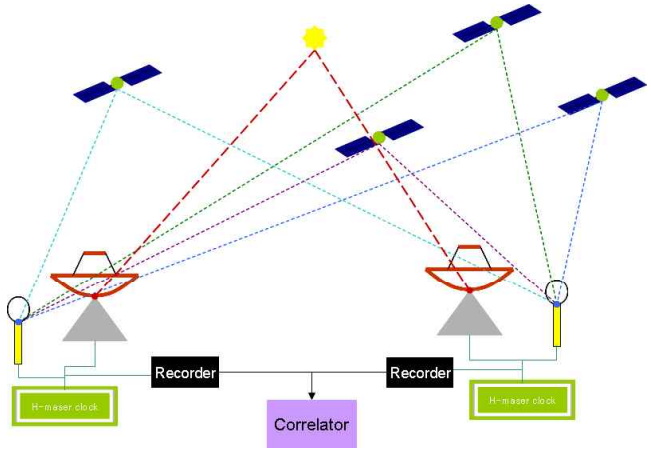
THE FIRST EXPERIMENT WITH VLBI-GPS HYBRID SYSTEM



Kwak, Y.[1,2], Kondo, T[1,3], Gotoh, T.[3], Amagai, J.[3], Takiguchi, H.[3], Sekido, M.[3], Ichikawa, R.[3], Sasao, T.[4],Cho, J.[2], Kim, T. [1]

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[2] Korea Astronomy and Space Science Institute, Rep. of Korea
[3] National Institute of Information and Communications Technology, Japan
[4] Yaeyama Star Club, Japan

Motivation

- In VLBI geodesy

  Water vapor + clock = Arch-enemy

  How to defeat?

  - Observing as many sources as possible within a session
    - Many VLBI antennas(Radio Telescopes) at the same site
    - Combined system with other space geodetic tech.

Motivation

- A problem in Combination
  - Systematic errors b.t.w. different systems

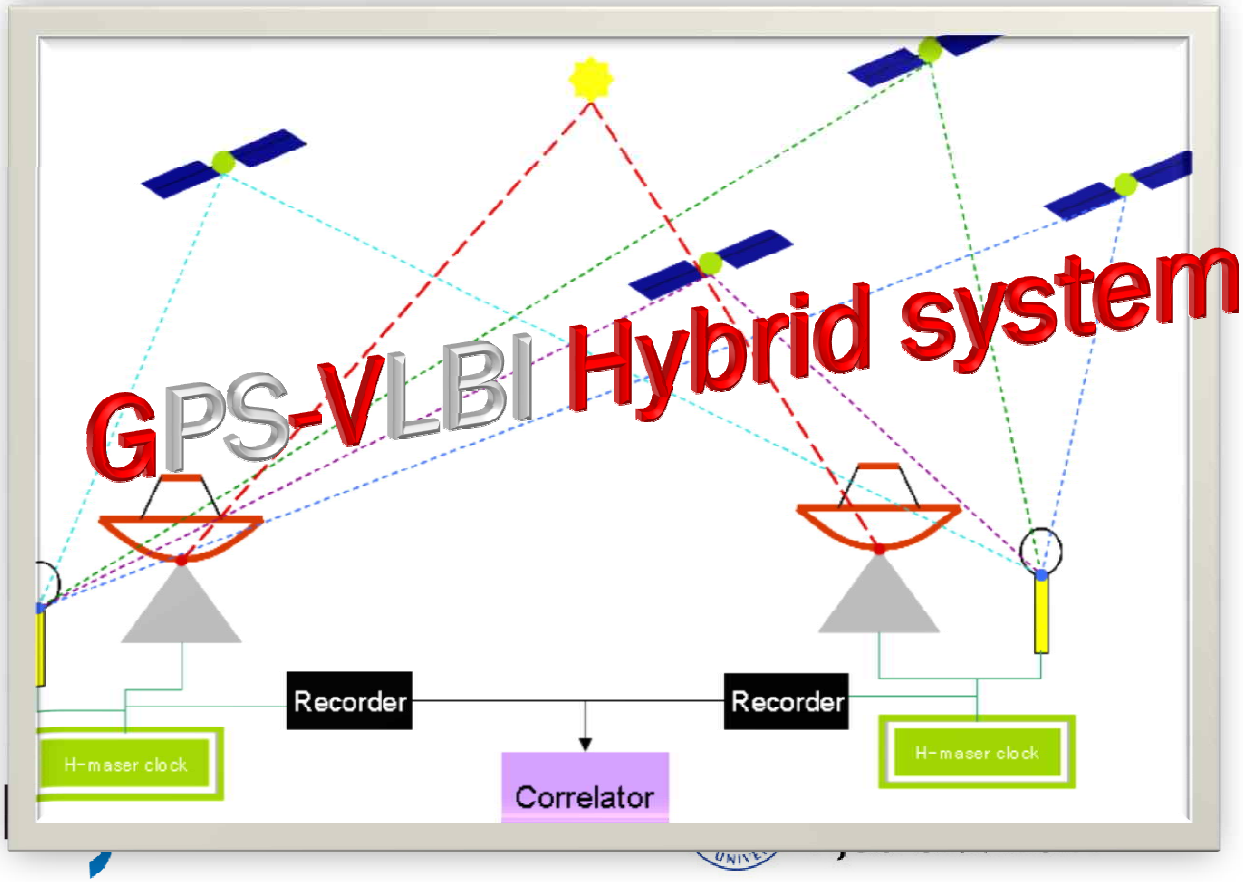
- **Solution**

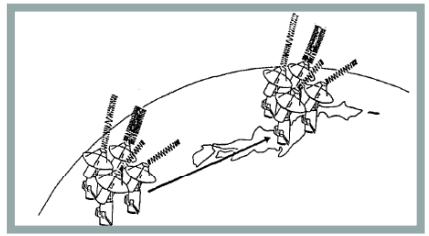
Sources should be observed, and every data should be analyzed in as common method as possible.

Concept

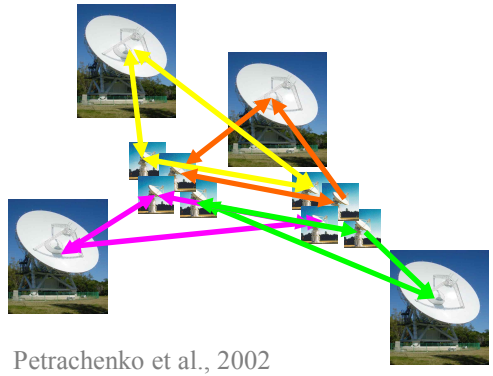
VLBI and GPS combination in observation level

A kind of multi-beam VLBI, observing quasars and GPS satellites at the same site, at the same period of time, and with identical H-maser clock.





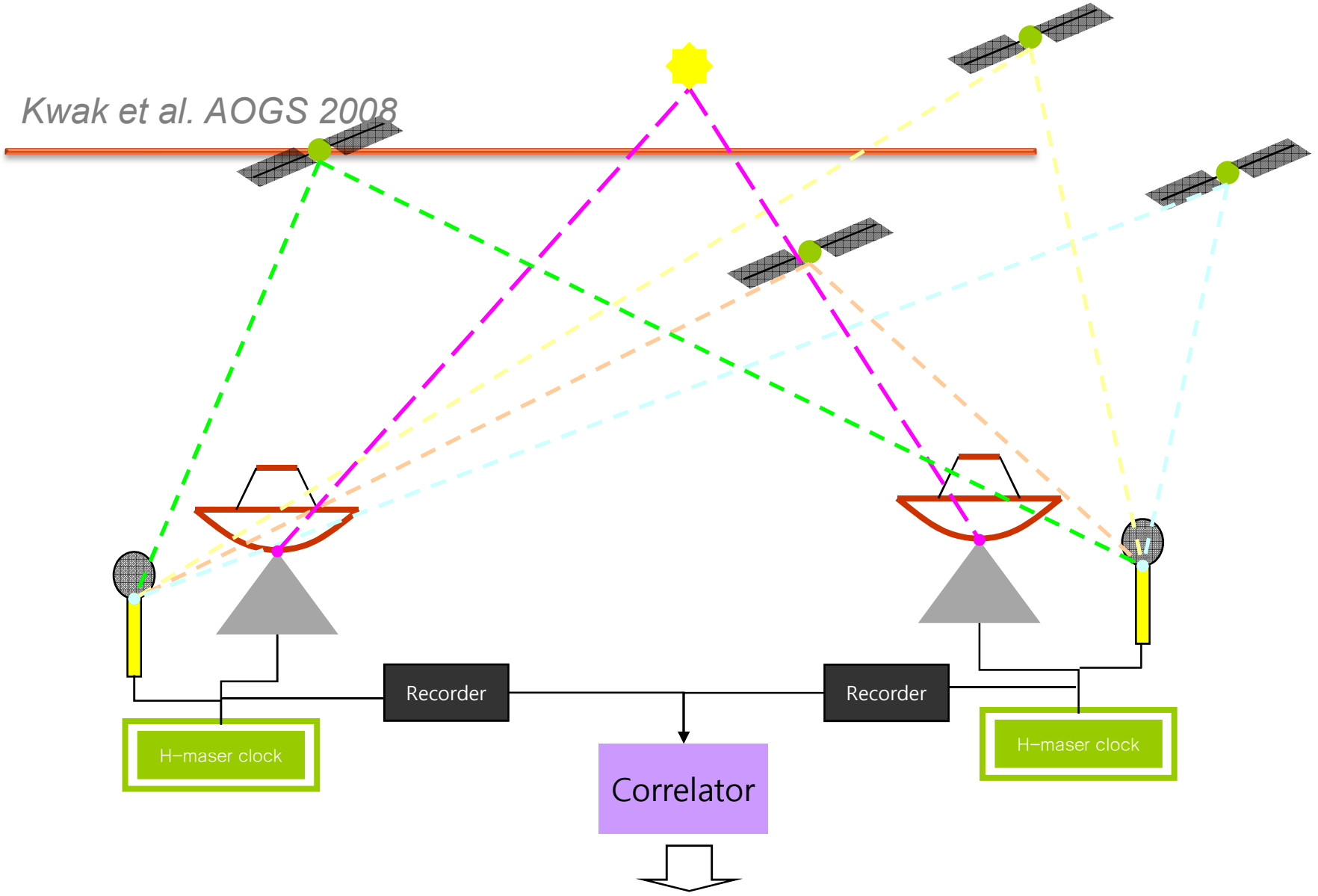
Sasao and Morimoto, 1991



Petrachenko et al., 2002

VLBI2010
Observing Strategies

Kwak et al. AOGS 2008



Group delay (Quasars)
Group delay (GPS satellites)

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GPS-VLBI HYBRID SYSTEM

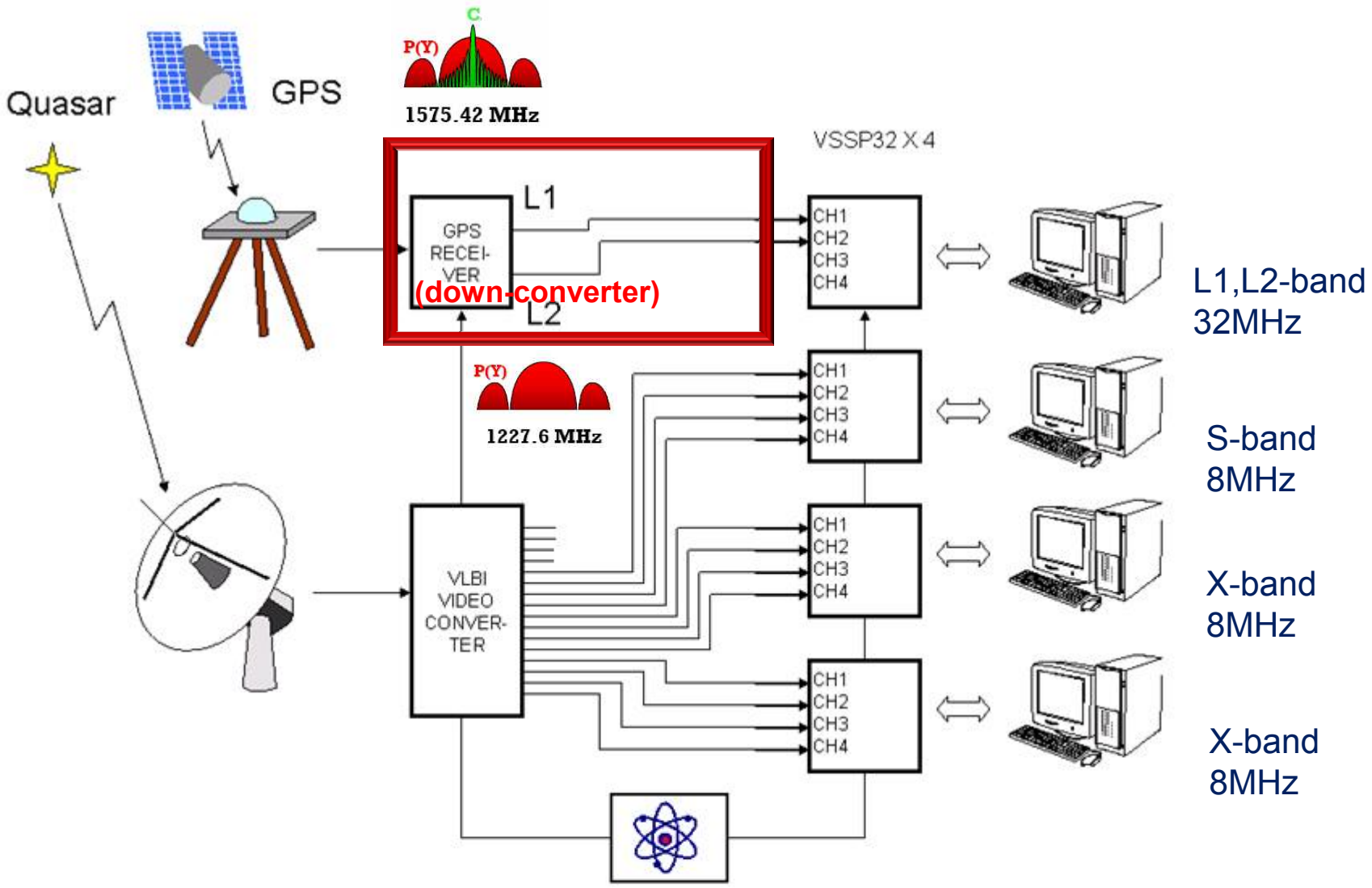
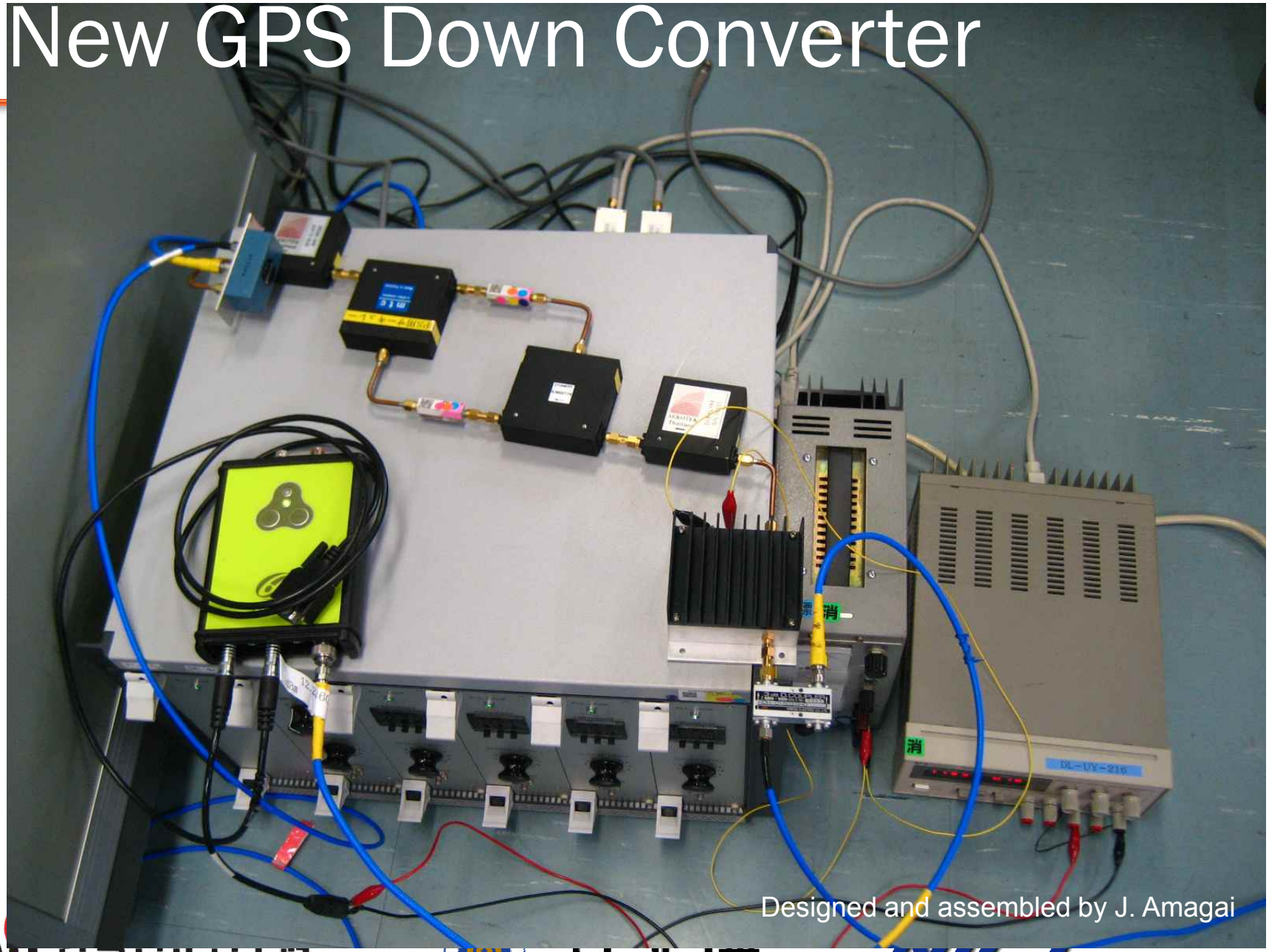


Figure 1. Schematic Block Diagram of Data Acquisition System

Revised from T. Kondo's diagram

L1, L2 signal figures brought from Hernandez-Pajares et al. 2004-2005

New GPS Down Converter



Designed and assembled by J. Amagai

Estimation of Raw Data Volume for 24 Hrs.

	VLBI	GPS
Bandwidth / ch.	8MHz	32MHz
Number of channels	12ch (Hybrid case)	2ch
Bit number	1bit/sample	1bit/sample
Observation duration	~ 30,000sec	86,400sec
Recording rate	384Mbits/sec	256Mbits/sec
Data volume / 24 hrs obs.	1.4TB	2.8TB
Necessary HDD volume / pc	**480GB**	**2.8TB**

GPS-VLBI Hybrid Observation

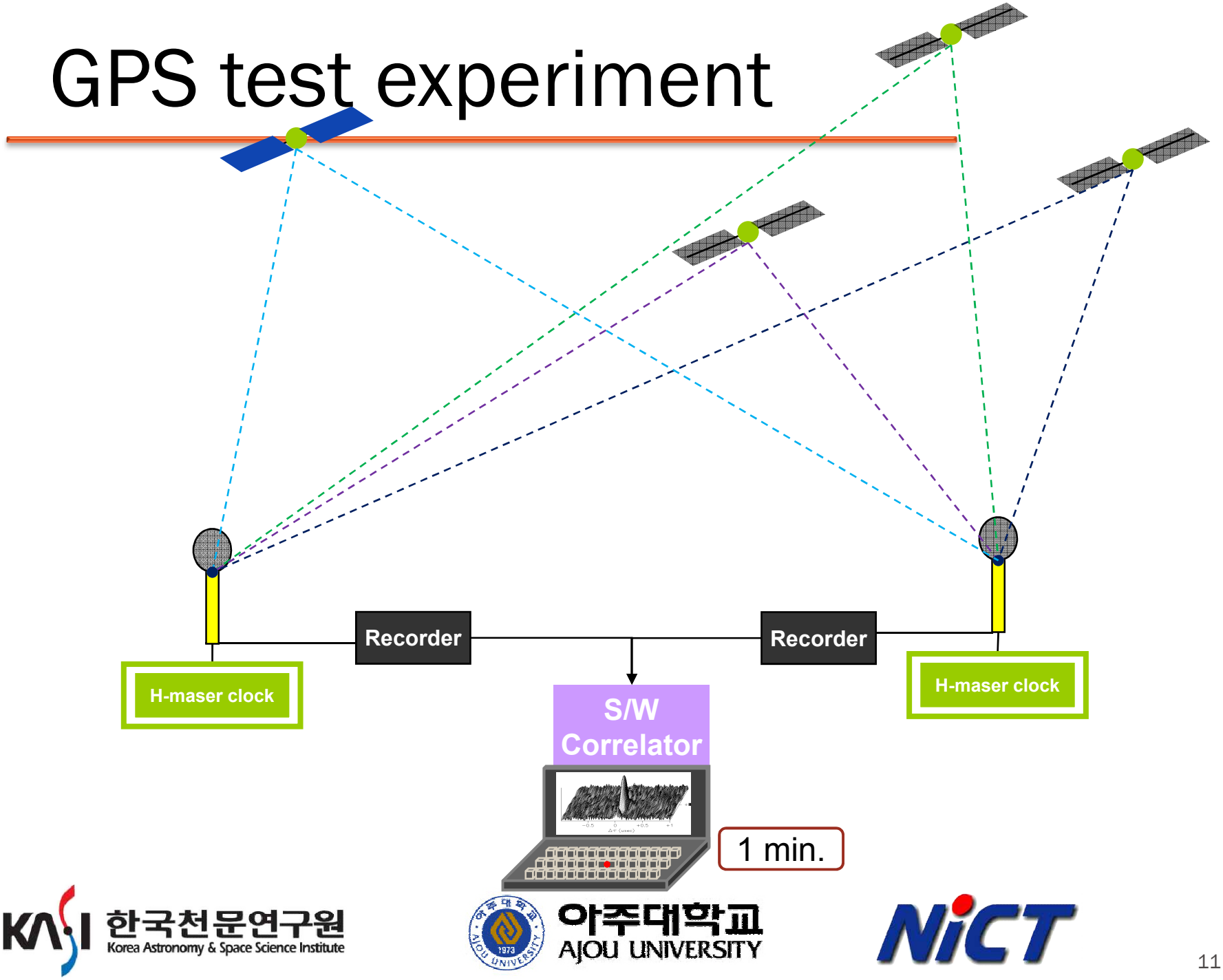
- Normal VLBI 24hr session +
- To reduce GPS data volume to 1/3
  - GPS Observation schedule

- Let's see how 1min. GPS Observation is

GPS test experiment

- On 9th Oct. 2009

GPS test experiment



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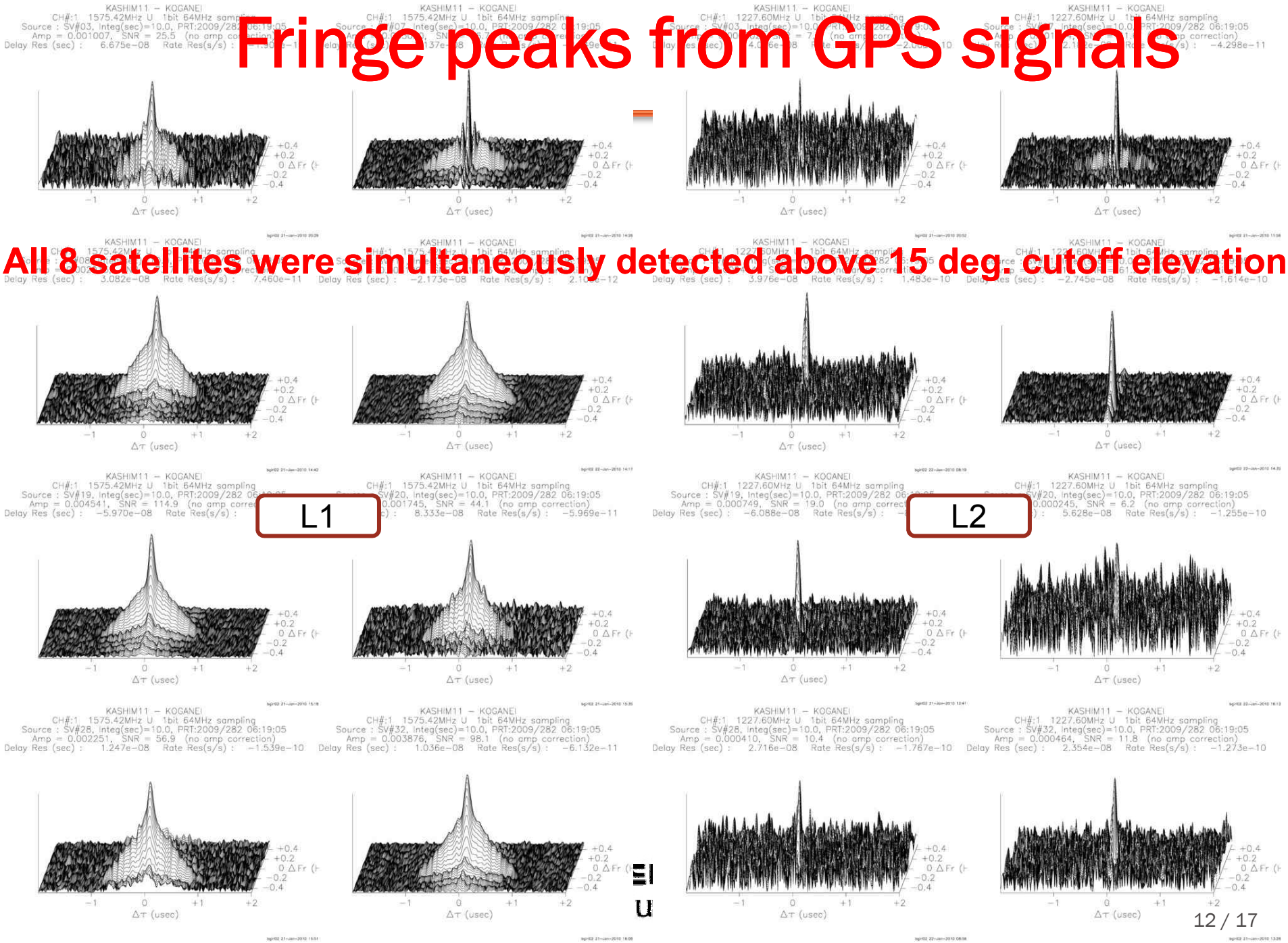
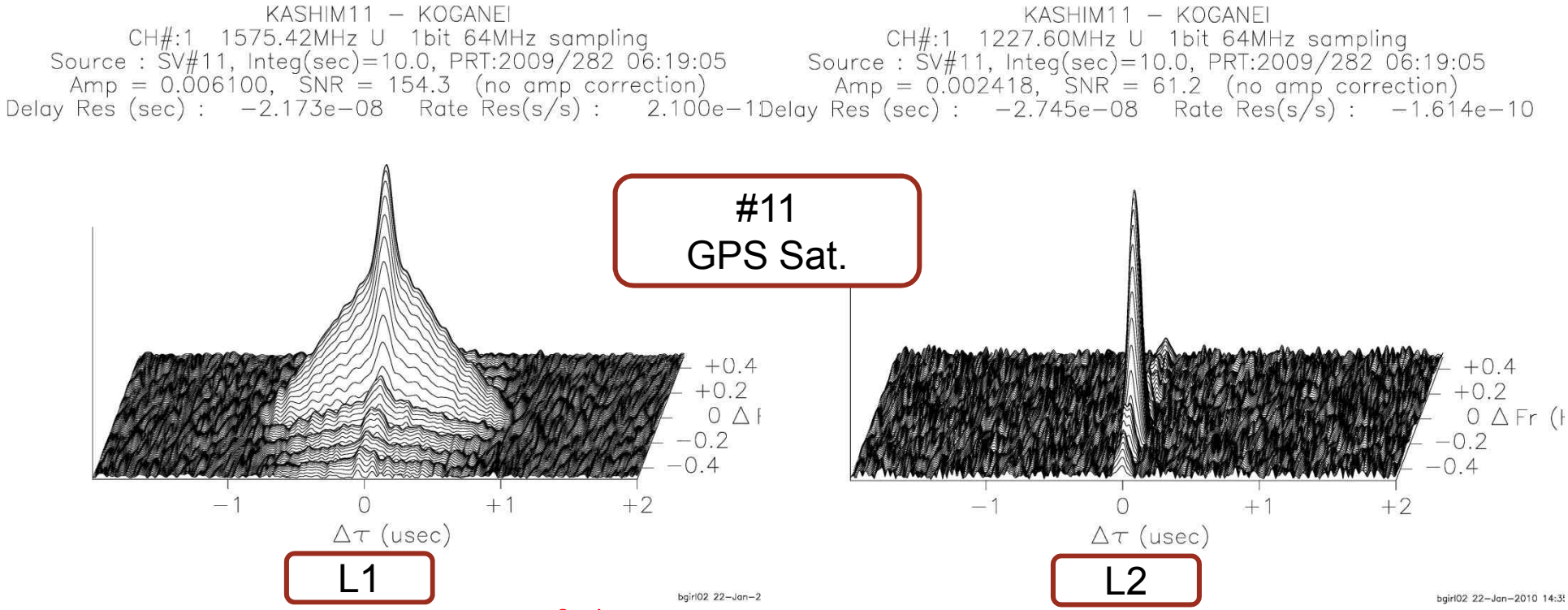
Fringe peaks from GPS signals

All 8 satellites were simultaneously detected above 15 deg. cutoff elevation



Fringe peaks –best case



S/N=154.3

~ 0.1 nsec

~ 0.04 psec/sec

S/N= 61.2

Elevation angle : 76.0° at Kashima 77.1° at Koganei

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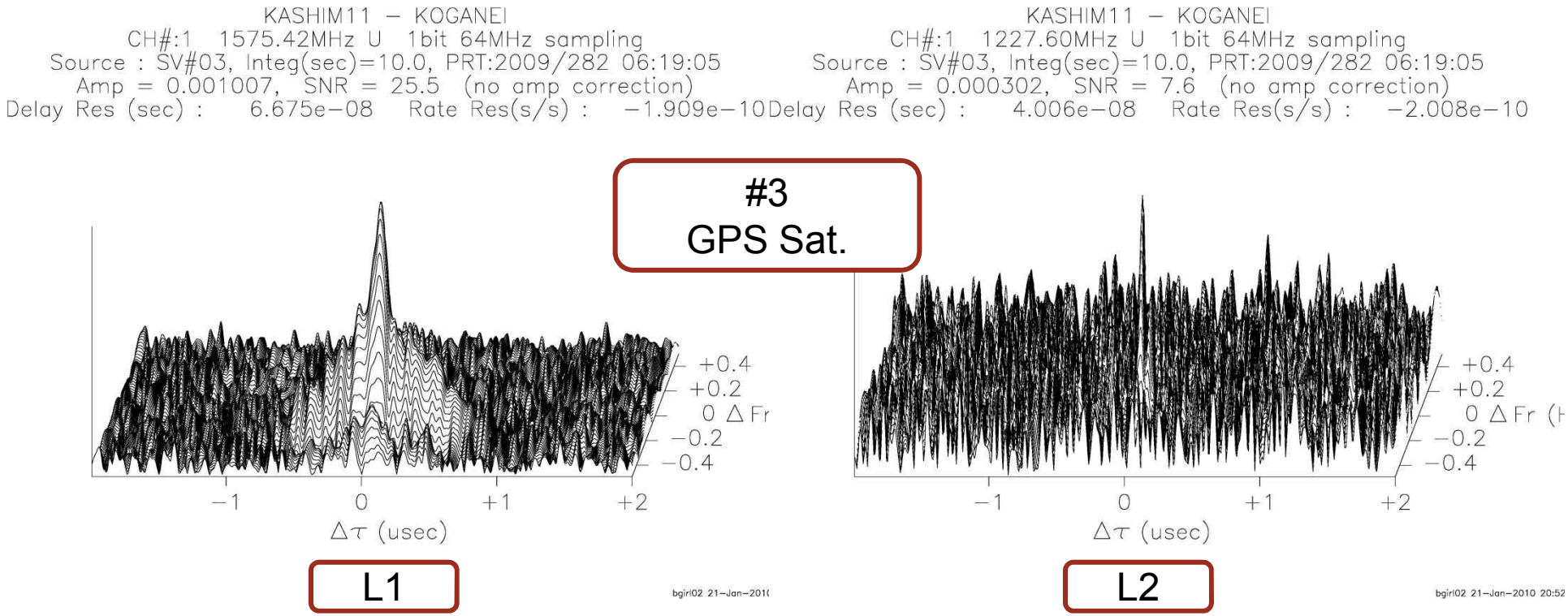
Fringe peaks – worst case



S/N=25.5

S/N= 7.6

Elevation angle : 23.4° at Kashima 22.4° at Koganei

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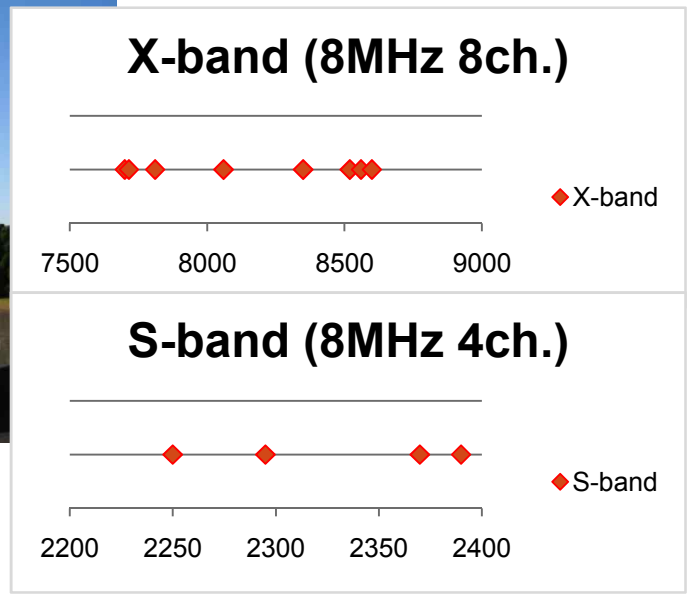
The First experiment with GV Hybrid System

- Now under Correlation Processing (generating a priories)

<VLBI>

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$SOURCES
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$SKED
GPSALL 10 L PREOB 0934409 0000 60 MIDOB 0 POSTOB R-G- 1F000000 1F000000 YYYN 60 6
GPSALL 10 L PREOB 0934409 0300 60 MIDOB 0 POSTOB R-G- 1F000038 1F000038 YYYN 60 6
GPSALL 10 L PREOB 0934409 0600 60 MIDOB 0 POSTOB R-G- 1F000046 1F000046 YYYN 60 60
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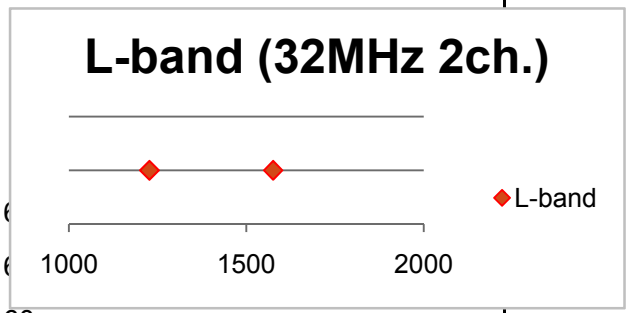
<GPS>



Conclusion

- New GPS down-converter worked well and GPS signals were successfully sampled and recorded in VLBI system.

- Some data from GPS satellites satisfied VLBI precision in thermal noise errors

- Longer observation duration necessary

Future Works

- Test experiment data of G-V Hybrid system in December 2009 will be correlated and analyzed.

- Analysis S/W for GPS & VLBI Observation for consistency b.t.w. techniques.

- Larger network(global scale)
  - ➔Tie GPS satellite to ICRF and determination of UT1