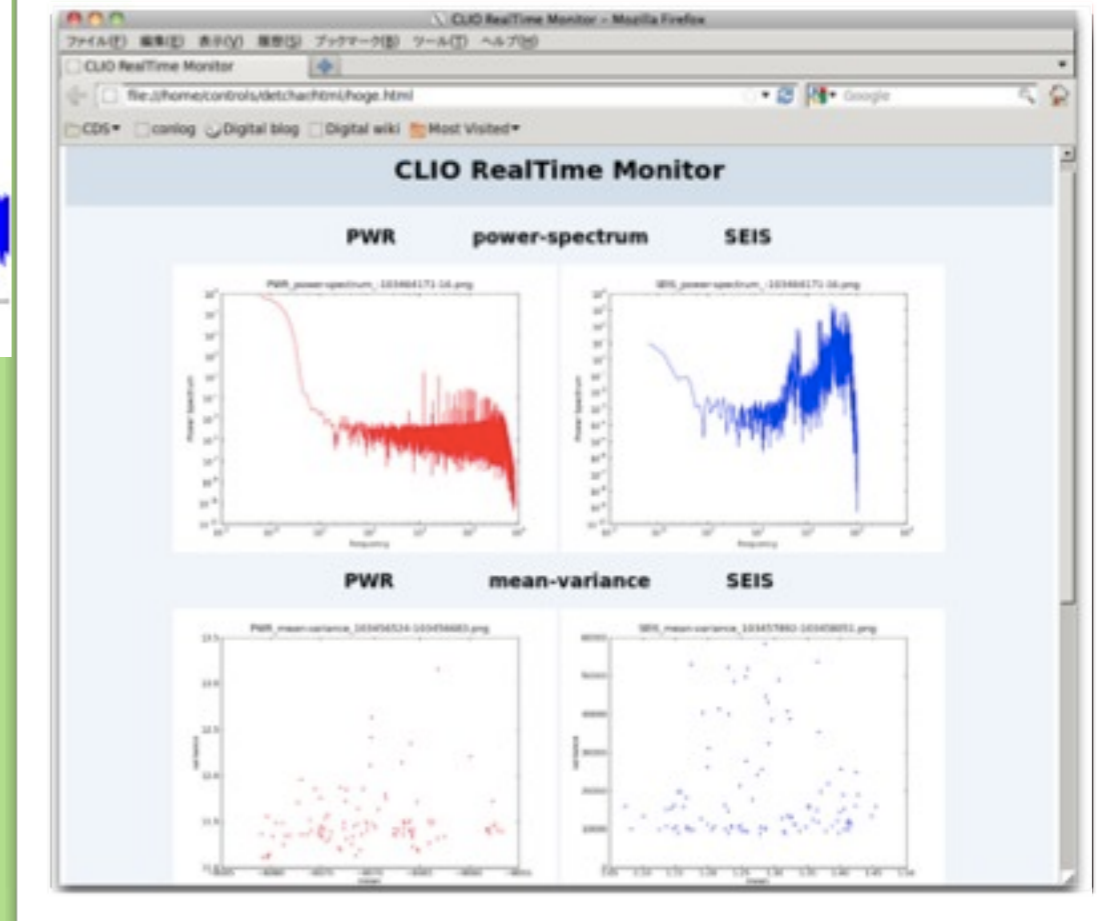
16s



**Sens. Mon**

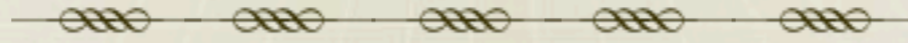


CLIO



K.Tanaka





## Calibration

Convert to physical unit

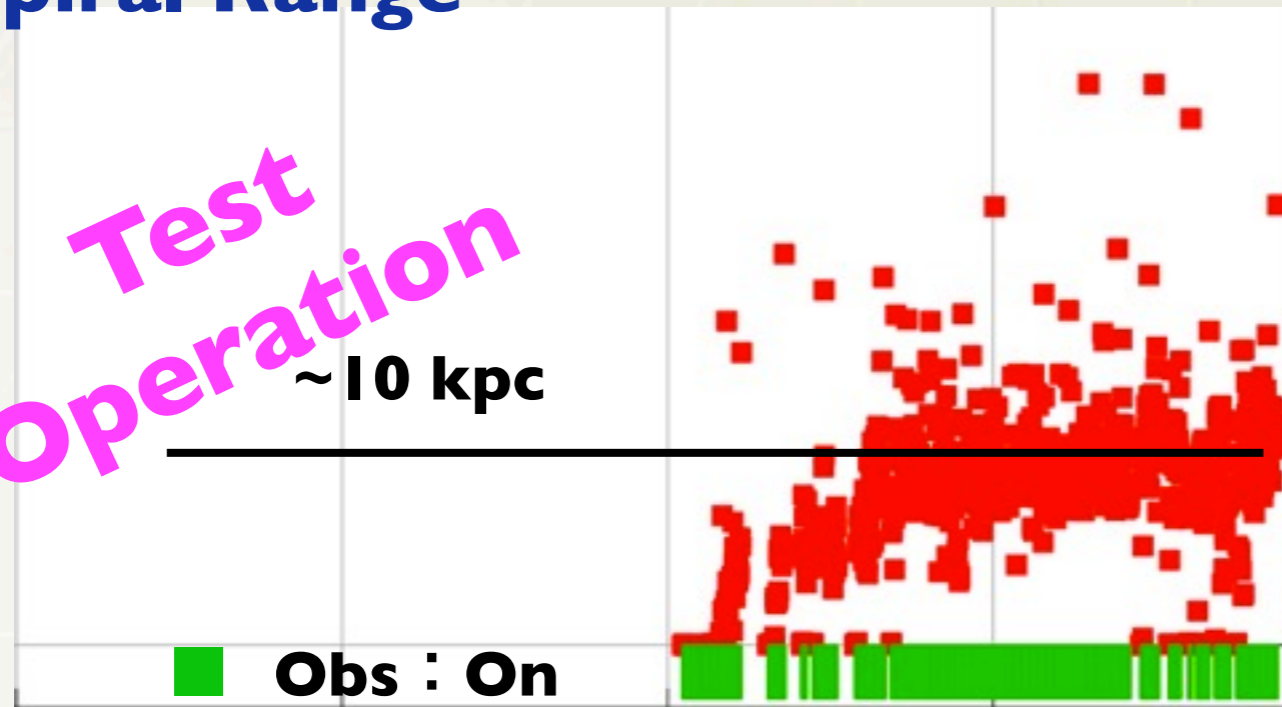
Processing on time-series data

Generation of filters of TF

→ various kinds of analysis

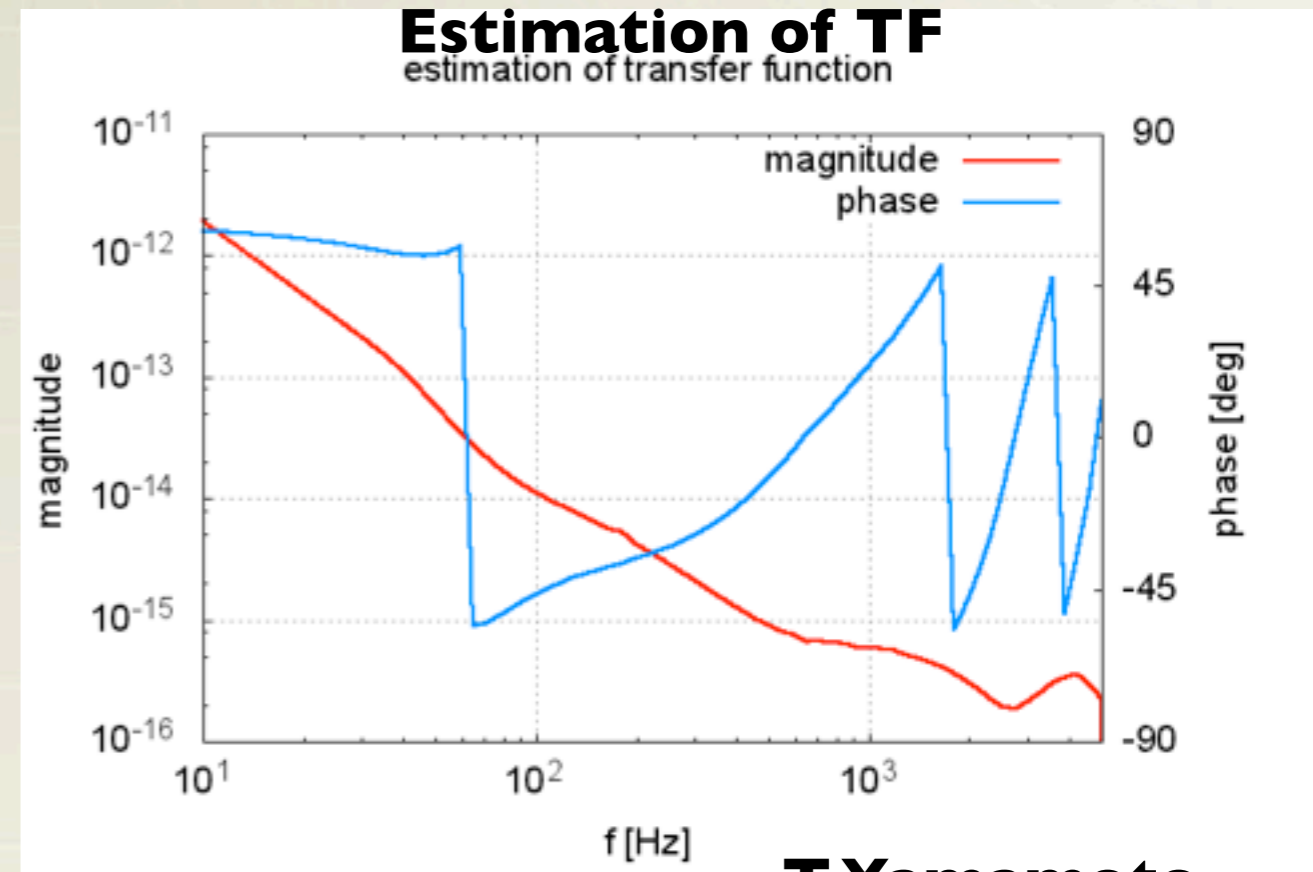
## Inspirational Range

**Test Operation**  
~10 kpc



000 30000 40000 50000  
GPS time - 1034600000 (2012-9-19)

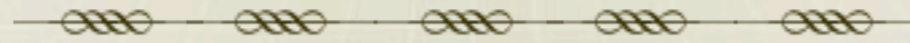
- Real time display of the inspiral range
- Total locked time ~13hrs



T.Yamamoto

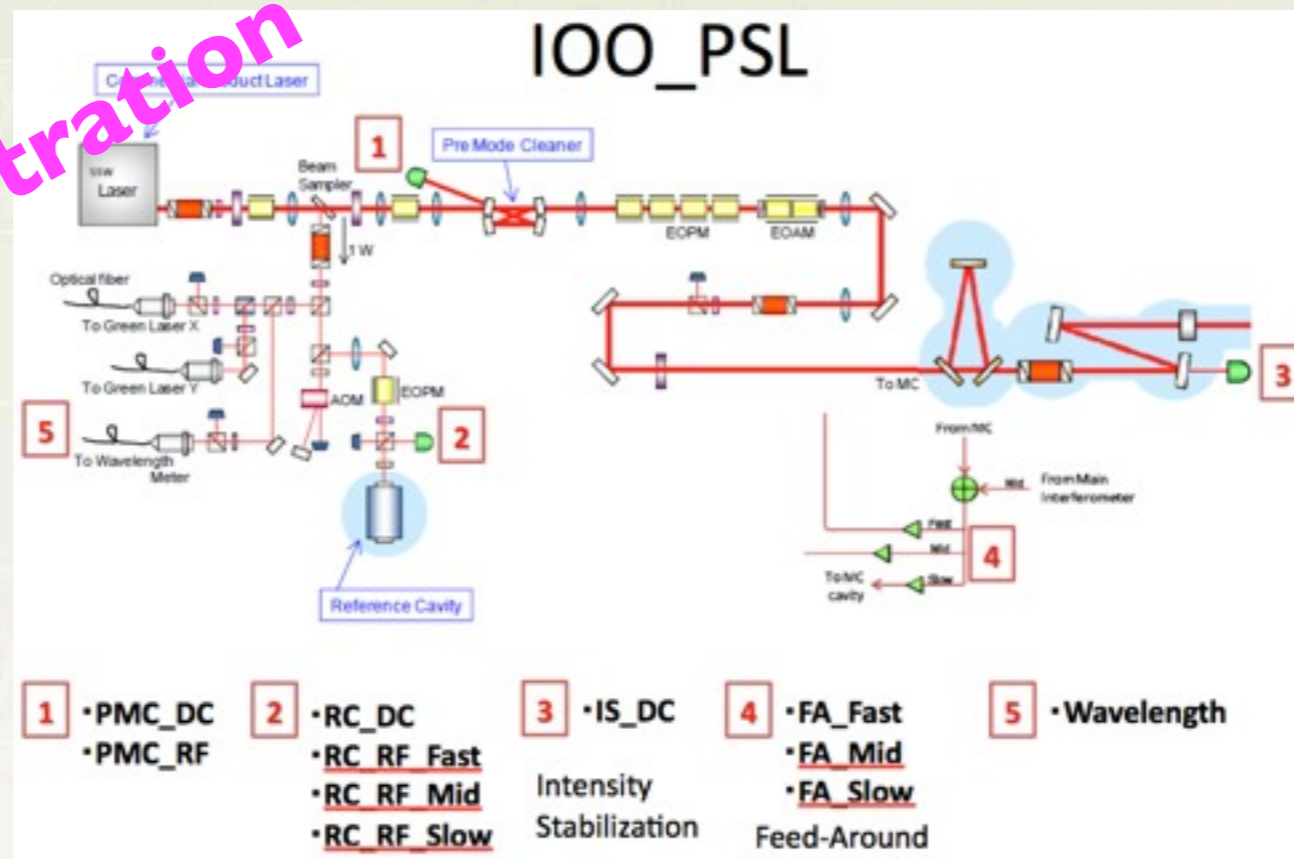
H.Yuzurihara

# Commissioning Stage



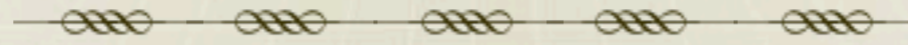
- **Subsystem diagnostics**
  - **ADC noise is within range ?, Whitening requirement**
  - **Channel-correlated noise ?**
  - **Find frequency of calibration line**
  - **Components consisting the subsystems is healthy?**
- **Kill sources of glitches, lines**
- **Speed-up commissioning**
- **Calibration Accuracy**

Just illustration

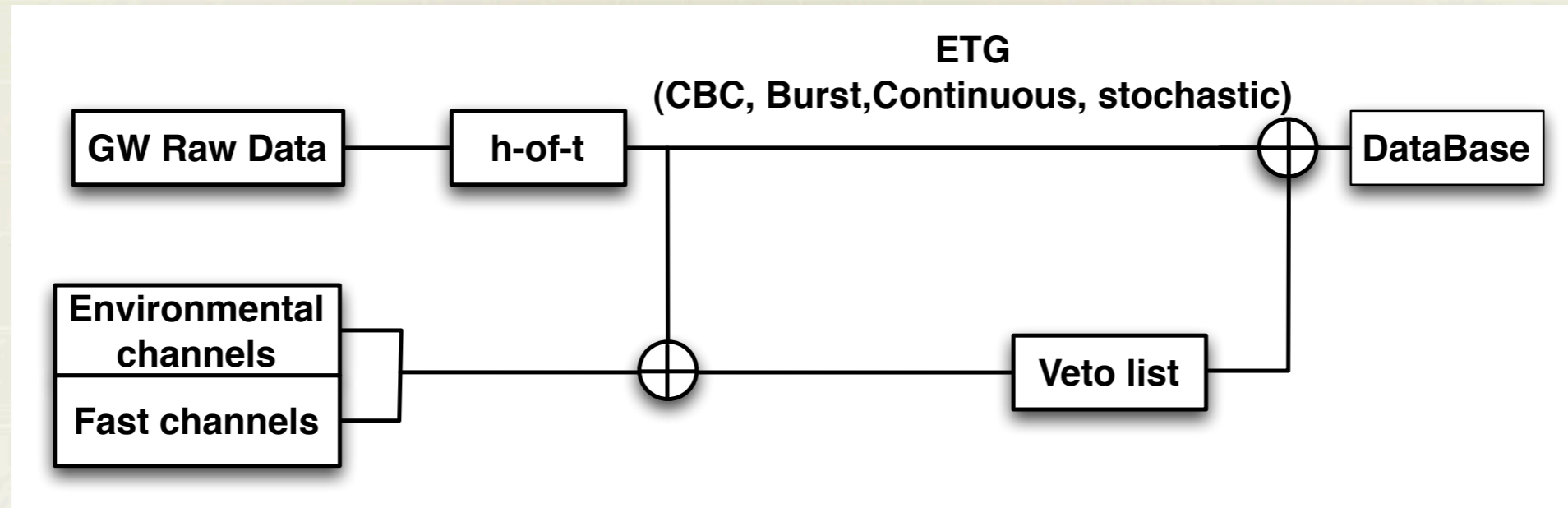


**K. Agatsuma**





- **Veto analysis (rejection of glitches)**
- **Improve false alarm rate**
- **Multimessenger observation**



## Veto list generation

### Transient GW (CBC, Burst)

- Real-time glitch detection
- Glitch classification
- Coincidence analysis between the GW channel and auxiliary sensor channels.
- ...

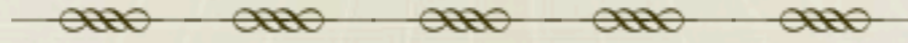
### Continuous GW (pulsar, LMXB, ...)

- Line tracking
- Line detection
- Removal of high frequency spikes
- ...

### Stochastic GW (Early Univ, ...)

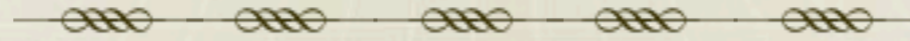
- Noise floor monitor
- Non-stationary
- ...





- **An interferometric GW telescope is changing its statistical behavior with short-time scale (~minute-hours).**
- **An interferometric GW telescope is very sensitive to instruments, environmental phenomena around.**
- **Artificial noise is mixed into gravitational wave channel of the telescopes as well, which is sometimes very difficult to distinguish between glitches and GW signals.**

**False alarm rate becomes high.**



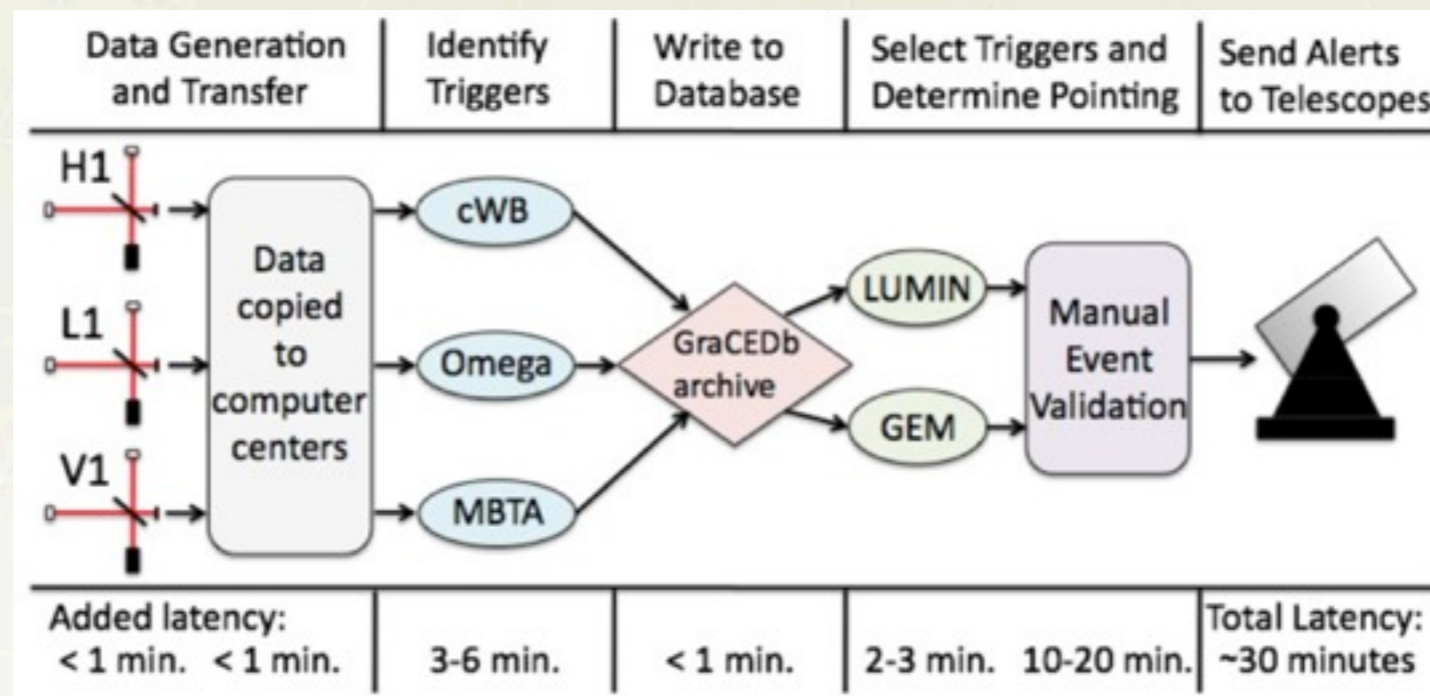
## Very important 2 issues to make MMO success from GW side.

- **Real-time distribution of data-quality information to collaboration.**

- **Low latency data analysis**

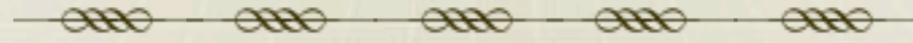
- **Rate of GW event alert should be low (not 1 event/one day)**

- **Low false alarm rate**

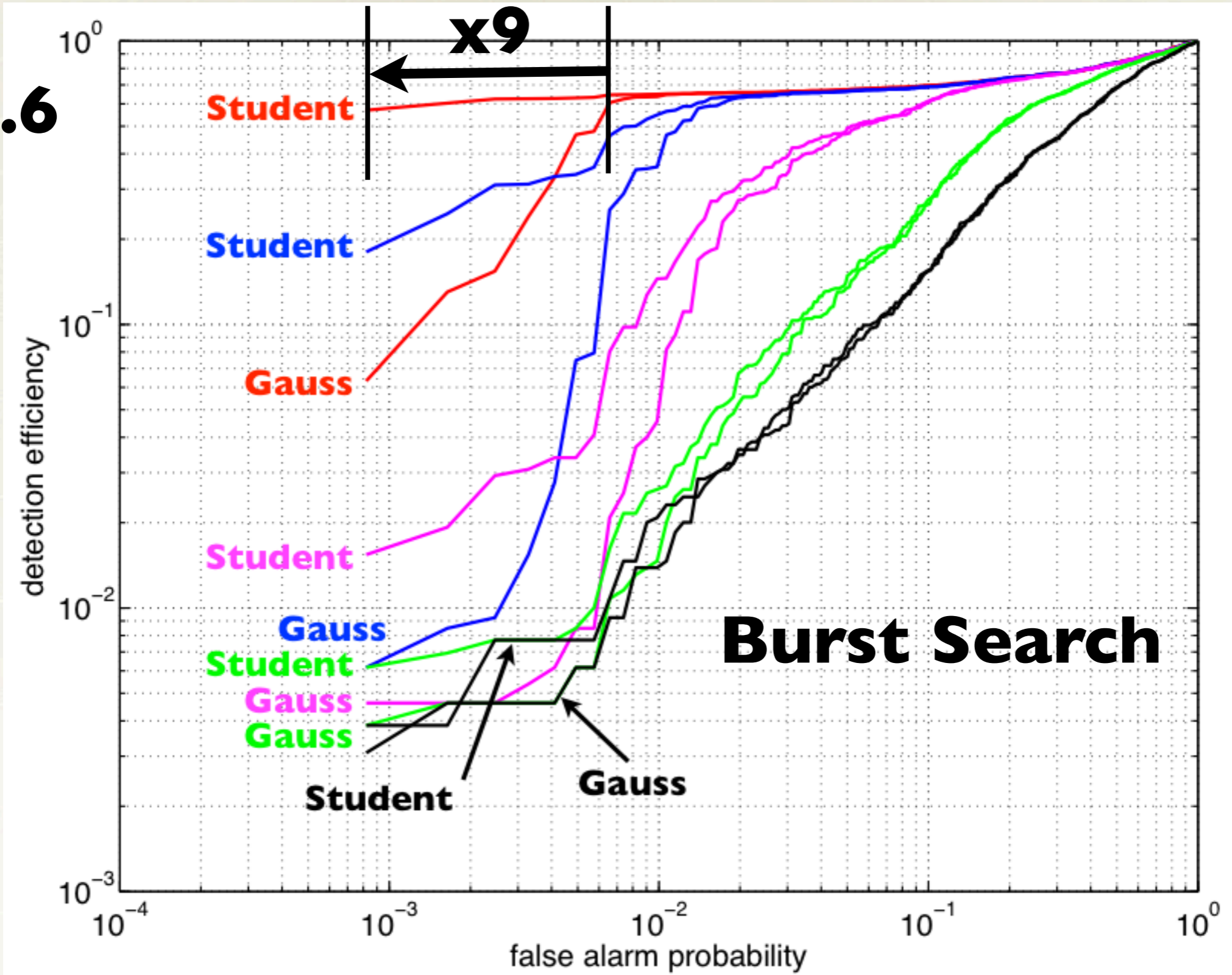




# Reducing FAR : New technique

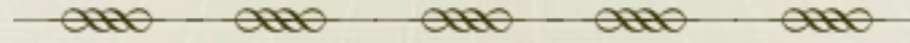


0.6

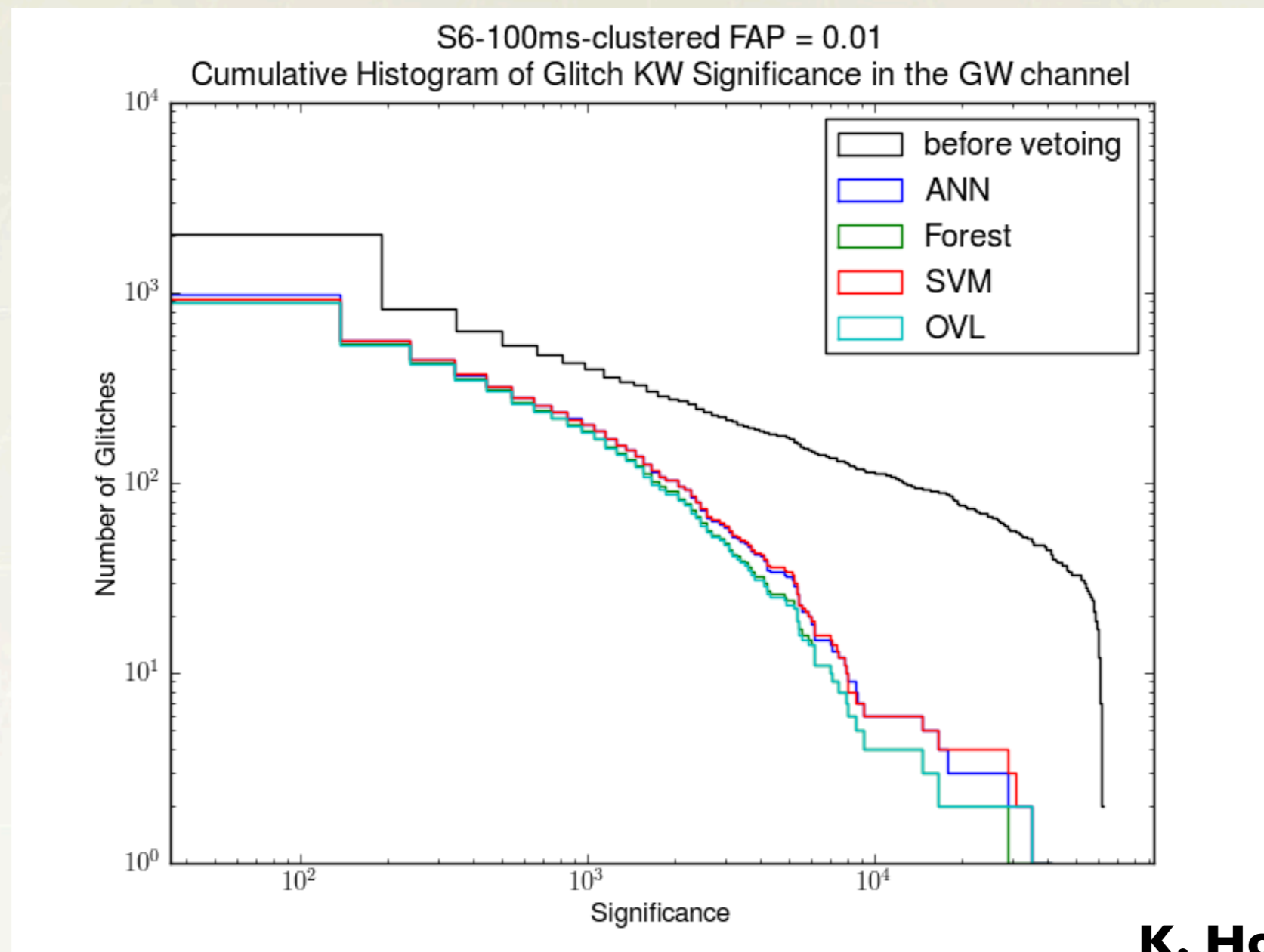


**Burst Search**

**Hayama, Roever**



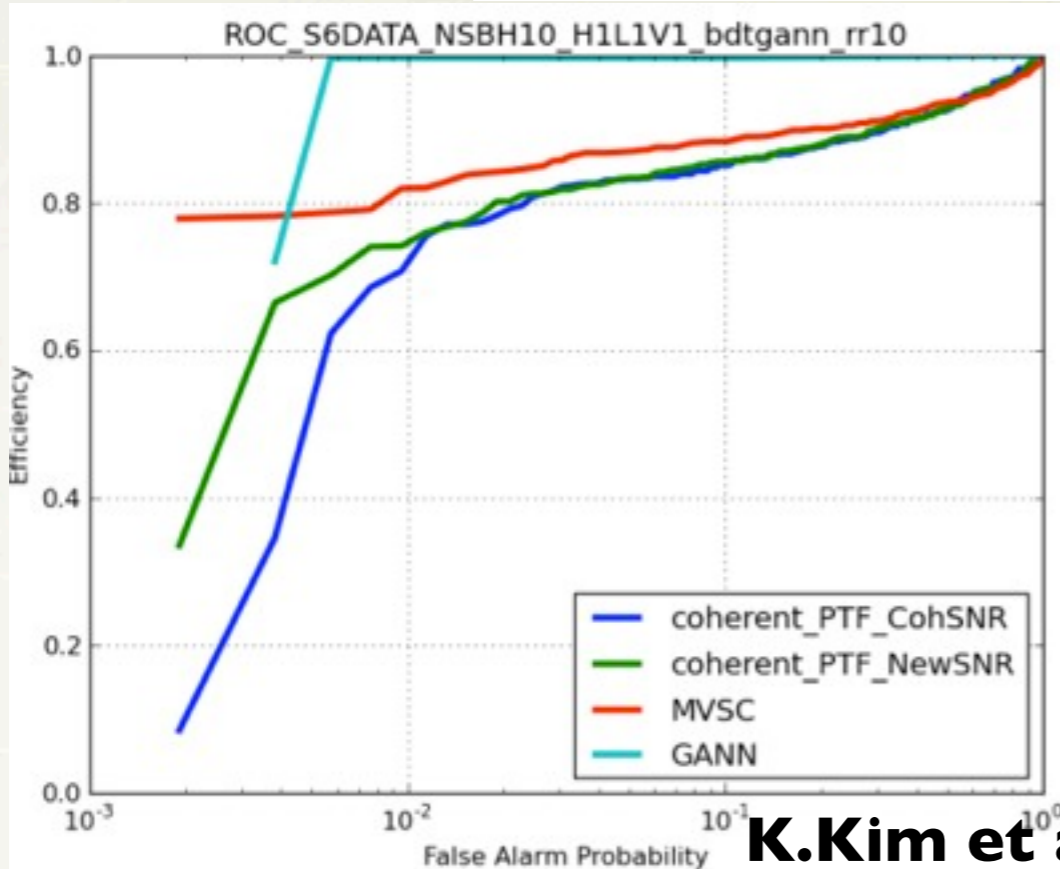
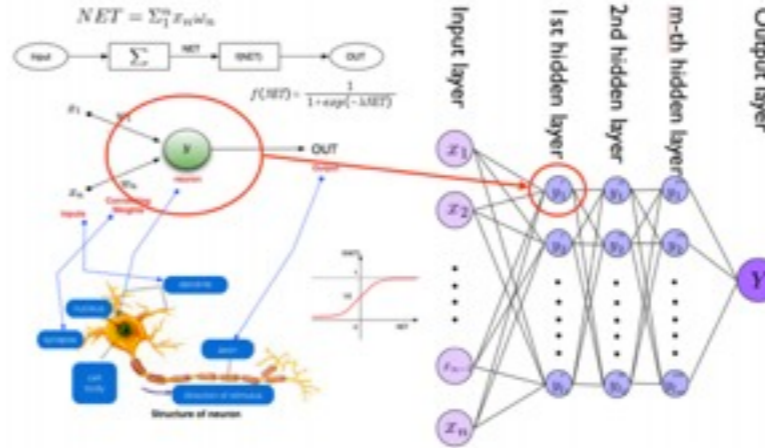
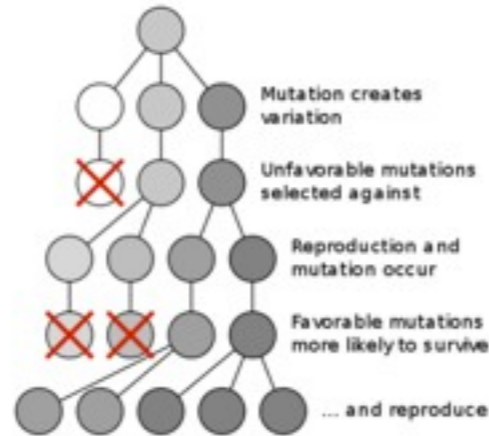
- **Several methods are being developed.**
  - **Analysis of auxiliary channels using multi-variate analysis**
    - **Supervised classifier : ANN, RF, SVN,...**



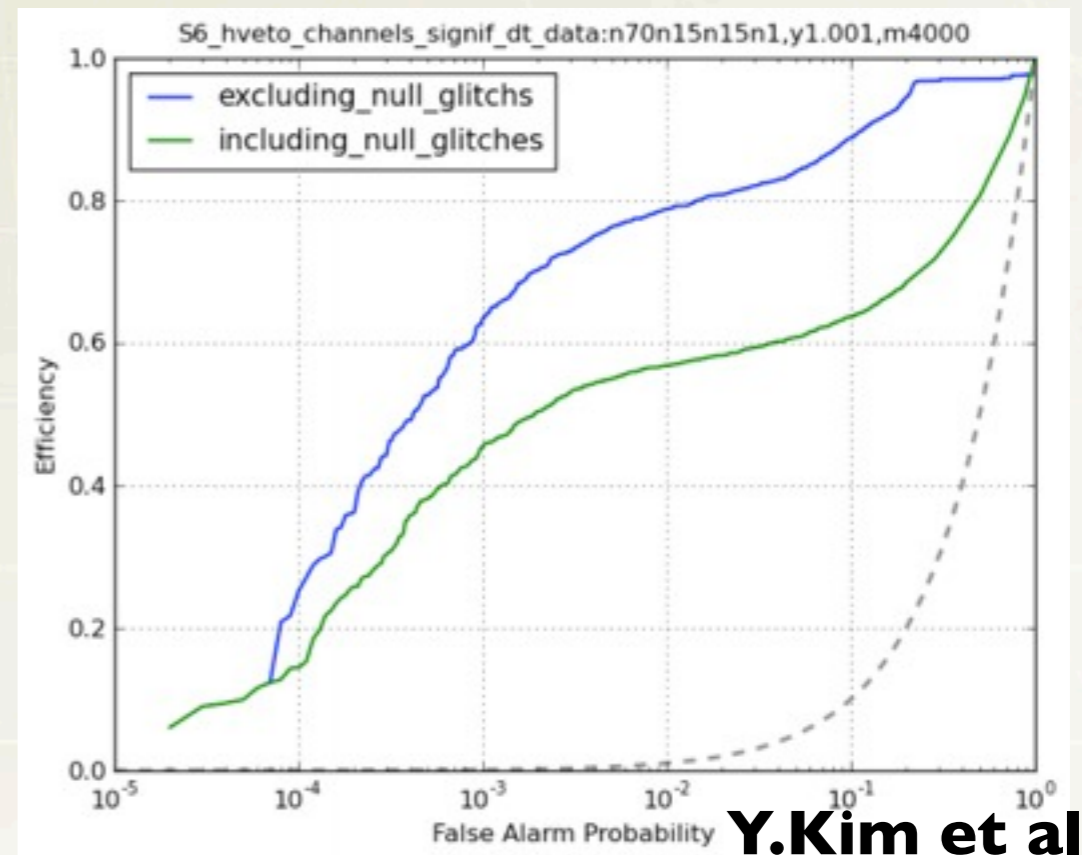
**K. Hodge et al**



**Artificial Neural Network based.  
Genetic Algorithm included. (E. Son's talk tomorrow)**

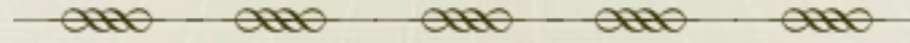


**K.Kim et al.**



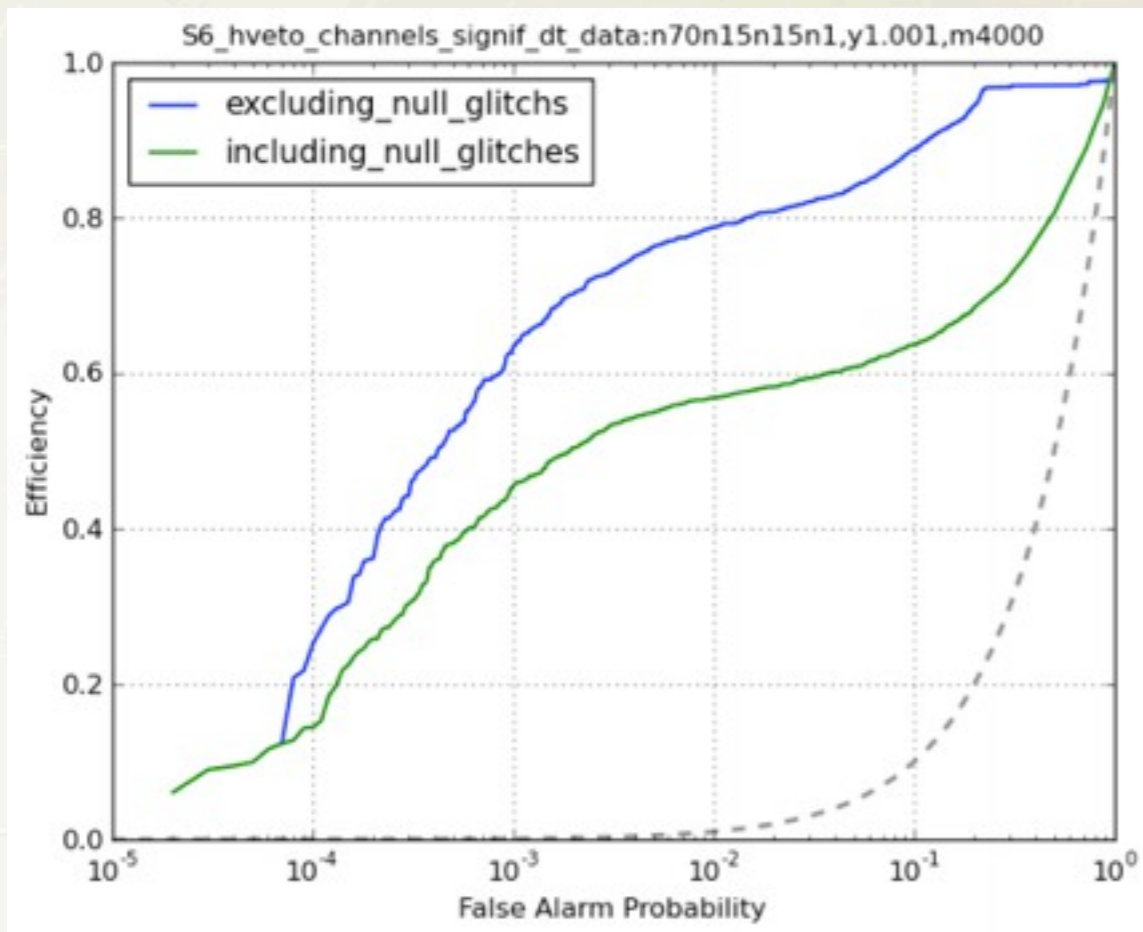
**Y.Kim et al.**

**SangHoon will introduce them.  
See K. Kim and Y.Kim's talks tomorrow**

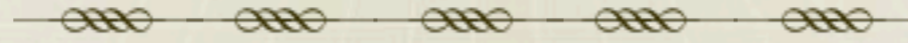


## ● Discussion on multi-channel analysis using ANN

See SangHoon's slides







## ● 7 Aug., 2012, KGWG F2F meeting on mainly data analysis at SNU.

### Program (tentative)

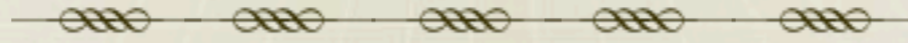
Time	Title	Speaker
13:30-14:00	Paper Review 1 <i>The NINJA-2 catalog of hybrid post-Newtonian/numerical-relativity waveforms for non-precessing black-hole binaries</i> <sup>†</sup>	Gungwon Kang
14:00-14:30	Invited talk <b>Current Status of KAGRA Data Analysis</b>	Kazuhiro Hayama
14:30-15:00	Coffee Break	
15:00-15:30	Report I: Santa Barbara meeting "Shine & Rattle" report	Hyung Mok Lee
15:30-16:00	Report II: GA-ANN development progress report <a href="#">Report</a> <a href="#">Old Report</a>	John J. Oh
16:00-17:00	Discussion	

- † Published in Class.Quant.Grav. 29 (2012) 124001, DOI: 10.1088/0264-9381/29/12/124001, Conference: C11-07-10.1, e-Print: arXiv:1201.5319, <https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=85265>

### Participants

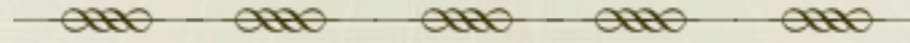
Hyung Mok Lee, Gungwon Kang, Hyunkyu Lee, John J. Oh, Sang Hoon Oh, Edwin J. Son, Sooil Lim, Young-Min Kim, Kyungmin Kim, Yong Bum Kim, Kazuhiro Hayama





- **Supervised (Korea, currently on-going in LVC)**
- **Unsupervised (New project)**





- **Affinity propagation based**
- **Too many classes for now**

