



Development of a Wideband VLBI System (GALA-V)

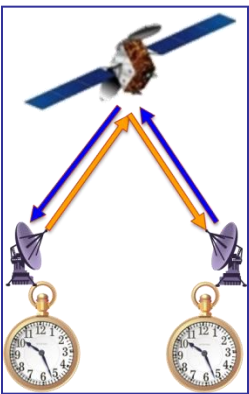
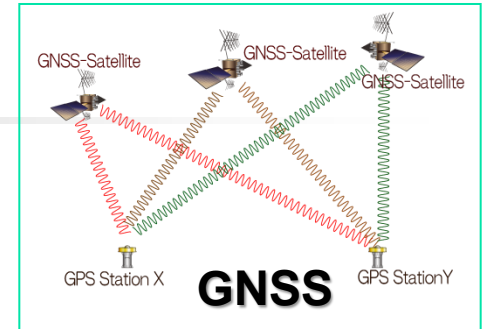
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NICT/ Space-Time Standards Laboratory

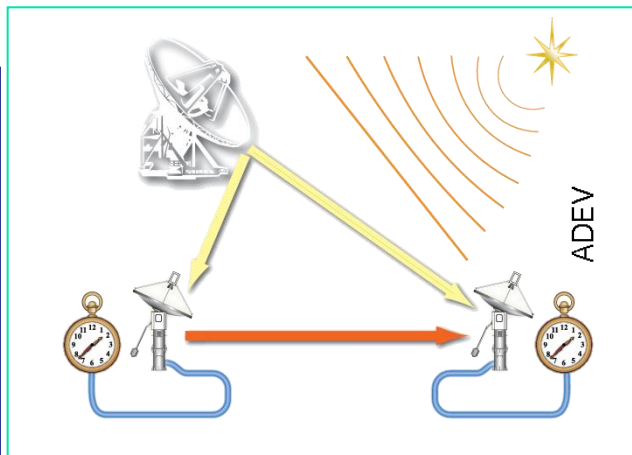
Precise Frequency Transfer over intercontinental distances

Space Technologies for Distant Frequency Comparison

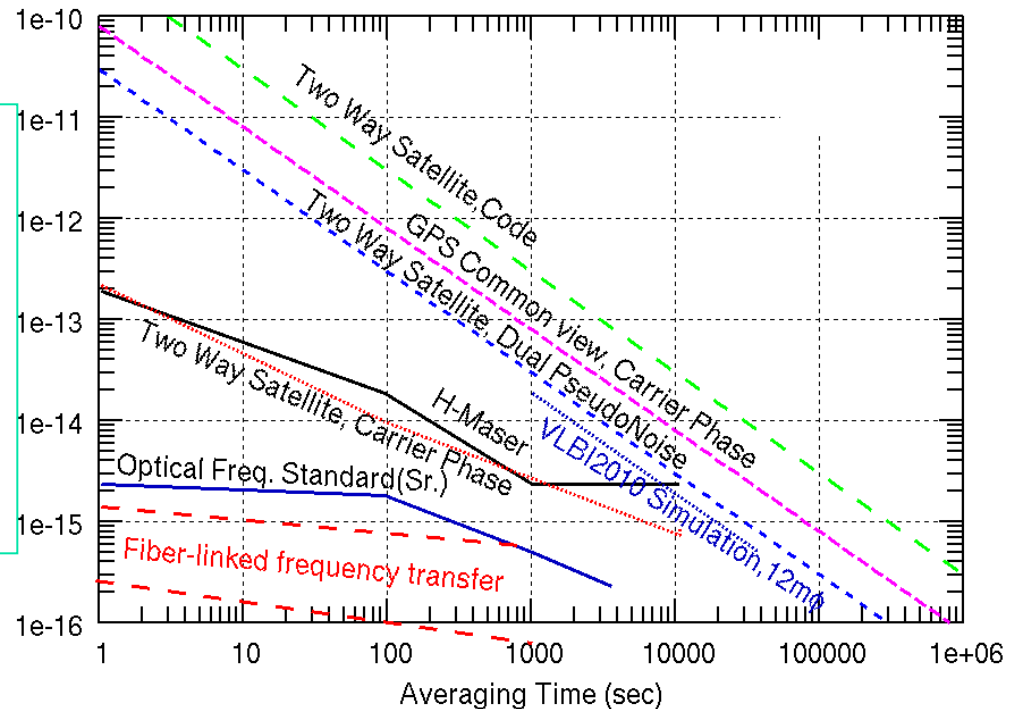
- GNSS(Common view, PPP)
- Two way Satellite Time and Frequency Transfer(TWSTFT)
- **VLBI**



TWSTFT



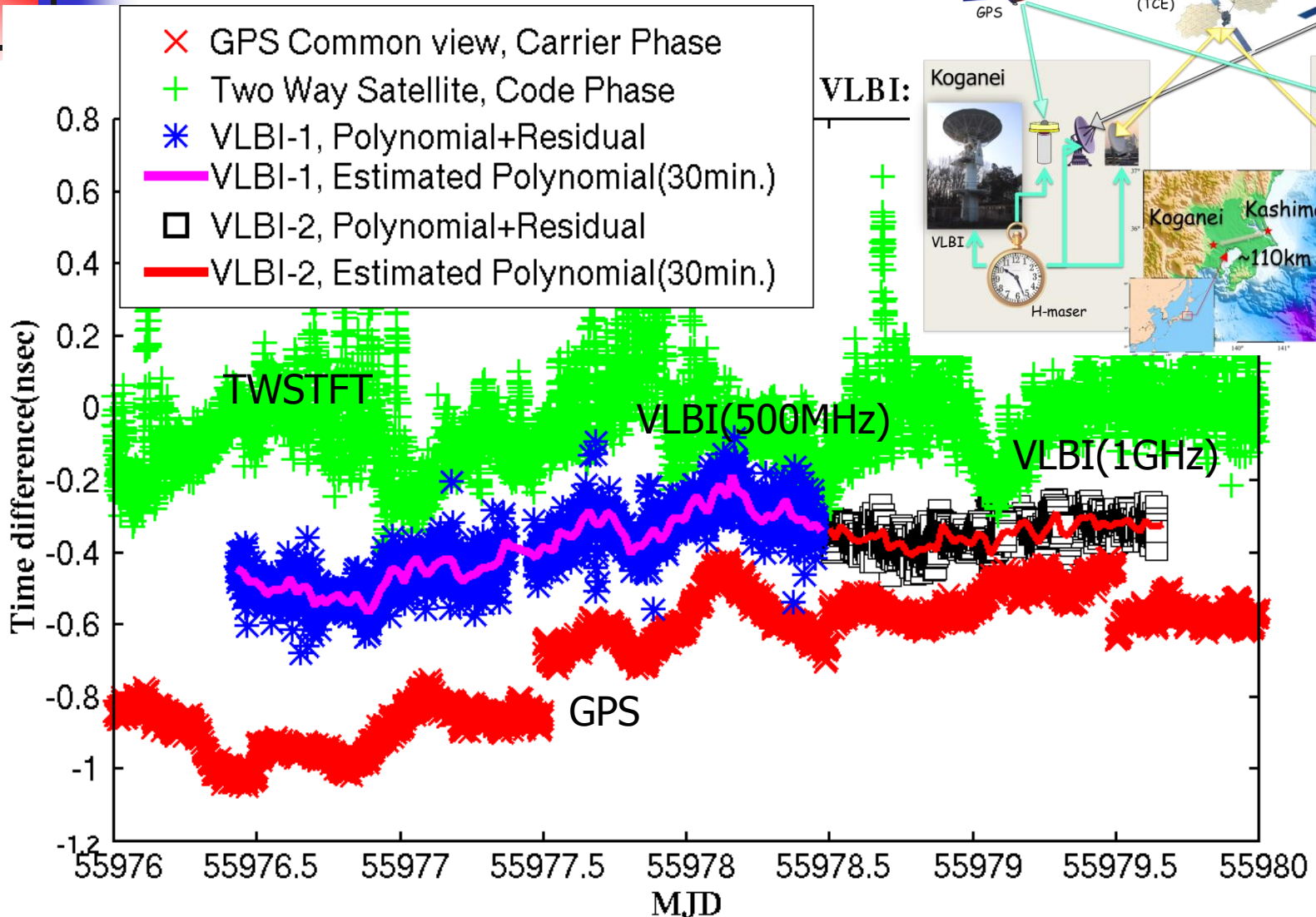
VLBI



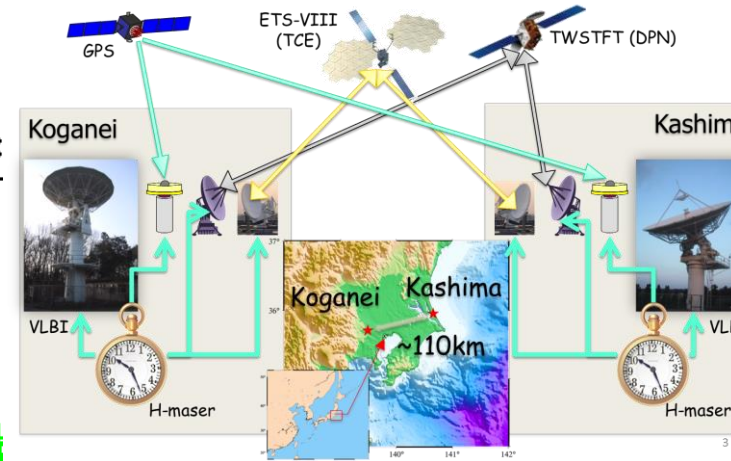
Comparison of TWSTFT, GPS, VLBI

Exp. on 19-22 Feb. 2012

Comparison of Frequency Transfer Technique
Experiment on 100 km baseline



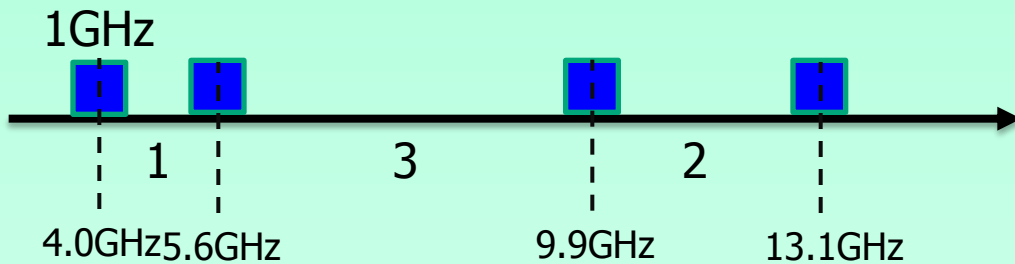
VLBI:



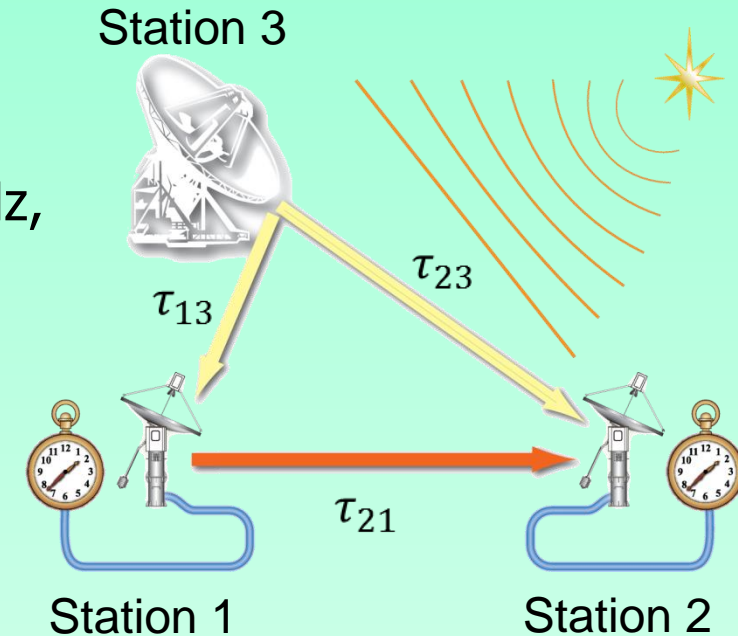
Gala-V project Overview

Target Precision: 30 ps -> 7 ps

- Obs. Freq. : 3-14GHz Freq. Range
- Observation: 4 band (1024MHz)
 - Fc = 4.0GHz, 5.6GHz, 9.9GHz, 13.1GHz,
 - Effective BW: 3.8GHz



Combination of Small and Large Diameter antennas

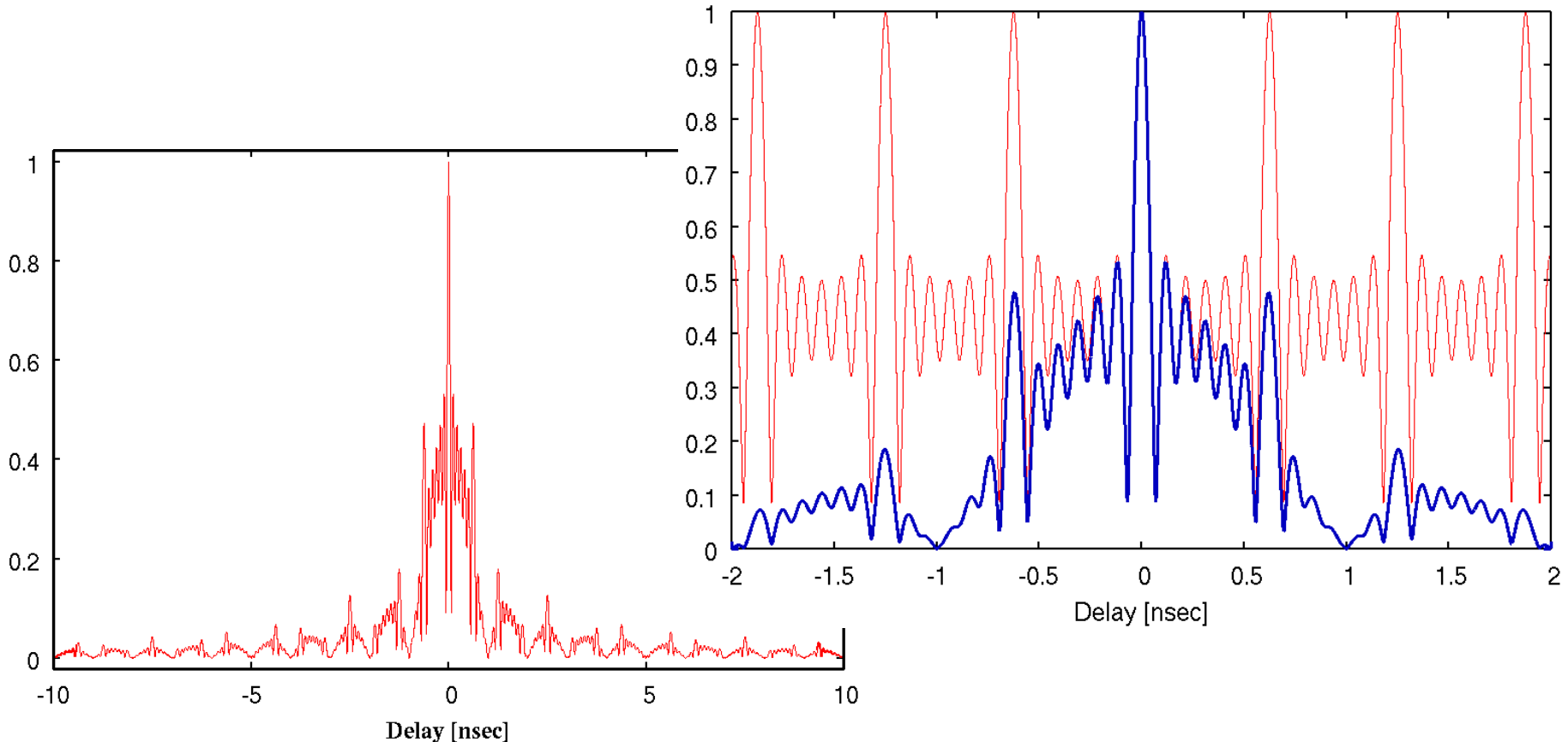


■ Difference from the VGOS specs.:

	Benefit	Drawback
Single Channel for each band	Fine DRF without ambiguity	Less compatible, but mixed corr. is to be possible.
Phase Cal. 50/100MHz	Easier to generate	Less compatible

Delay Resolution Function of the Frequency Array

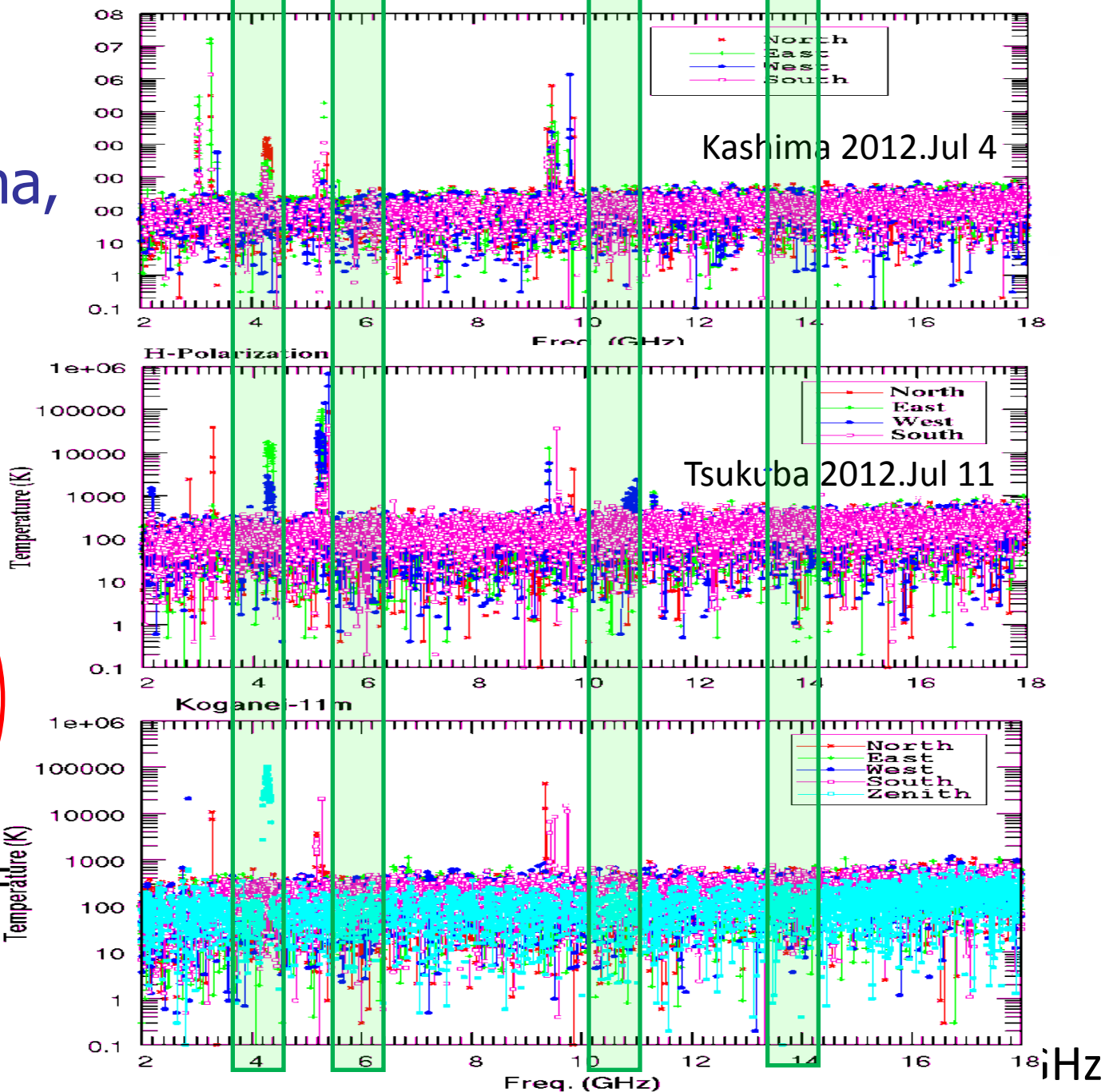
- Zero redundancy Array for 4 channels.
- Fine Delay resolution without ambiguity.
- Frequency Setup is not fixed but tunable if digital filter of the direct sampler (GALAS) is used.



RFI Survey 2-18GHz at Tokyo, Kashima, and Tsukuba



With 3.5GHz HPF
before LNA



1.6/1.5m and 34m VLBI antenna



1.5m compact antenna



Kashima 34m antenna

- VLBI2010 semi compliant Observation System is under preparation
 - 1 GHz x 4 band in the 3-15GHz Frequency Range

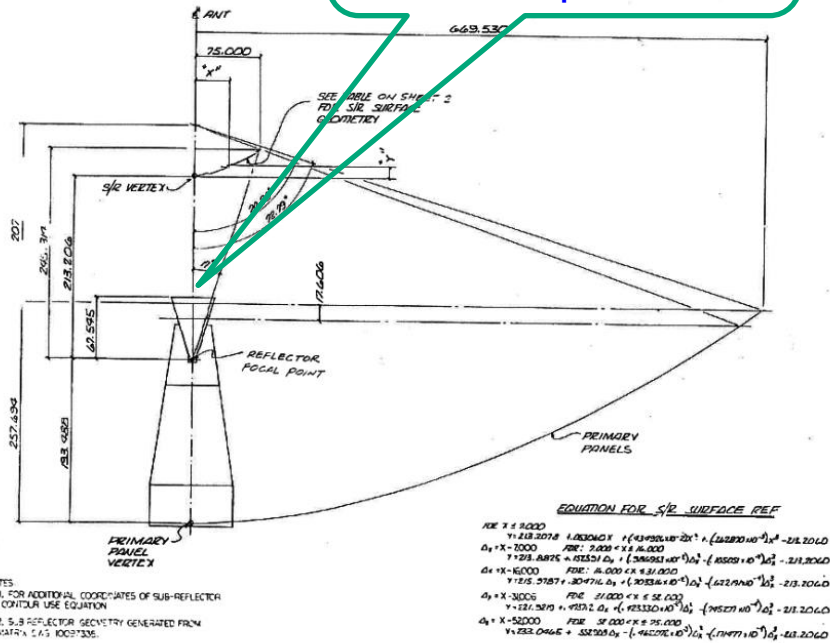


“Iguana” Feed

Requirement:

- 35 deg. Beam width over the wide frequency range.

Wideband prototype feed designed by Dr. Ujihara has been installed to Kashima 34m with room temp. LNA at the end of 2013.



This feed has sensitivity at 6.4-14GHz range at present. Upgraded feed with 2.2-18GHz Freq. range is intended.

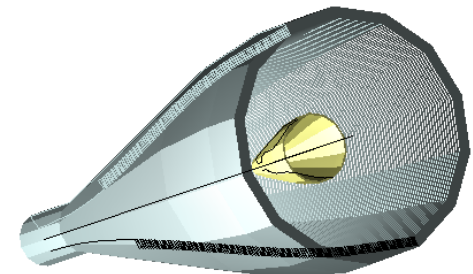
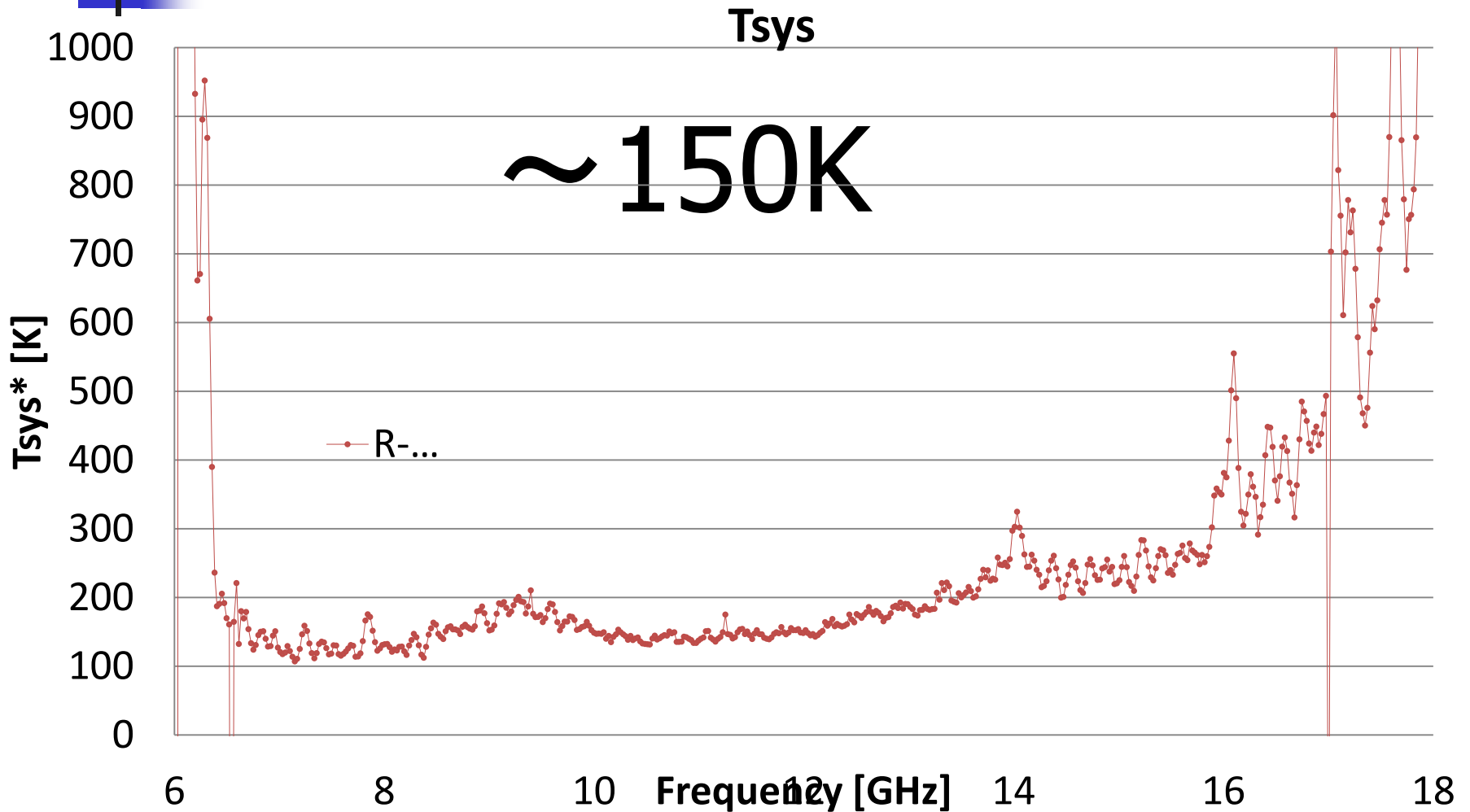


Image of 'Iguana' wideband feed

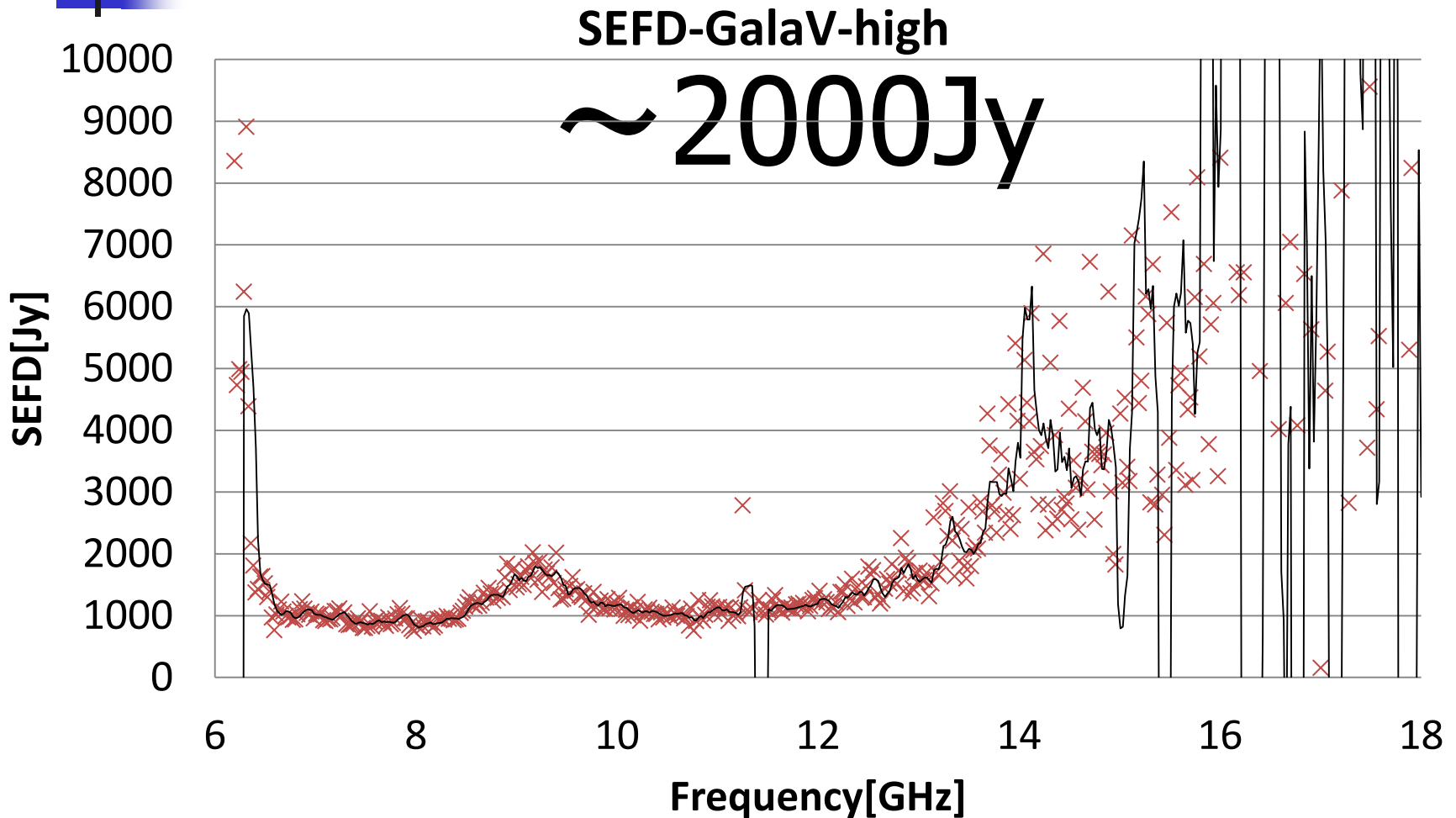


Modified System Temp. T_{sys}^*



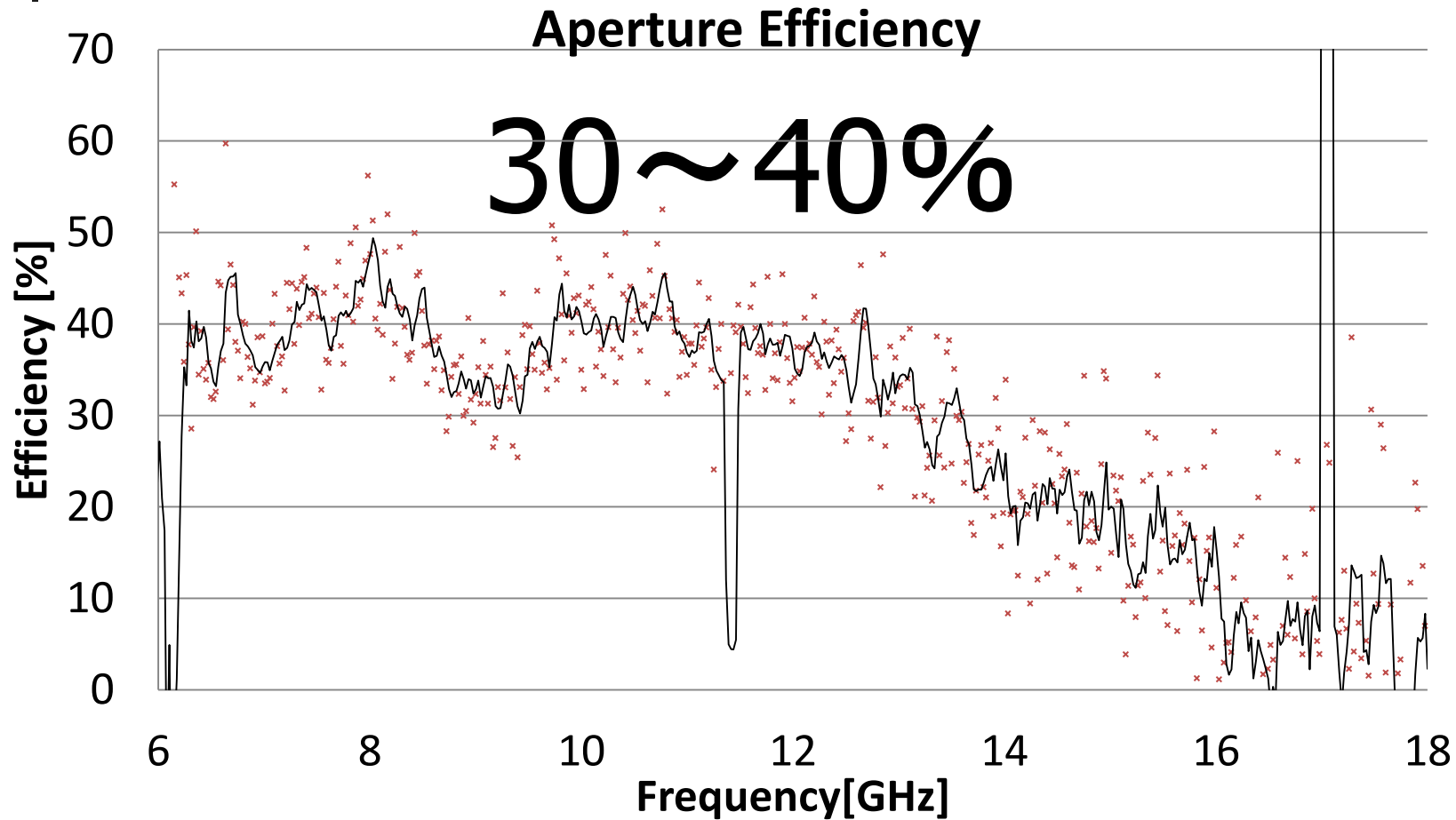


SEFD with Cyg-A

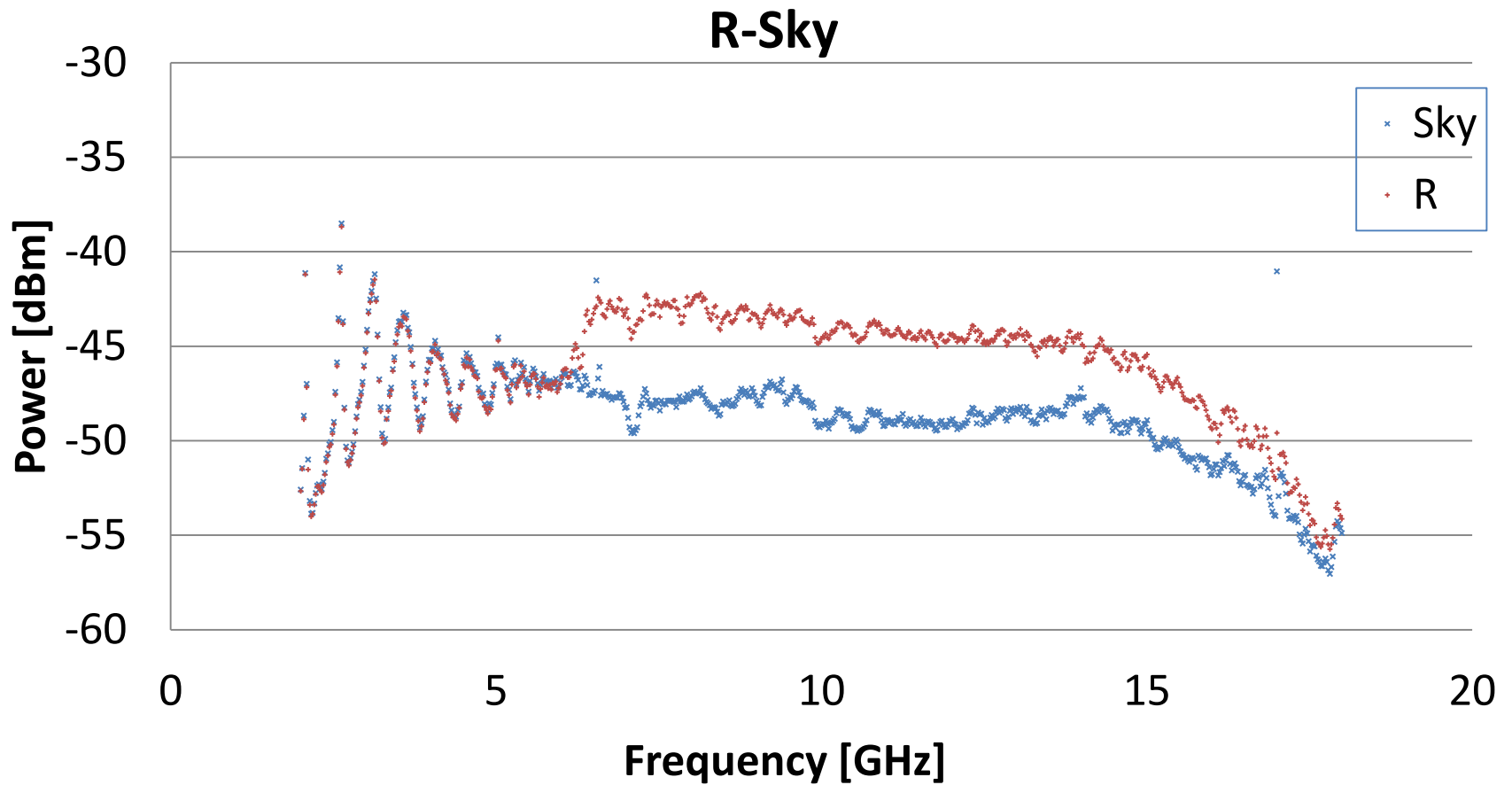




Efficiency with Cyg-A

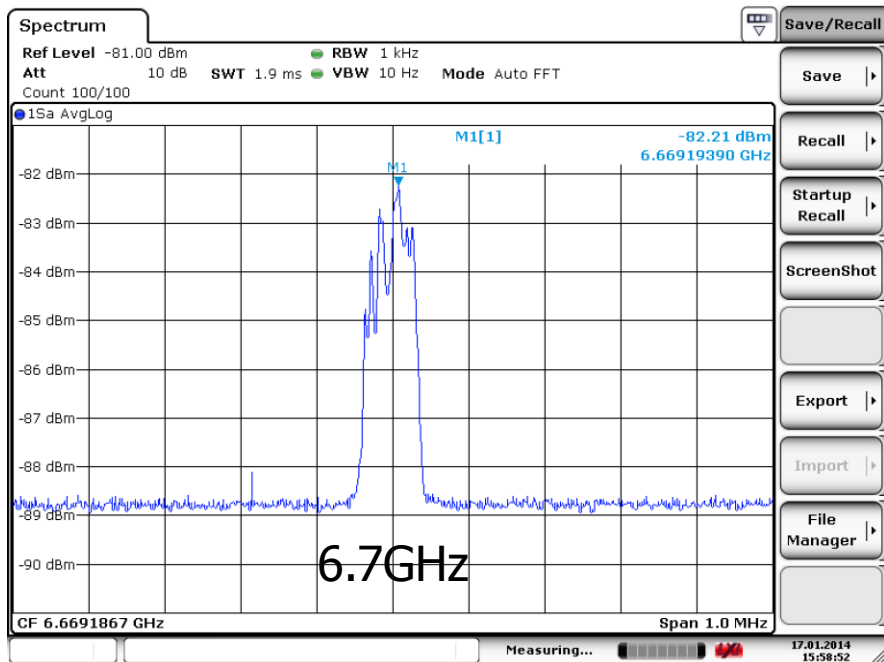


R-Sky data

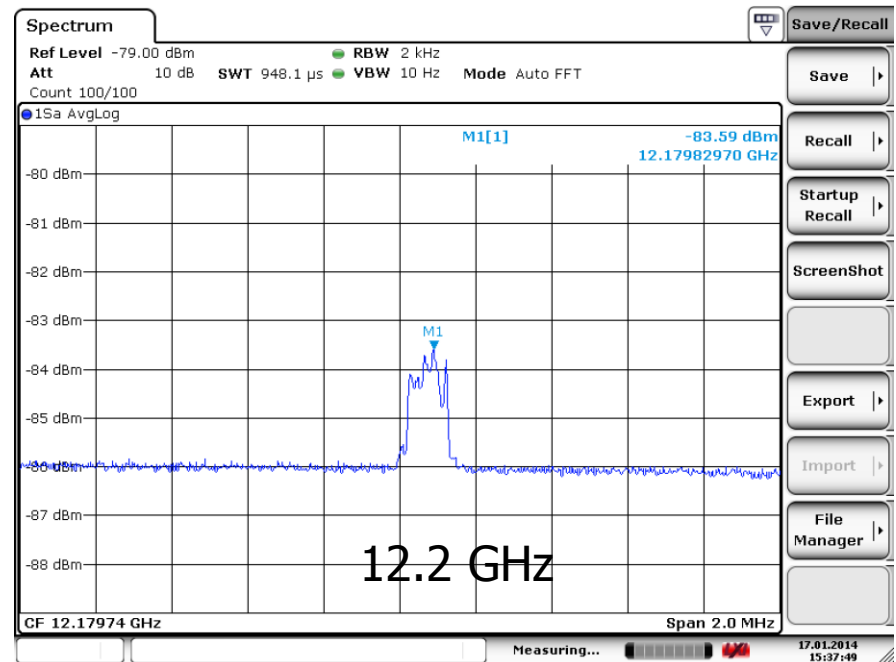


Methanol Maser

- Simultaneous Observation of Methanol Maser line at 6.7GHz and 12.2GHz on W3OH for test observation (first light) on 16 Jan.2014.

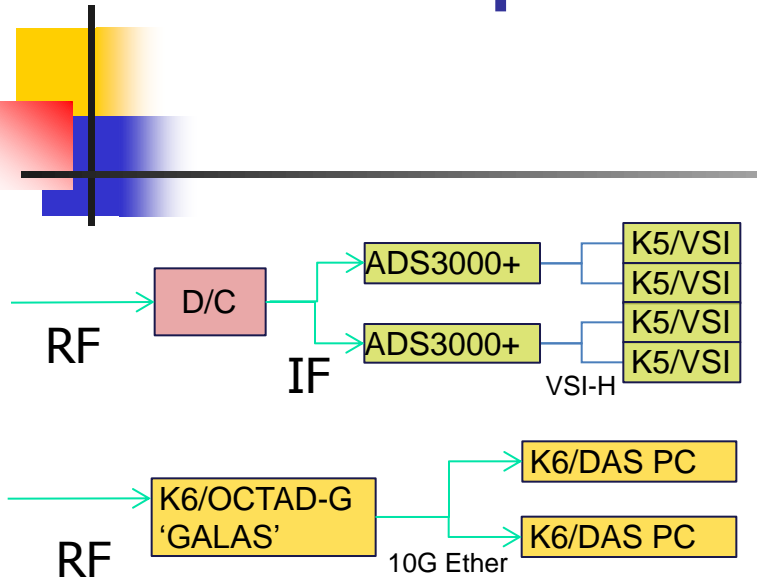


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Data Acquisition: 1GHz x 4 Ch

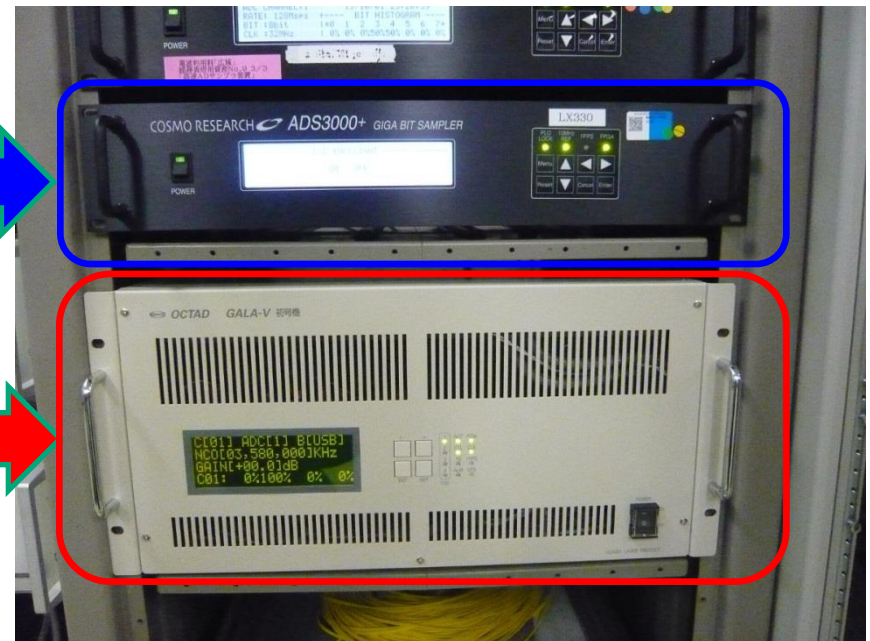
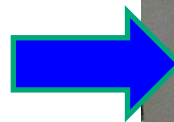


Two Approaches

1. Analog Down Converter + “ADS3000+”
 - Digital BBC function for legacy mode observation.
2. Direct Sampler “GALAS”
 - Digital Down Conversion function for any frequency by 1MHz step.

ADS3000+ Sampler
DBBC or 1-2 Gbps

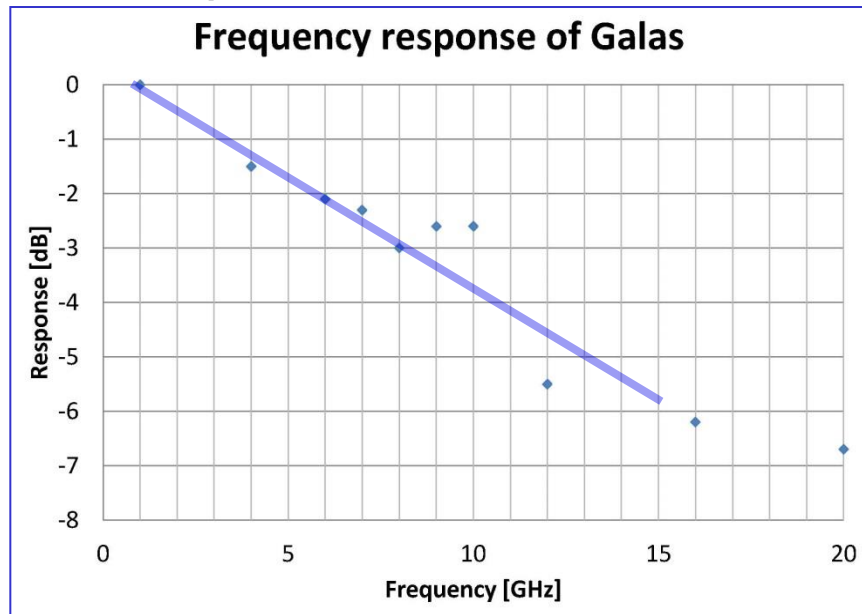
Direct Sampler
K6/OCTAD-G
code name=“GALAS”
DBBC(BW=1024MHz)



Evaluation of K6/OCTAD-G = "GALAS"

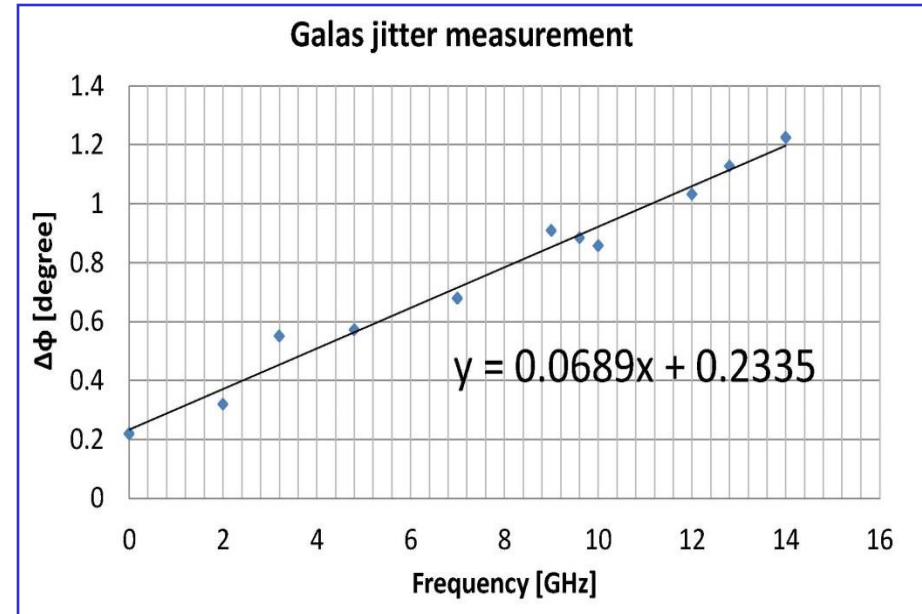
■ Input Frequency Response

- 1 - 14GHz -6dB
- To be equalized by enhanced input



■ Sampling jitter measurement

- Phase fluctuation vs frequency
- 0.19 psec RMS



RF-Box of MARBLE small antenna



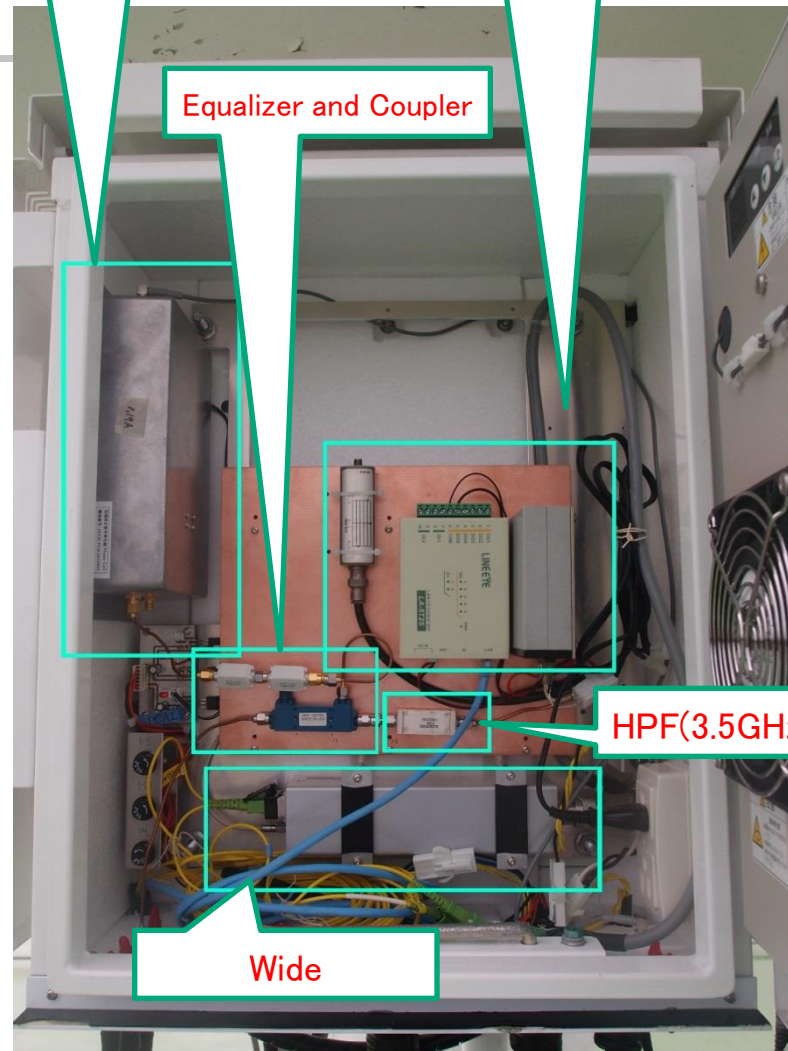
Peltier Cooler



PCAL Signal Generator



Noise-Cal Controller

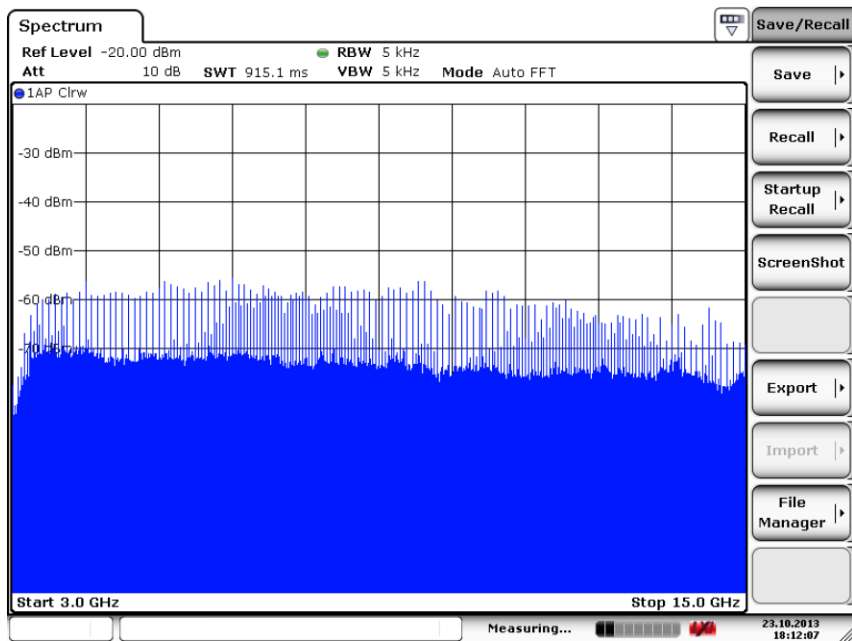


Equalizer and Coupler

HPF(3.5GHz)

Wide

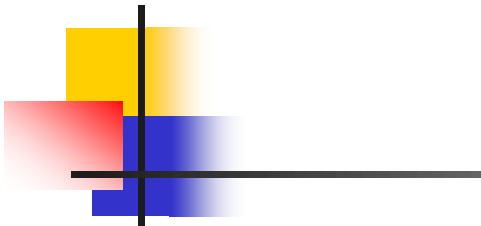
Monitoring at Observation Room
(3-15GHz). RBW=5kHz



Frequency Transfer Test with NICT and AIST/National Metrology Institute of Japan(NMIJ) and NICT

At the roof (3rd floor) of AIST/NMIJ building, 1.6m antenna was settled.





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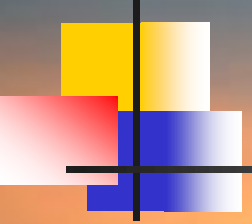
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Navigation and Control Panel:

- Left Arrow
- Up Arrow
- Down Arrow
- Right Arrow
- Center Navigation (Up, Down, Left, Right arrows around a central point)
- Zoom In (Magnifying glass with minus sign)
- Zoom Out (Magnifying glass with plus sign)
- Zoom Reset (x 1)
- Home/Reset (U and B symbols with arrows)
- Thumbnail View (Grid with numbers 1, 2, 3)



Development of Wideband Feed 'Iguana' was supported by collaboration fund provided from NAOJ.

Thank you for
Attention

