

## Geophysics Interferometer

Two fixed-mirror interferometers (1.5km) along LCGT

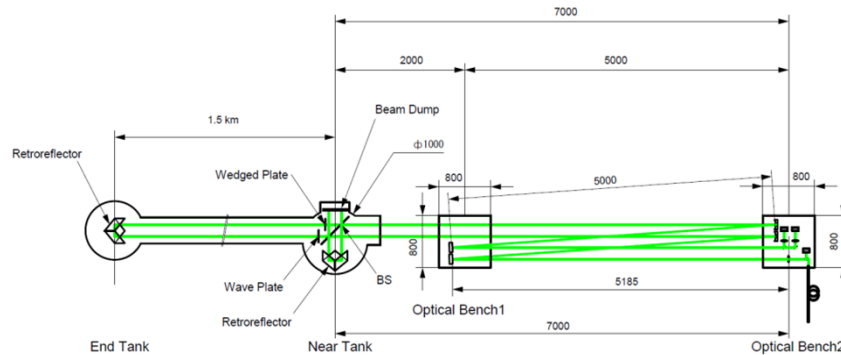
### Purpose

1. Baseline monitor for LCGT (Tides, microseisms, and earthquakes)
2. Regional crustal deformation monitor around Atotsu fault

... Evaluation of seismicity

3. Monitoring global deformation, such as Earth's free oscillations

... Determination of deep interior structure of Earth



Geophysics Interferometer along LCGT

## Optical layout:

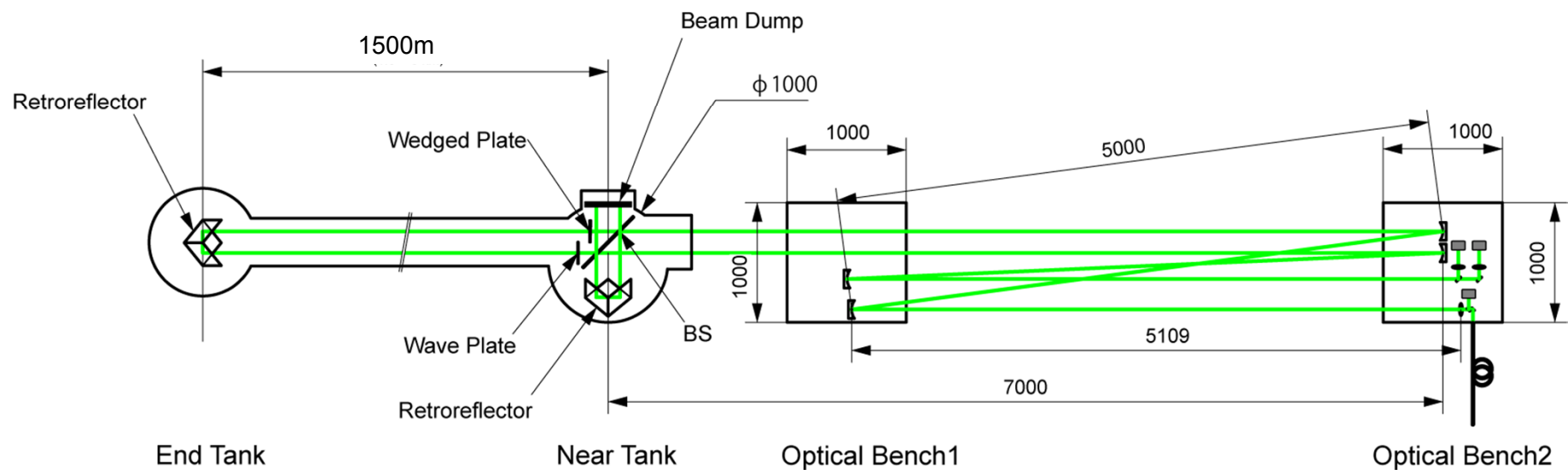
Baseline 1500m

Asymmetric Michelson interferometer with two retroreflectors

A 5-m input baseline

Iodine-stabilized 532nm laser

Essentially base on the current 100-m system.



## Layout of vacuum system and benchmarks

Strain sensitivity  $\sim 10^{-13}$

## Baseline 1.5km

Chamber diameter 1.0m

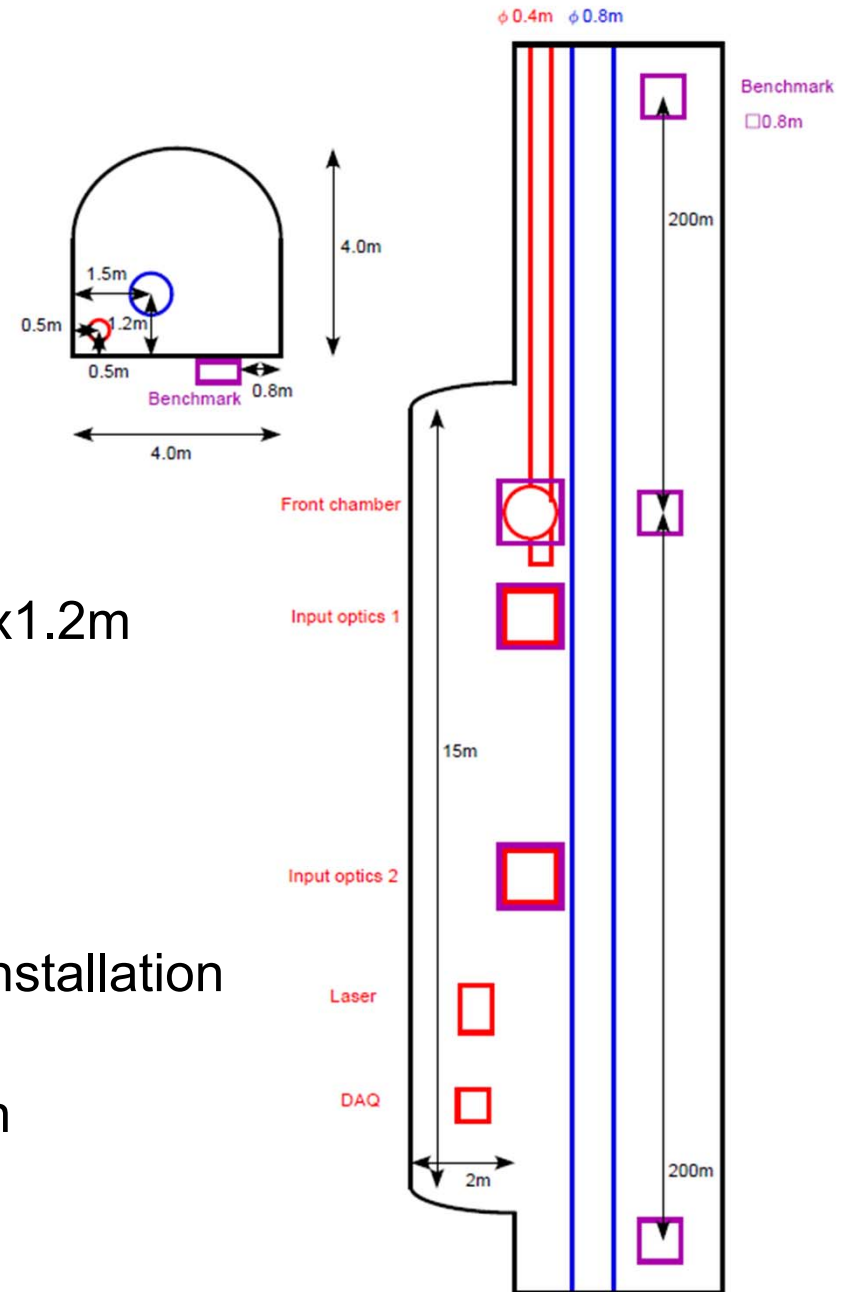
Chamber height 1.0m

installed on a granite base 1.2mx1.2m

Vacuum pressure  $\sim 10^{-4}\text{Pa}$

Granite benchmarks 0.6m x 0.6m,  
200-m separation used for

1. reference of vacuum system installation
2. monitoring tunnel deformation
3. research on standard of length

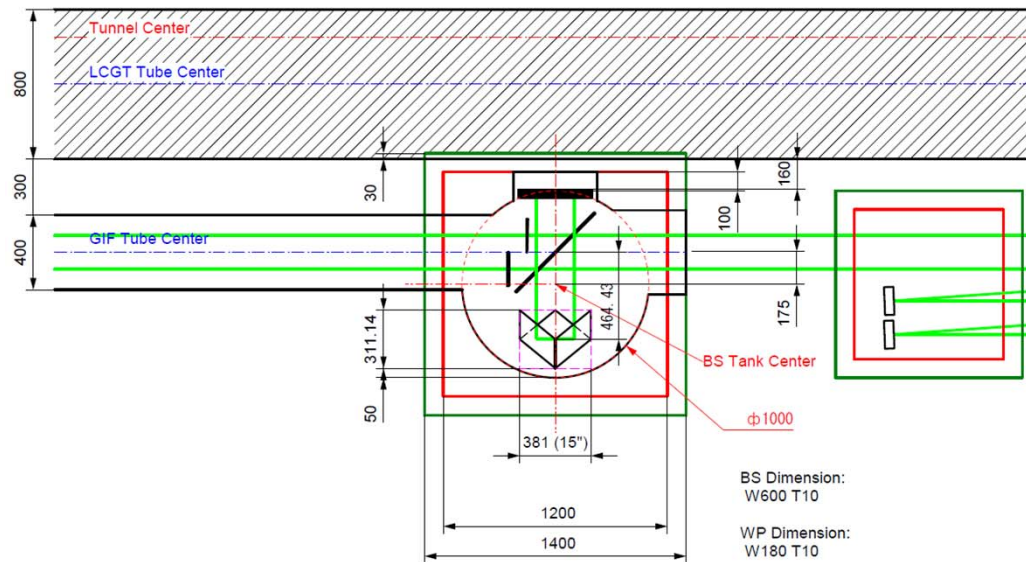


# Layout in the case of shrunk tunnel

## Compatible with the $\phi 3500$ tunnel

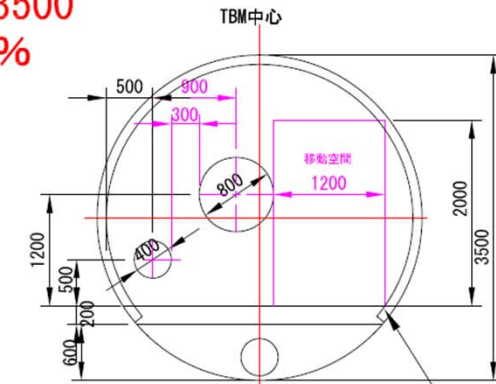
GIF BS Tank Layout

Jun. 11, 2011: Drawn by A. Takamori



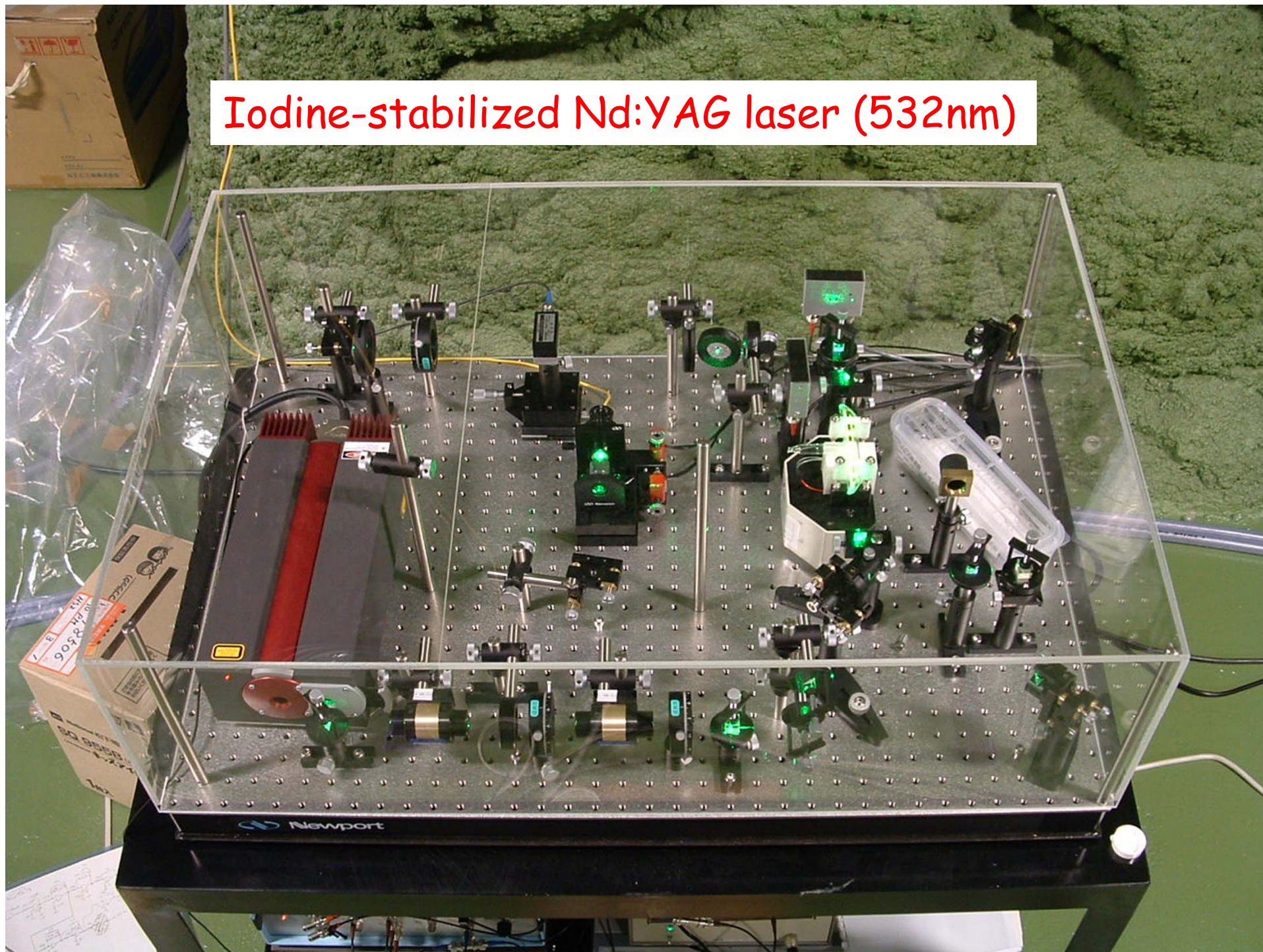
$\phi 3500$  支保工設置区間 (支保区分C II, D)

$\phi 4500 \Rightarrow 3500$   
面積60%





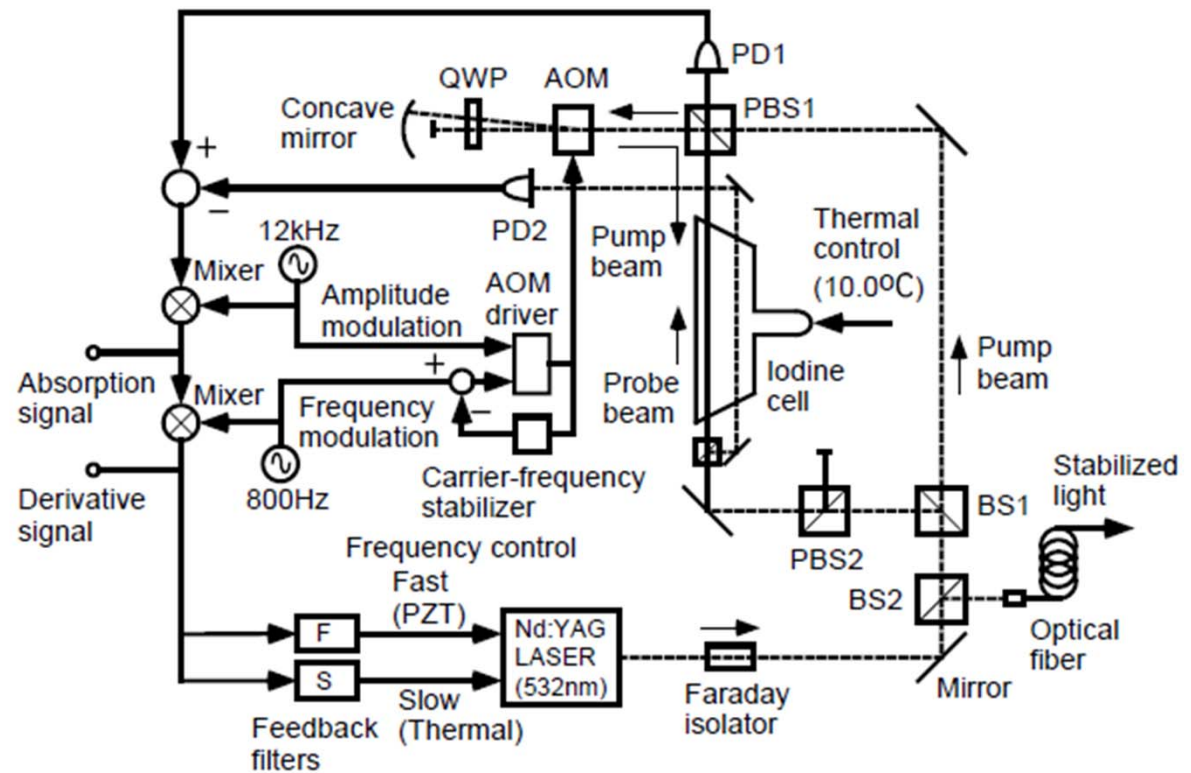
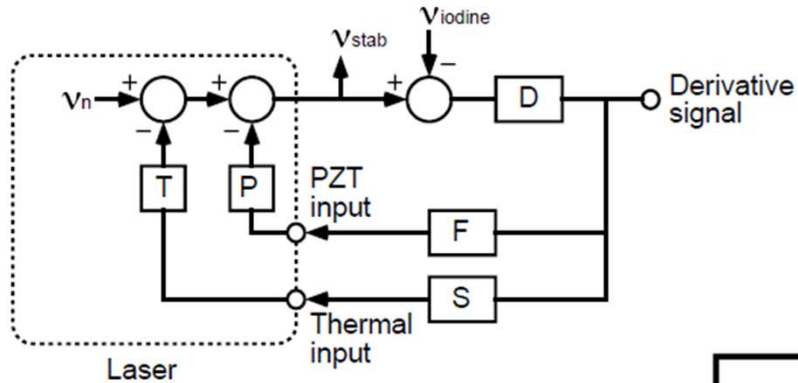
# Iodine-stabilized Nd:YAG laser (532nm)





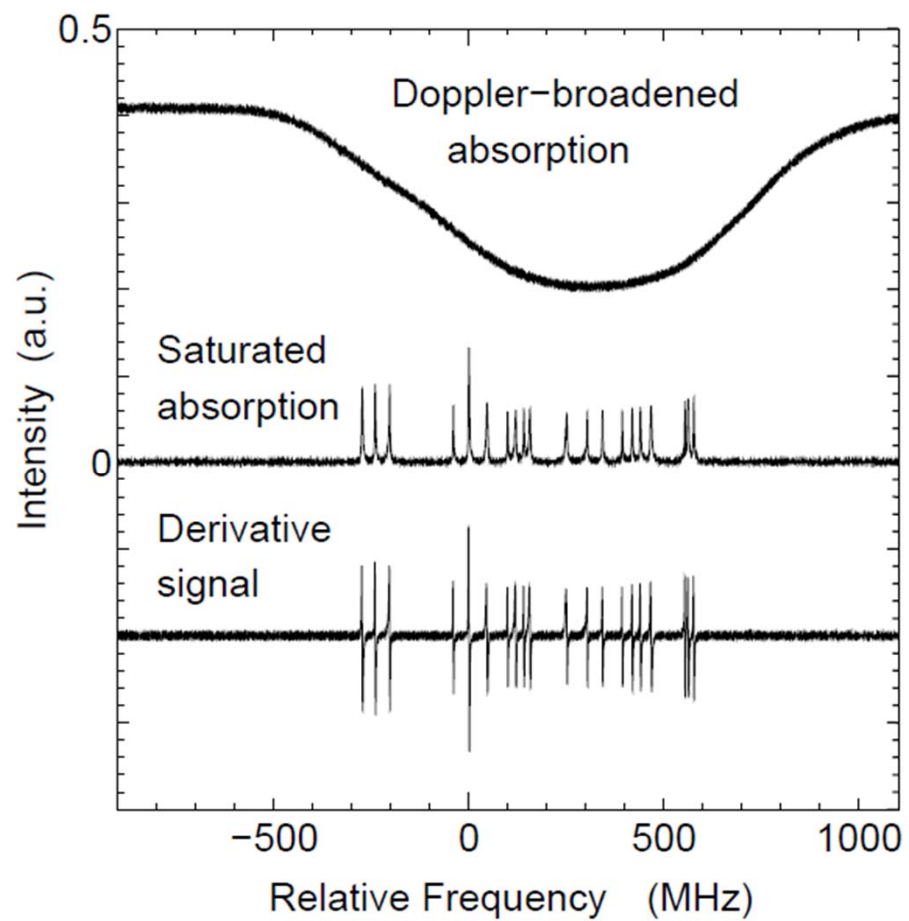
## Iodine-stabilized system

Locked to hyperfine absorption  $dv/v \sim 10^{-13}$



## Iodine-stabilized system

Frequency stability  $dv/v \sim 10^{-13}$



Mostly based on the current system, but several improvements are included:

Fiber-coupled connection

-> easy replacement in case of trouble

Remote control of optics alignment / drift

-> long-term unmanned operation

Housed in a double / triple clean environment

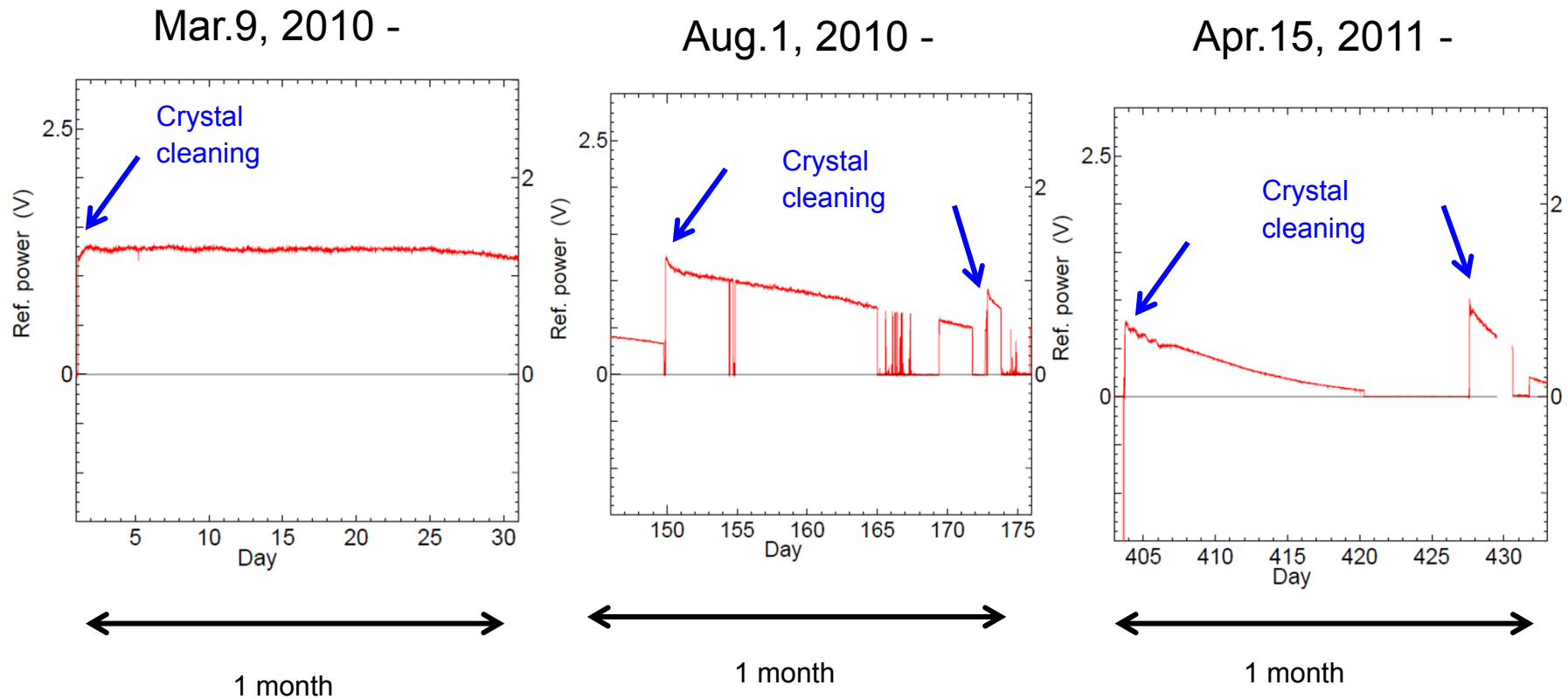
-> reduce risks of dust / mold contamination



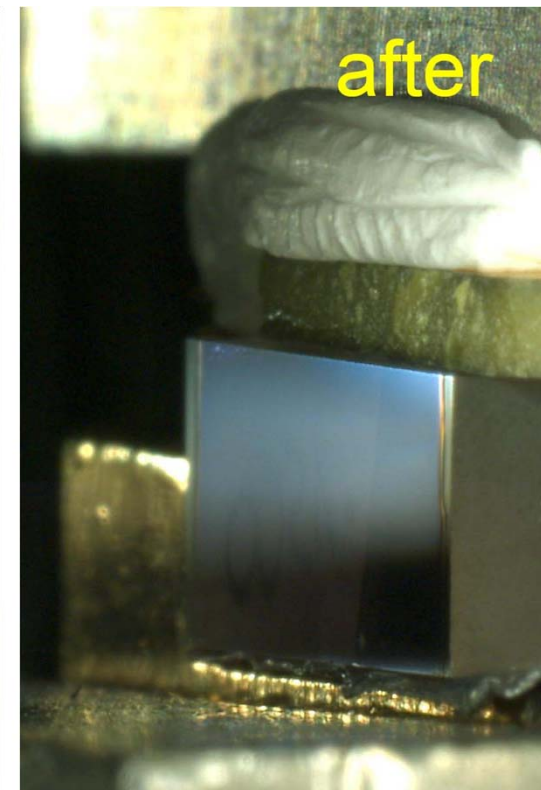
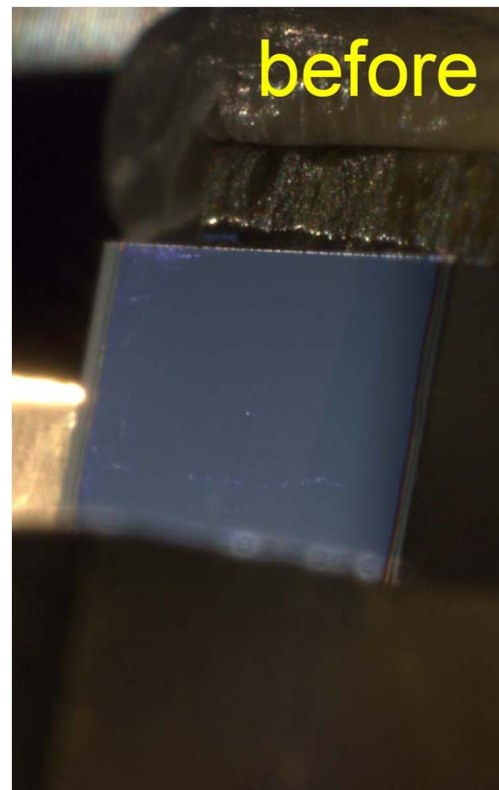
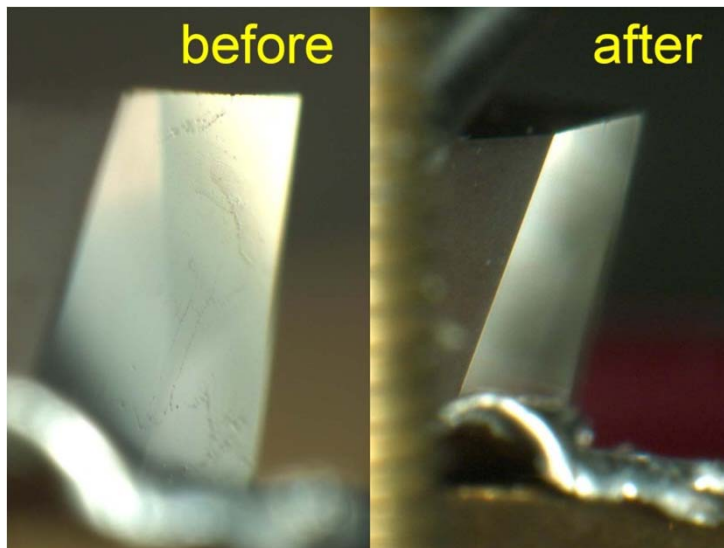
## Recent reduction of laser power:

No problems during 2003-2009

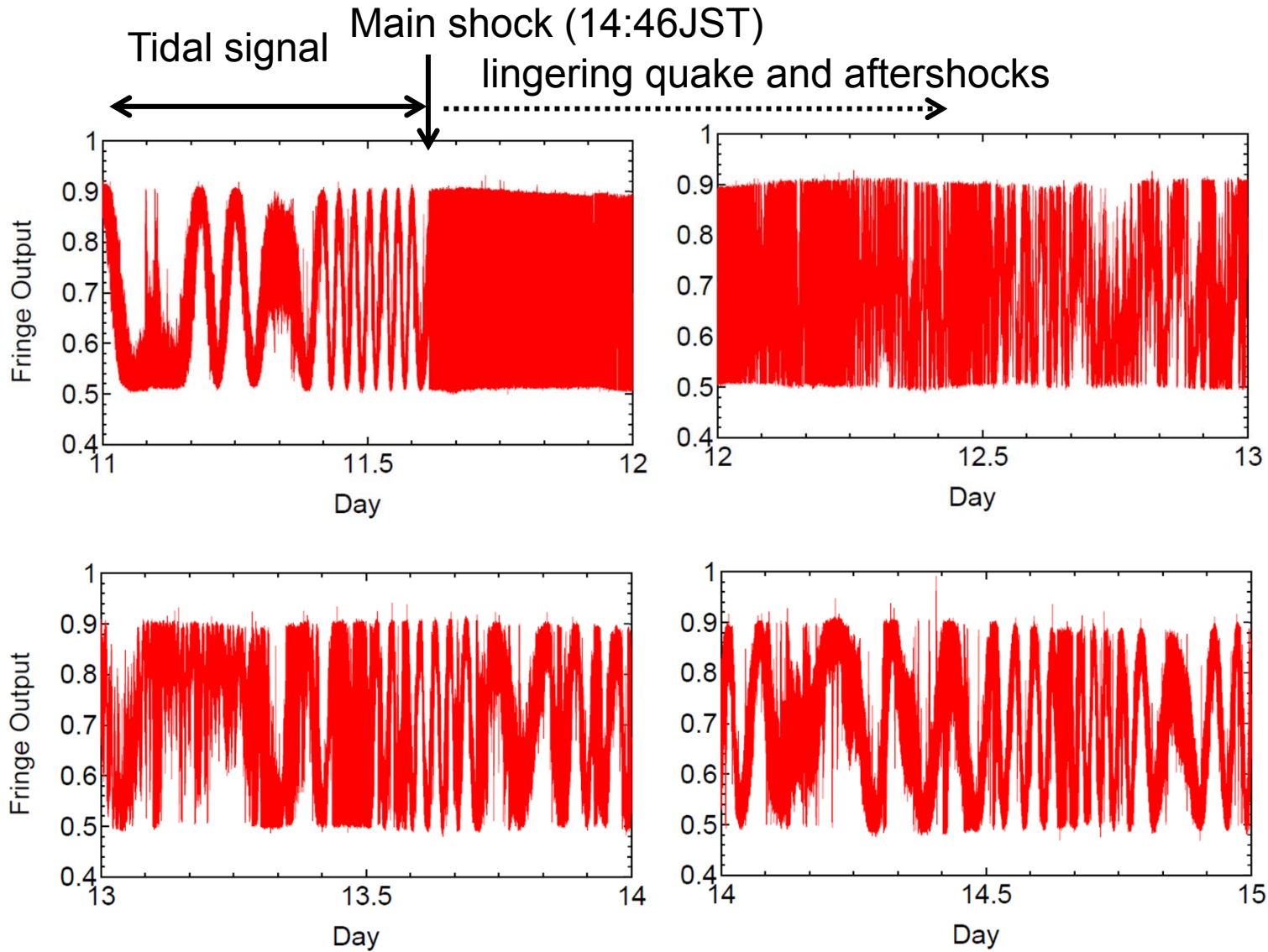
Power reduction begins from last year, after cleaning laser crystal on site.



Before and after cleaning  
... mold ?



# Fringe output of the Kamioka laser strainmeter on Mar.11, 2011



So rapid fringe change ... now trying to retrieve strain from the fringe signal.

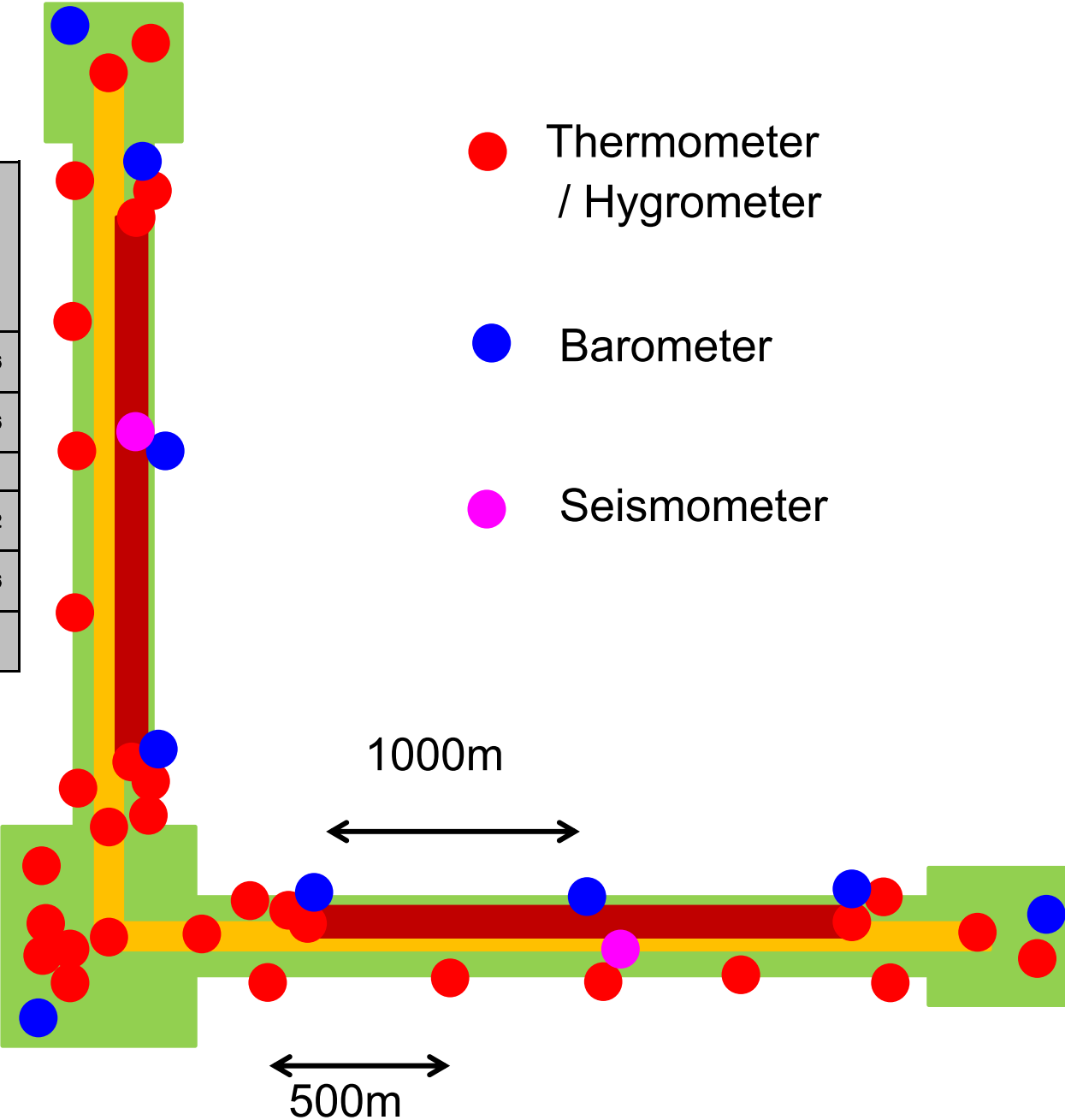
For 1500-m Gl... requiring high sampling rate DAQs (200Hz -> 2kHz~10kHz)





Just an example

	G W la se r	G W cha mb er	G eo la se r	G eo ch a m be r	C en te r ro om	E nd ro om s	G eo ar ea s	T un ne ls	T ot al
Ther mo.	3	8	2	4	3	2	4	10	36
Hygr o.	3	8	2	4	3	2	4	10	36
Baro.	0	0	0	0	1	2	4	2	9
Acc el.	2	8	2	4	2	2	0	2	22
Parti cle	1	8	2	0	1	2	0	2	16
Seis mo.	0	0	0	0	0	0	0	2	2



High end

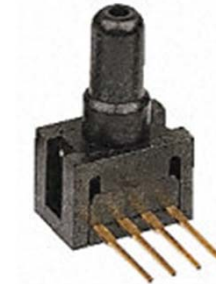
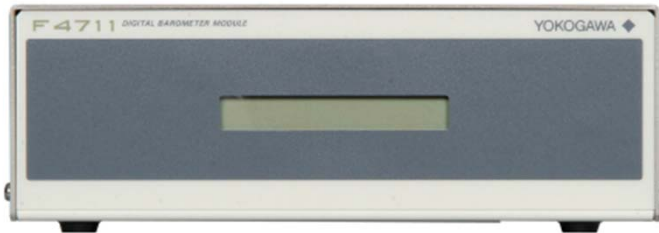
Low end



Thermometer



Barometer



Accelerometer



## Summary (Geophysics interferometer)

1. Two baseline-monitor interferometers (1.5km) along LCGT

Based on the current system, but several improvement will be applied for long-term stable operation.

2. Sensors for environment monitor will be proposed.

Flexible options available depending on purposes of the sensors

