



한국우주전파관측망
KOREAN VLBI NETWORK · KASI



Functional upgrade and operation status of Korea-Japan Correlation Center

Se-Jin Oh, Duk-Gyoo Roh, Y. Kan'ya, Jae-Hwan Yeom, Dong-Kyu Jung, Ju-Yeon Hwang, Chungsik Oh, T. Oyama, H. Kobayashi, K.M. Shibata, M. Honma

Contents



❖ KJCC correlation status

- Correlator operation status
- 8Gbps operation status
- Dual-pol support of CODA/FITS
- KVN Halcyon recorder development

❖ Summary and Future Work

Target Arrays of KJCC

East Asian VLBI Network (EAVN)

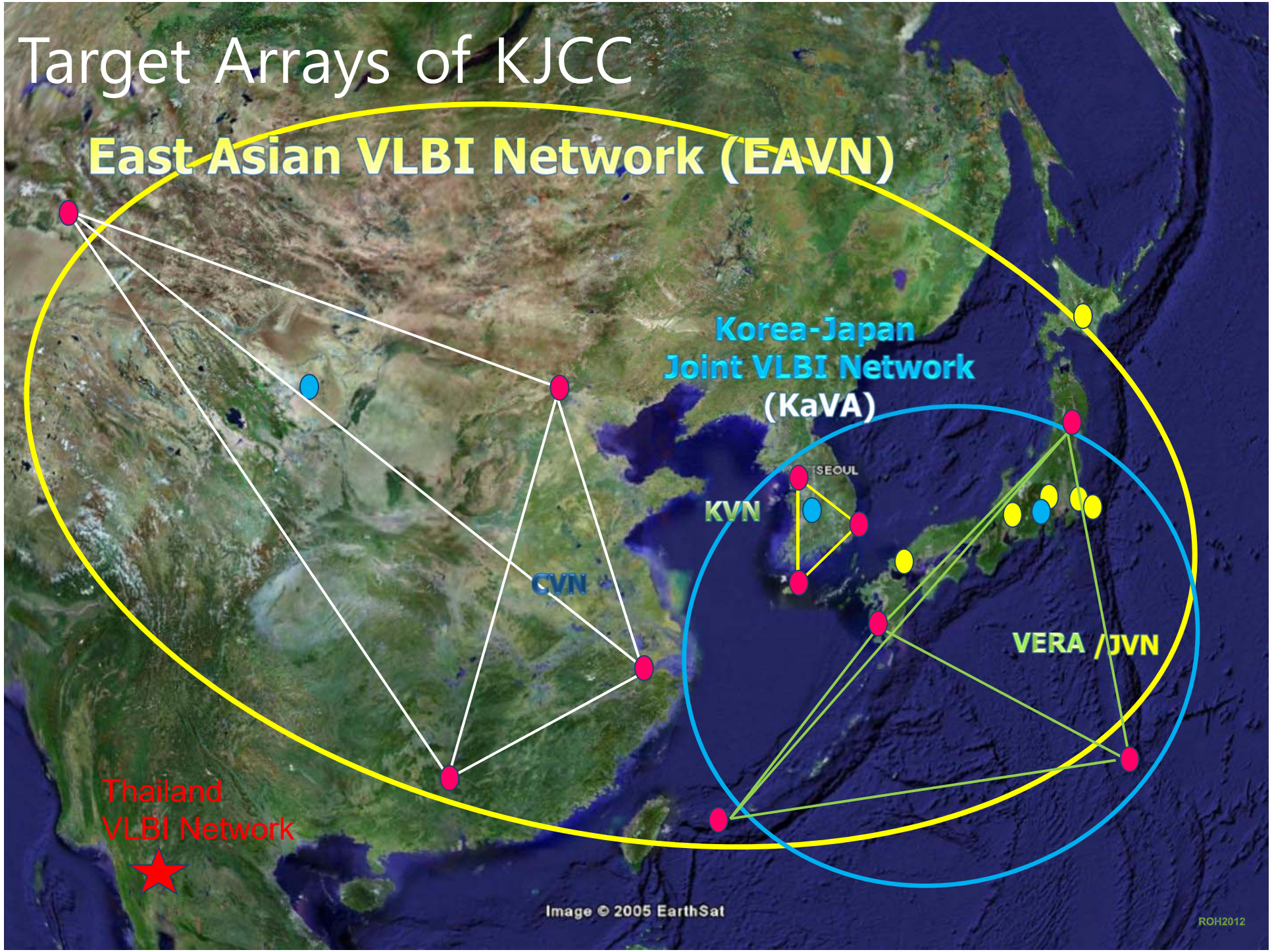
Korea-Japan Joint VLBI Network (KaVA)

KVN

CVN

VERA / JVN

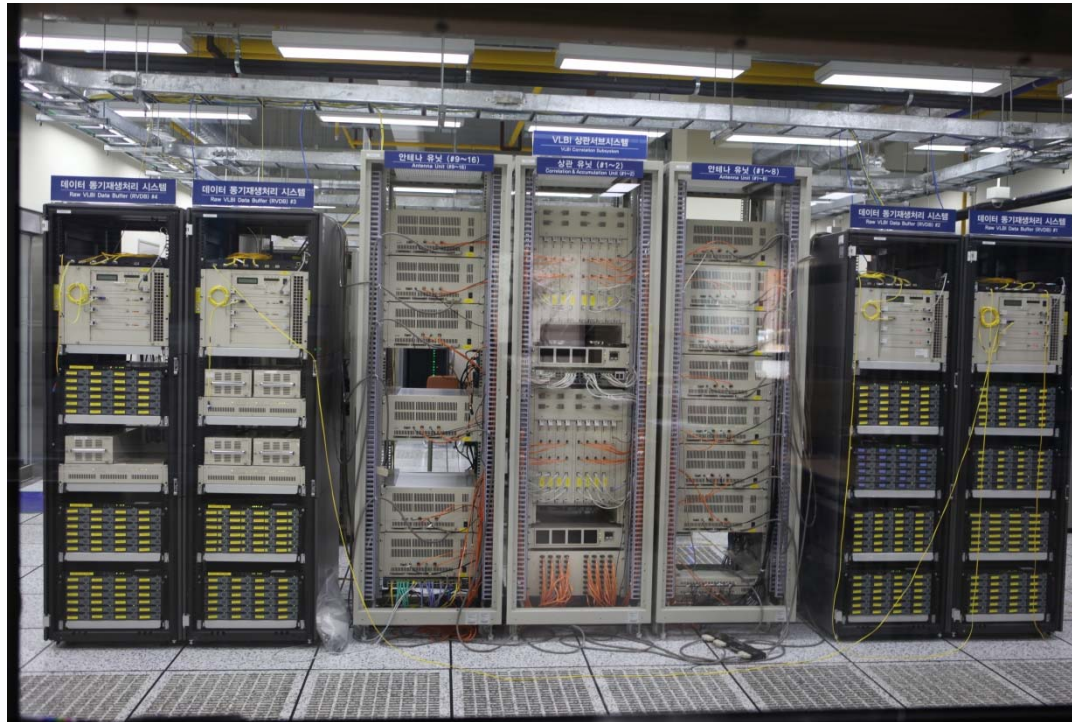
Thailand
VLBI Network



Korea-Japan Correlation Center(KJCC)



Executive Board



Daejeon HW Correlator



DiFX SW Correlator

Correlation Status



Season	Observation	Corr Finished	Remain Corr	FITS release
2017A	78(w/5 geo)	60	13	60
2016B	68(w/6 geo)	60	2	60

Radio Astronomy Division

Login

Korea-Japan Correlation Center

KJCC Main

Correlation Report

DiFX Report

User Support

Contact us

Correlation status : 2017A | 2016B | 2016A | 2015B | 2015A | 2014B | 2014A | 2013B | 2013A

2017A Correlation List

Season	#Observation	Corr Finished	Remain Corr	Remark	Update
KaVA 2017A	78	60	13	5	2017.07.03

Finished

Doing

Not yet

Suspend

KJCC evaluation

Not related in KJCC

Observation Date	Observation Code	PI & SWG	Frequency Band	Corr Mode	Objective	Media POS	Copy Status	Fringe Detection	Correlation Status	FITS release Date
2017.06.14 (17165a)	k17jp01e	Jongho Park/AGN	Q	VERA4S (C4)	Doppler factor measurement of 1928+738	KJC (17.06.28)	KVN Done (17.06.29)	All	Finished (17.07.03)	1:2017.07.03
2017.06.13 (17164a)	k17mk03f	Motoki Kino/AGN	Q	GEO1S(C5)	KaVA Observation of 3C84 at Q-band	KJC (17.06.28)	KVN Done (17.06.28)	All	Finished (17.07.03)	1:2017.07.03
2017.06.12 (17163k)	r17163k	T. Jike	K	GEO1K(C5)	GeodeticExperiment	STN	NY	NY	NY	NY
2017.05.26		Kazuhiro		VERA4S		KJC				

<http://kjcc.kasi.re.kr>
<http://kava.kasi.re.kr>

Correlation Mode



Corr. mode	Band width [MHz]	Output streams	#bits	Output data rate [Mbps]	Clock rate [MHz]
^a C1	256	1	2	1024	32
C2	128	2	2	1024	32
C3	64	4	2	1024	32
C4	32	8	2	1024	32
C5	16	16	2	1024	32
^b W1	512 x 4band	4	2	8192	64
W2	512 x 4band	1IF ^c x2P ^d 2IFx1P	2	8192	64
W3	512 x 4band	2IFx2P	2	8192	64

a, Narrow band, b. Wideband, c. IF, d. Polarization

Observation Trend & Prospect



- ❖ **To get the high quality image with high sensitivity, resolution,**
 - Conduct high speed observation as like 2/4/8 Gbps
 - In case of 16/32 Gbps, some observatory developed their own sampler and recorder and test observations are now temporally performed
- ❖ **In KaVA,**
 - 1, 2Gbps operation is now normally conducted.
 - 8Gbps normal operation will be also planned in 2018

For wideband and dual-pol. correlation by Daejeon Correlator

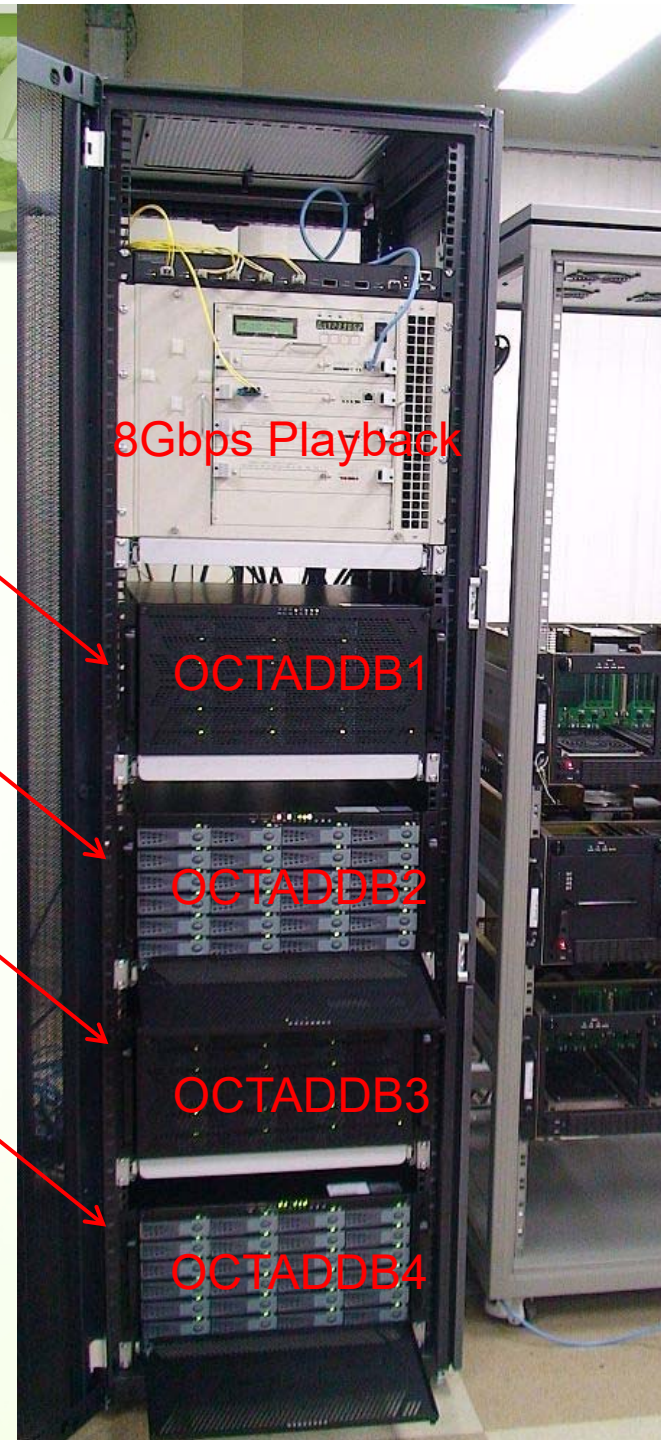
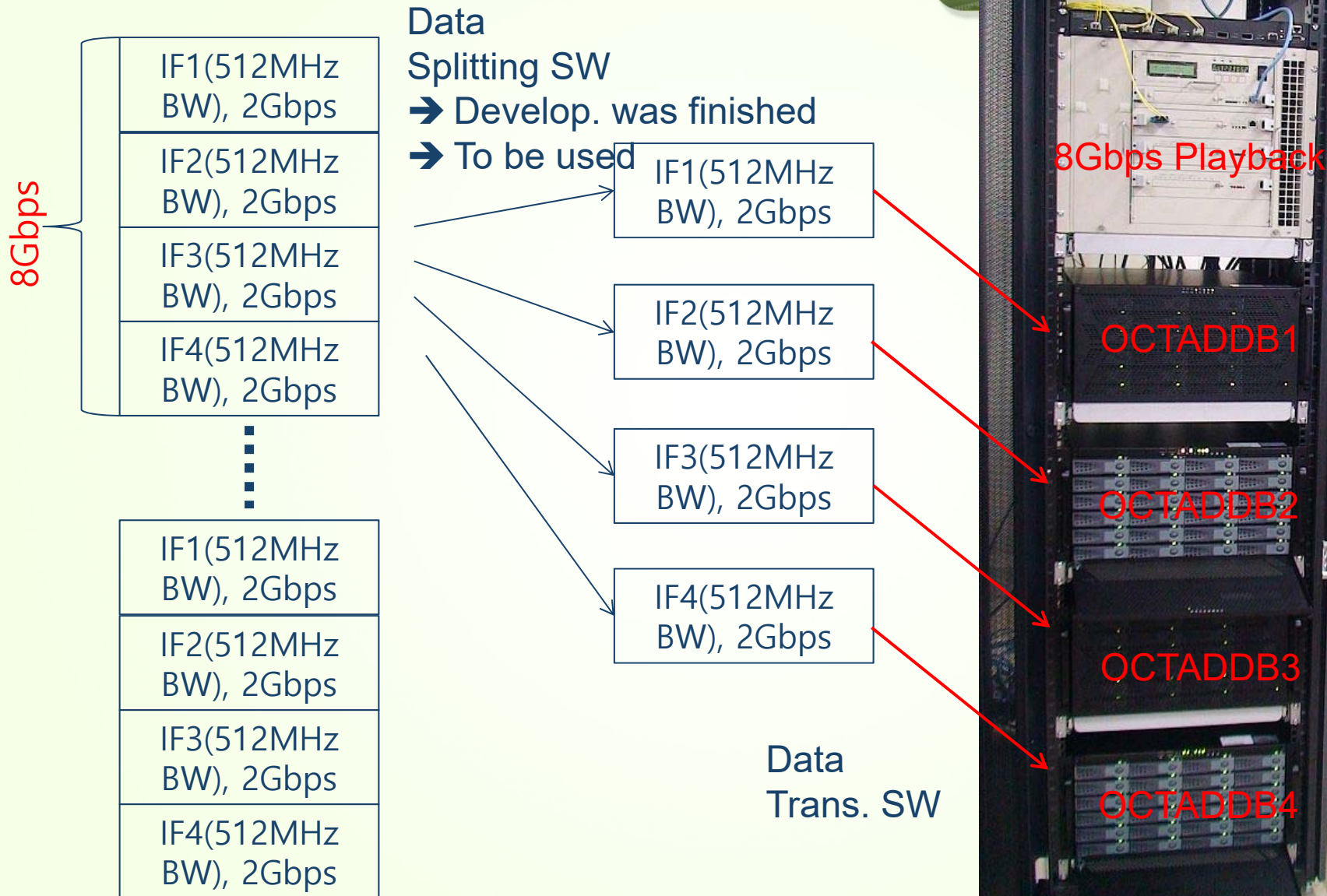


❖ VCS specification

- Already designed and implemented for wideband(8Gbps) and dual-polarization correlation
 - But the other equipment as playback terminal is also needed to be prepared.
1. The software for data splitting and upload to the RVDB are required.
 2. The playing back of the RVDB with 8 Gbps observation data to the VCS is needed.
 3. 8Gbps correlation by the Daejeon correlator is also needed according to the 4 VSI input.
 4. CODA/FITS SW(Post processing SW) for correlated result is also needed to be improved(to support dual-pol.).

Data Upload to RVDB

Data Splitting & Transmission Basic



STARDOM server to upload data to RVDB or e-transfer

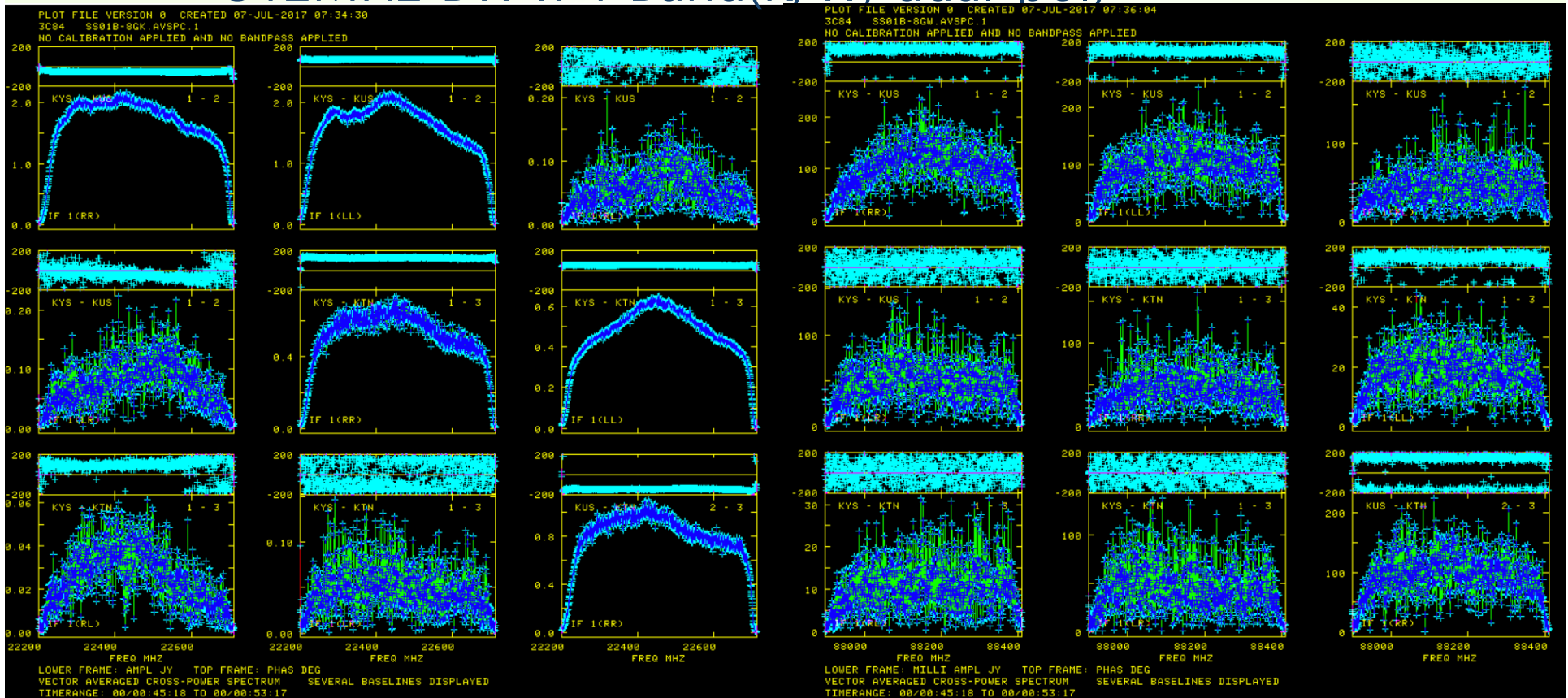


8Gbps cross-spectrum (n17ss01b, K/W-band), W3 mode



❖ **KVN only**

■ 512MHz BW x 4 Band(K/W, dual-pol)



K-band (LR)

W-band(LR)

CODA/FITS development

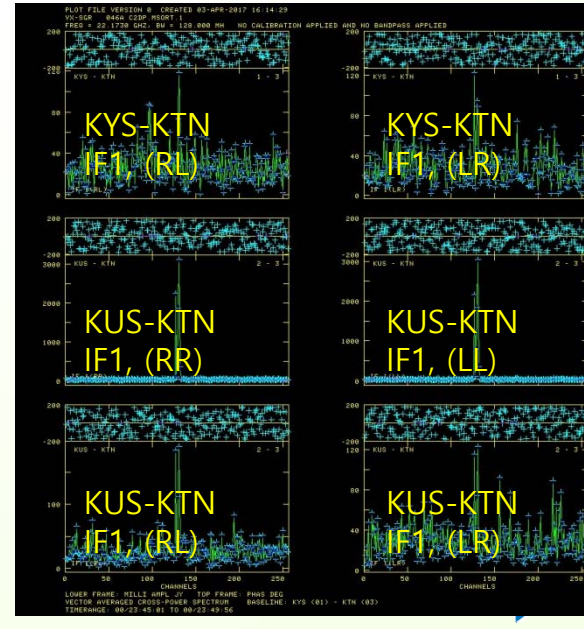
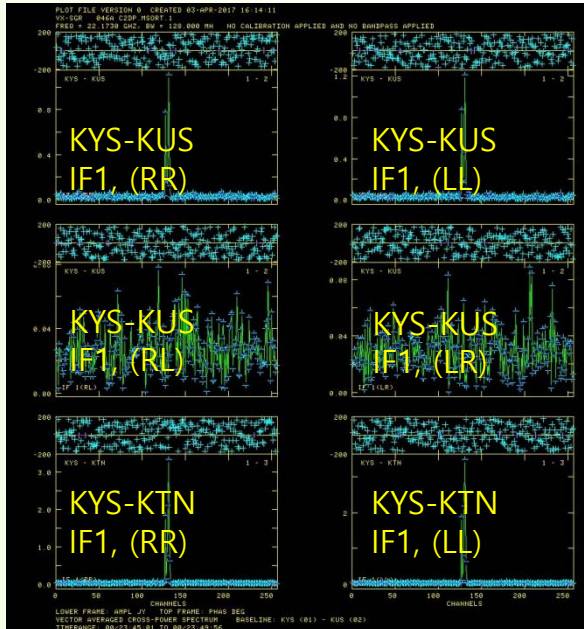
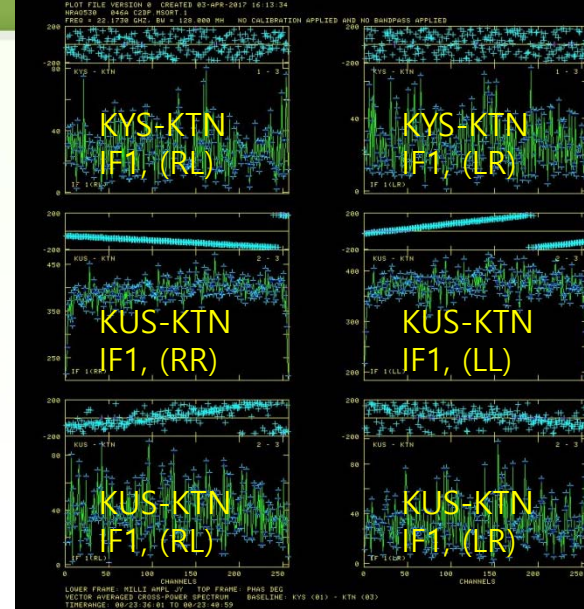
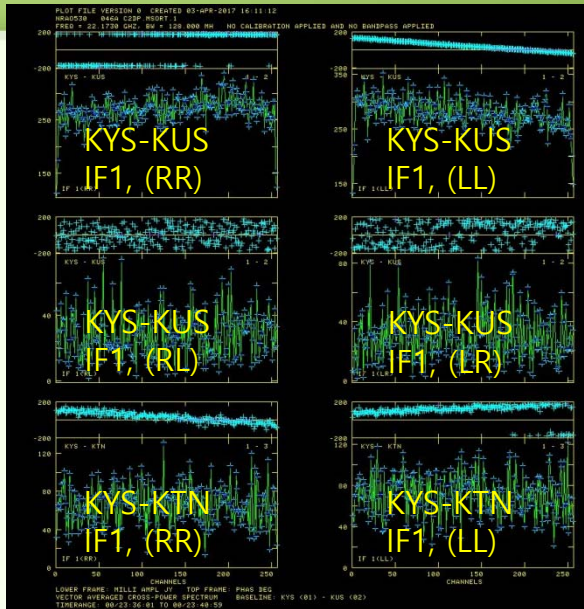


- ❖ **Direct FITSgen SW development**
 - In order to reduce the time for CODA/FITS generation, CODA generation step was skipped
 - Prototype version is now testing

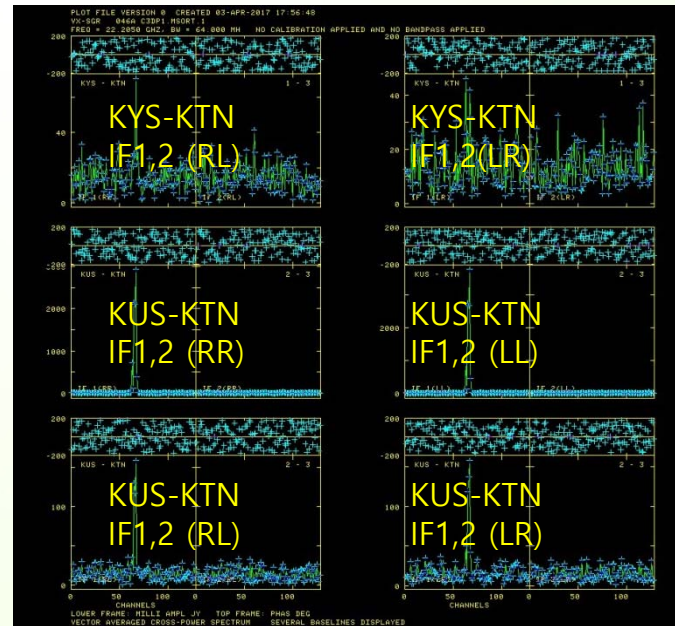
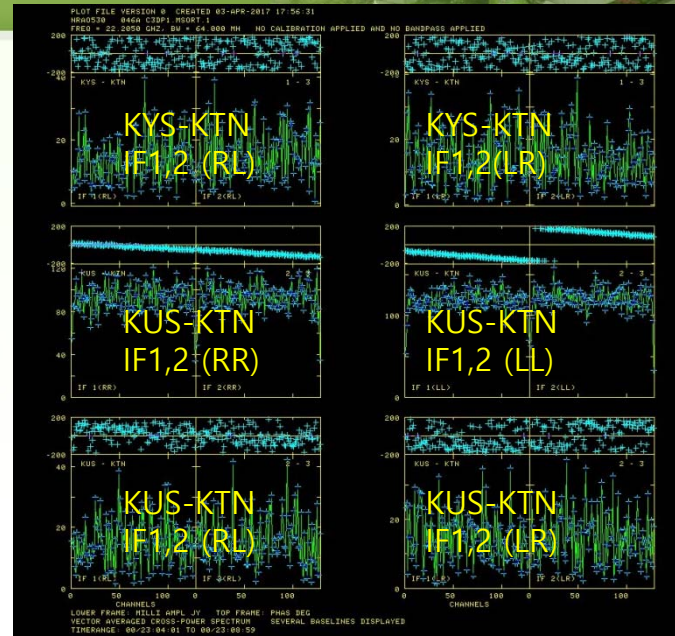
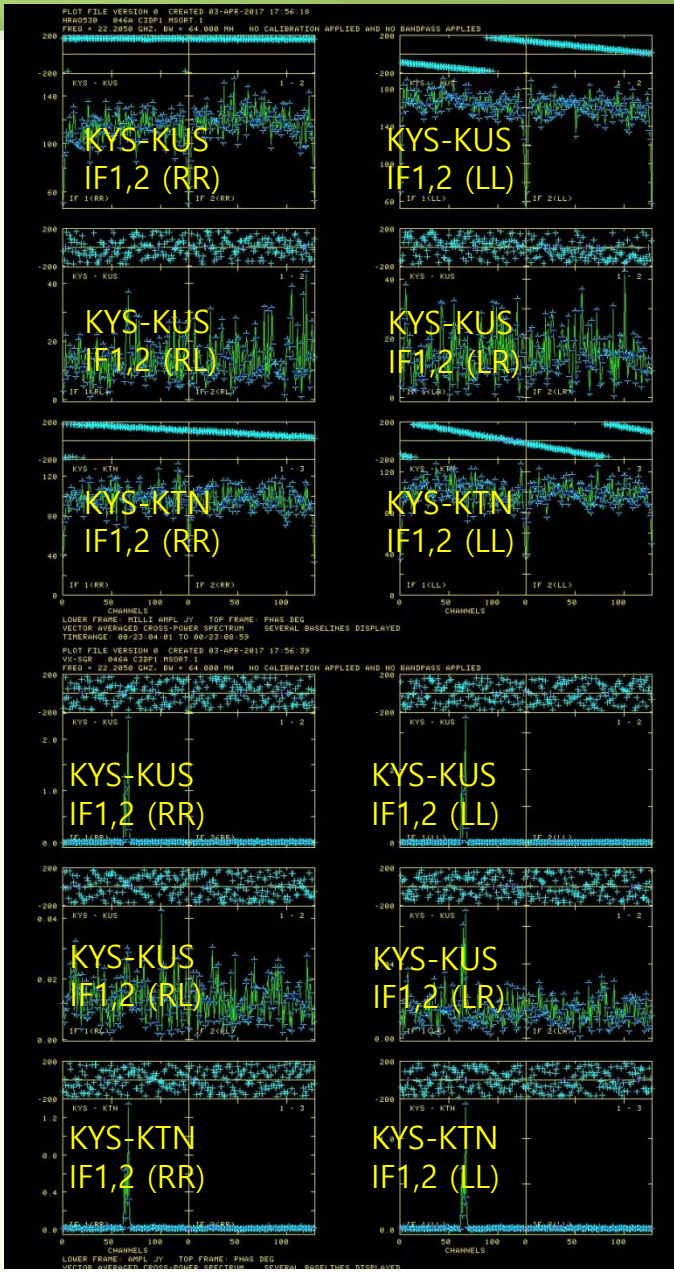
- ❖ **Dual-polarization mode support**
 - CODAgen SW development was completed.
 - Test obs data was used (s17so01a(k17046a), C2~C5 mode)
 - Please see next pages.

- ❖ **Multi-frequency Multi-polarization (wideband mode, ex: 8Gbps)**
 - CODA/FITS SW was improved to support
 - Test was finished and generated the data for n17ss01a
 - Please see next slide.

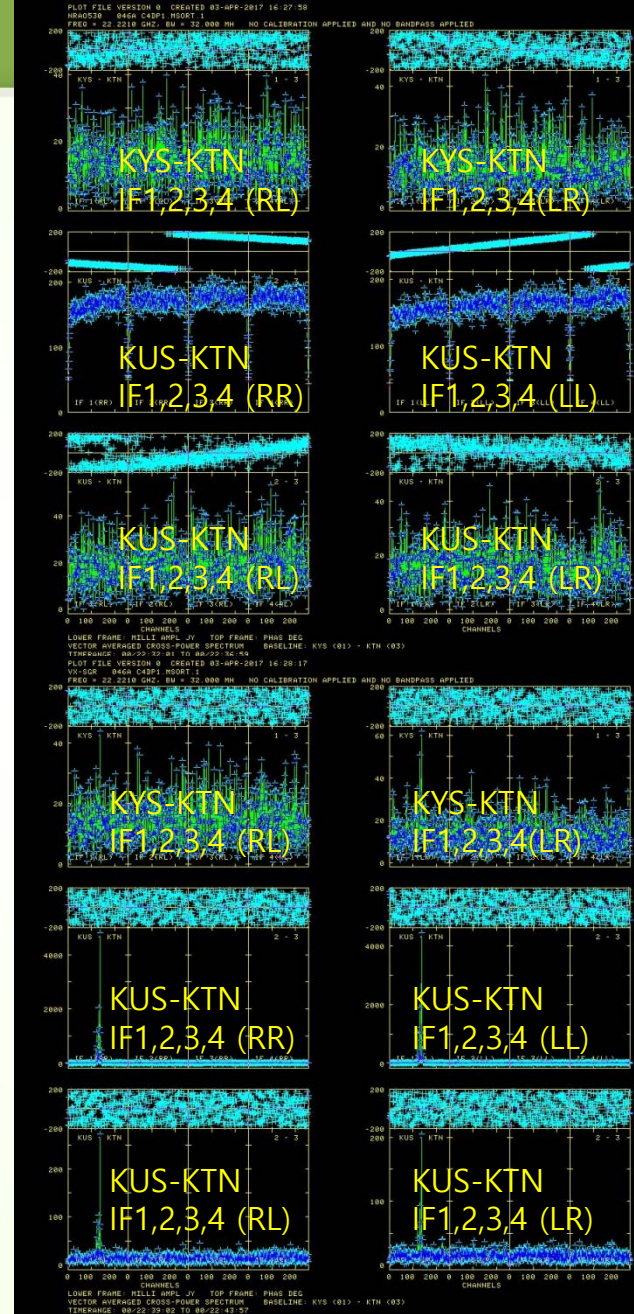
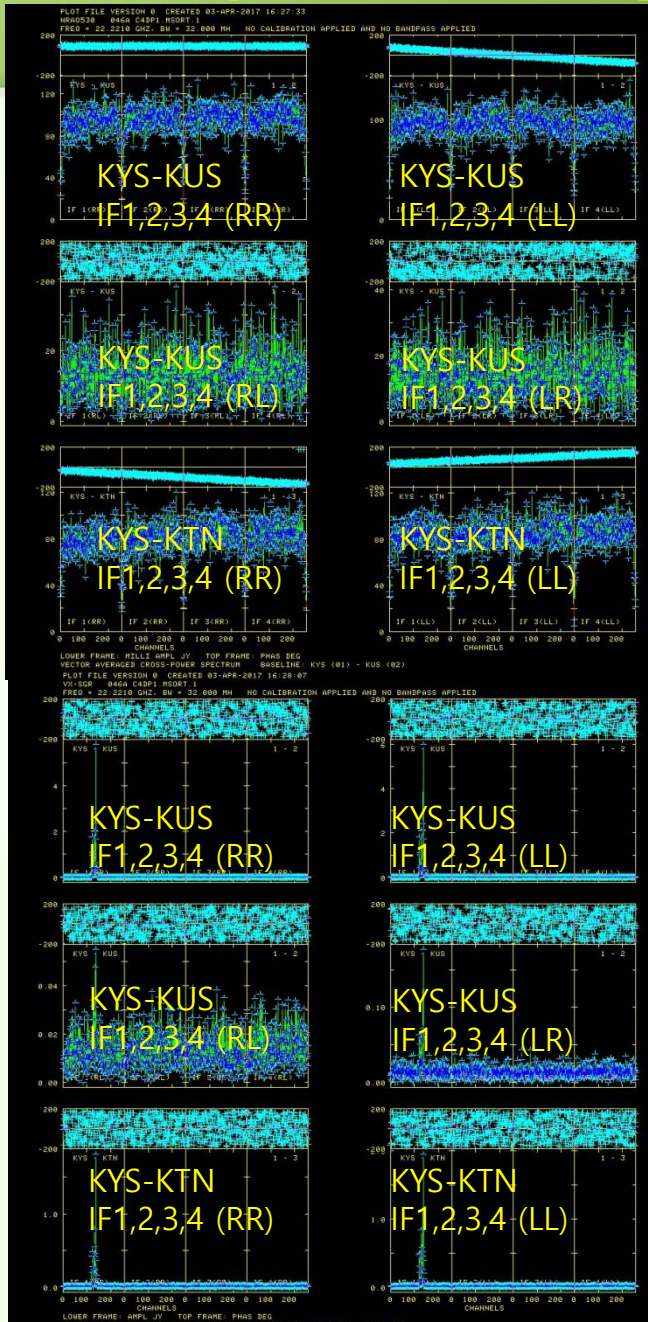
Narrowband dual-pol C2 mode(LR) – 128 MHz BW x 2 IFs



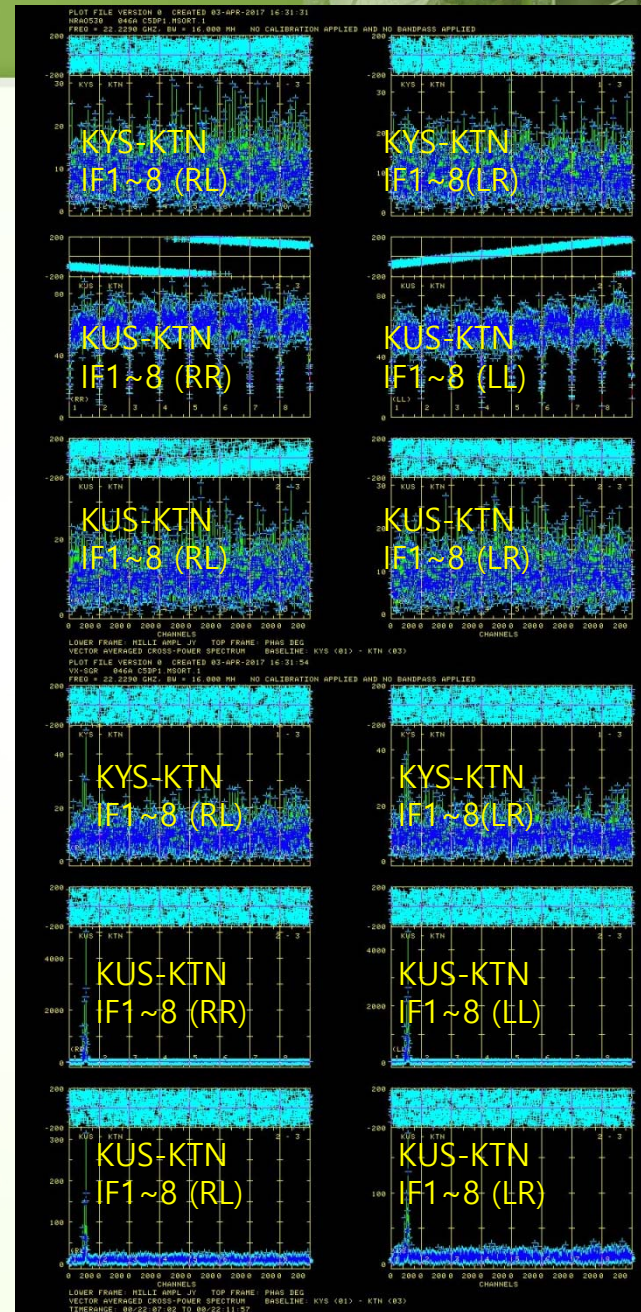
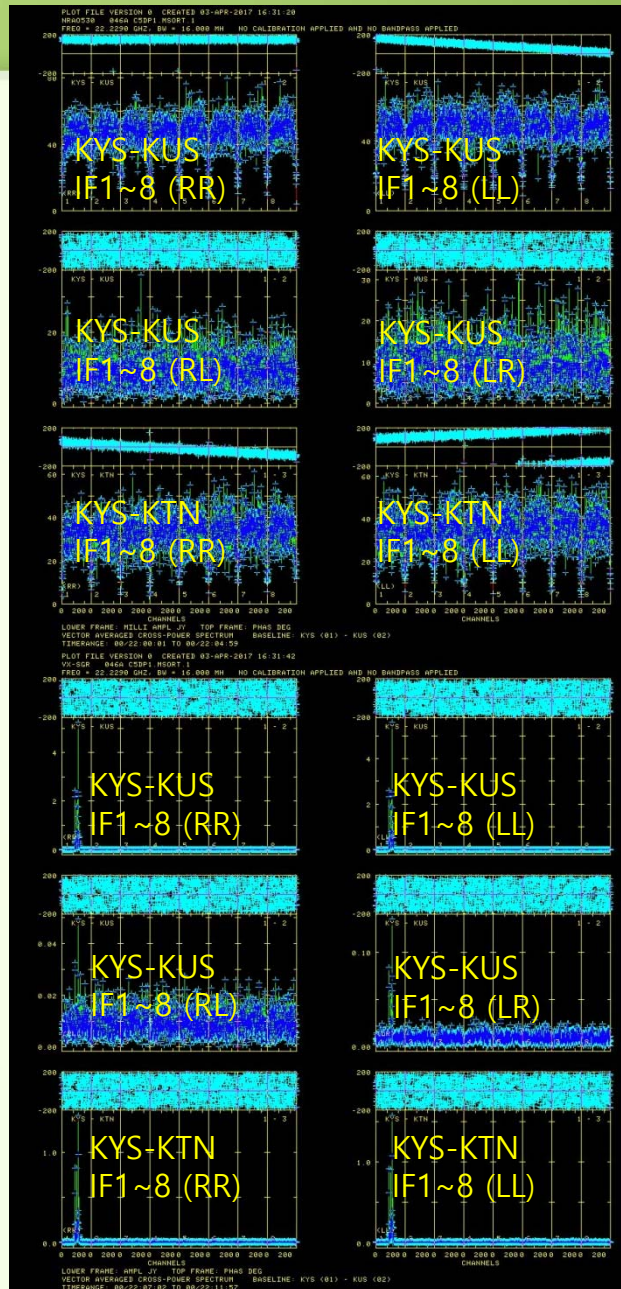
C3 mode(LLRR) – 64 MHz BW x 4 IFs



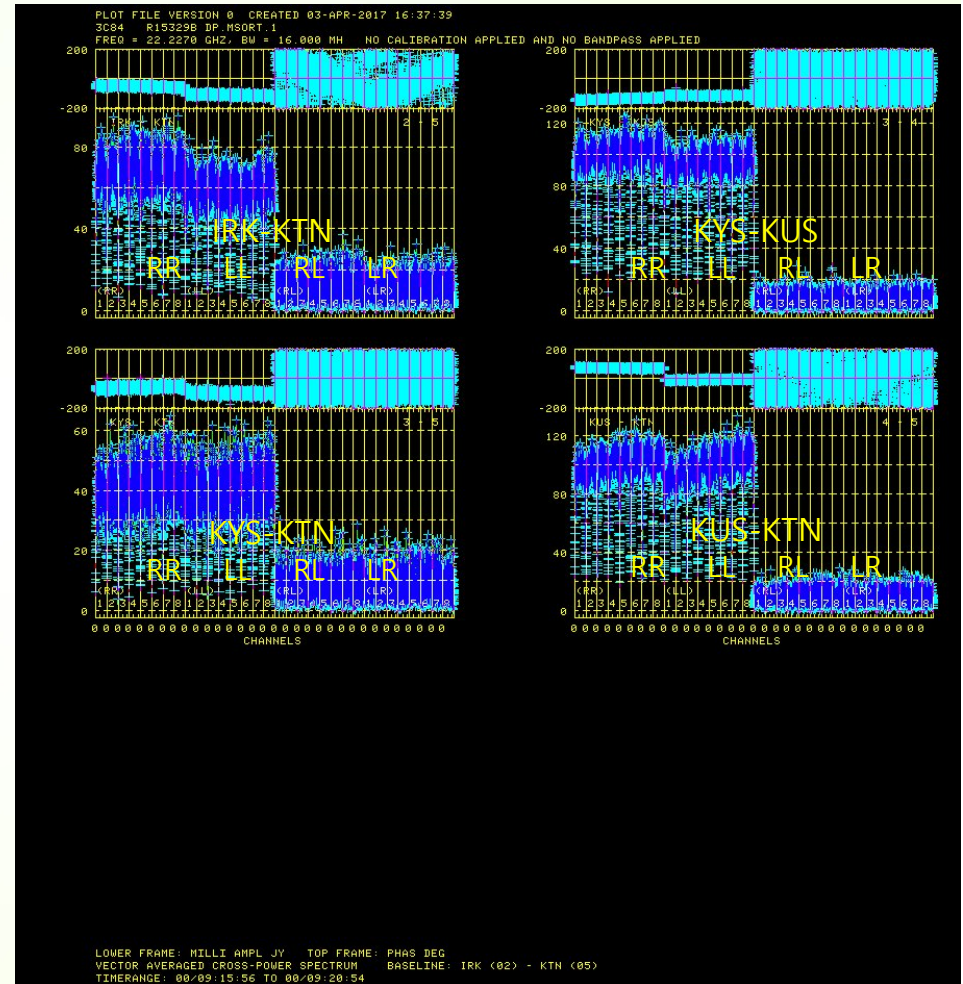
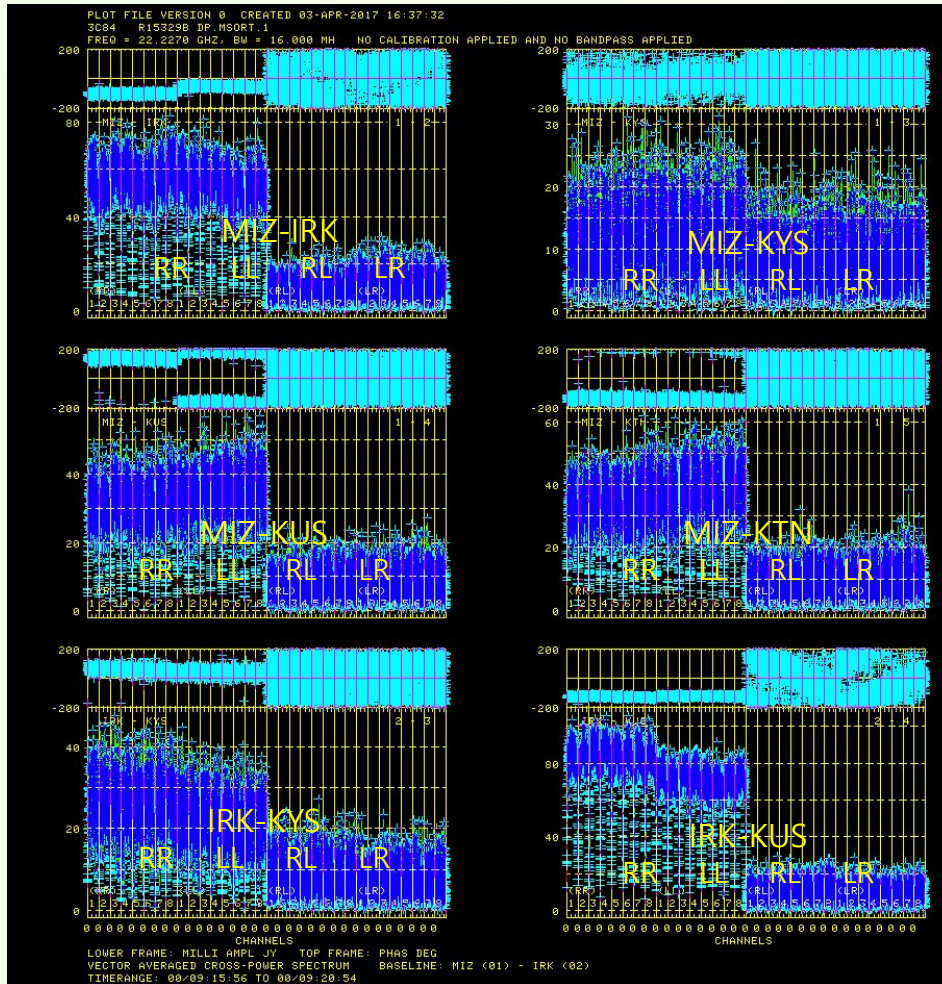
C4 mode(LLLLRRRR)- 32 MHz BW x 8 IFs



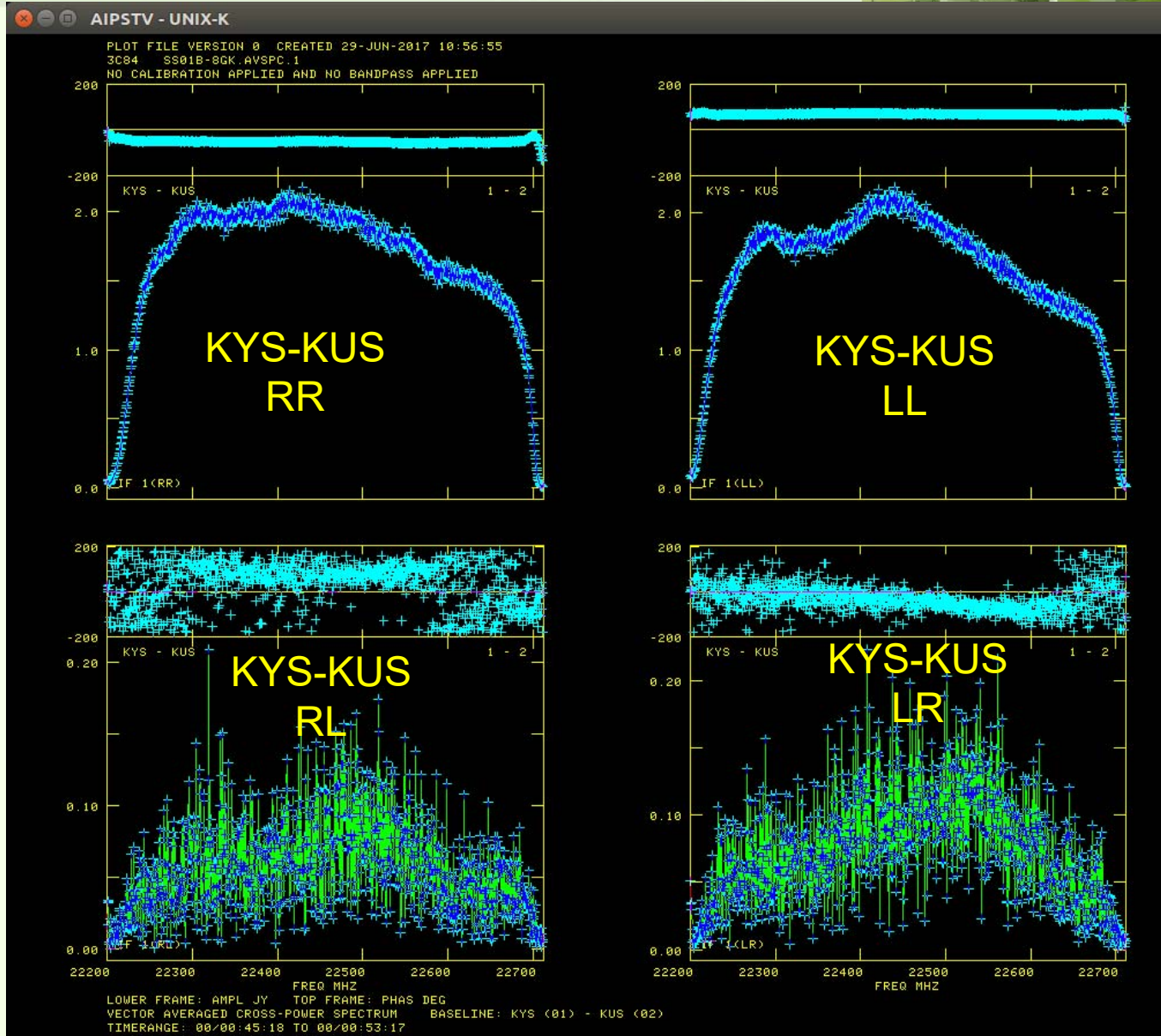
C5 mode(LLLLLLLRRRRRRRR) – 16 MHz BW x 16 IFs



C5 mode(LR 8times repeated) (r15320b)



Wideband(W3 mode) dual pol-correlation



Recorders in the World(8~32Gbps)



Mark6



FlexBuff



OCTADISK2

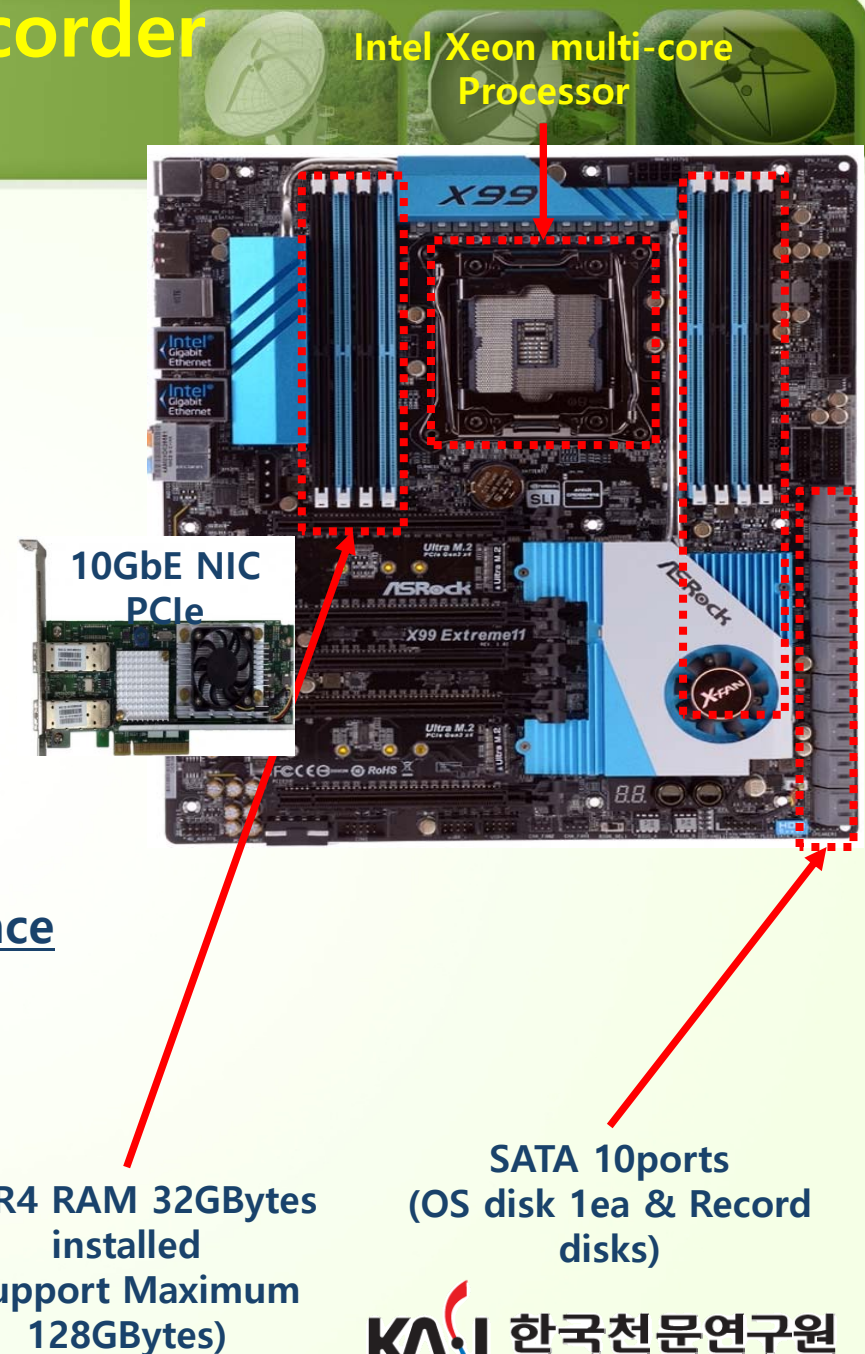


OCTADISK2
(VSREC)

- ✓ Linux OS base, Linux file system
- ✓ Resource Management needed
- ✓ Expensive(cost)

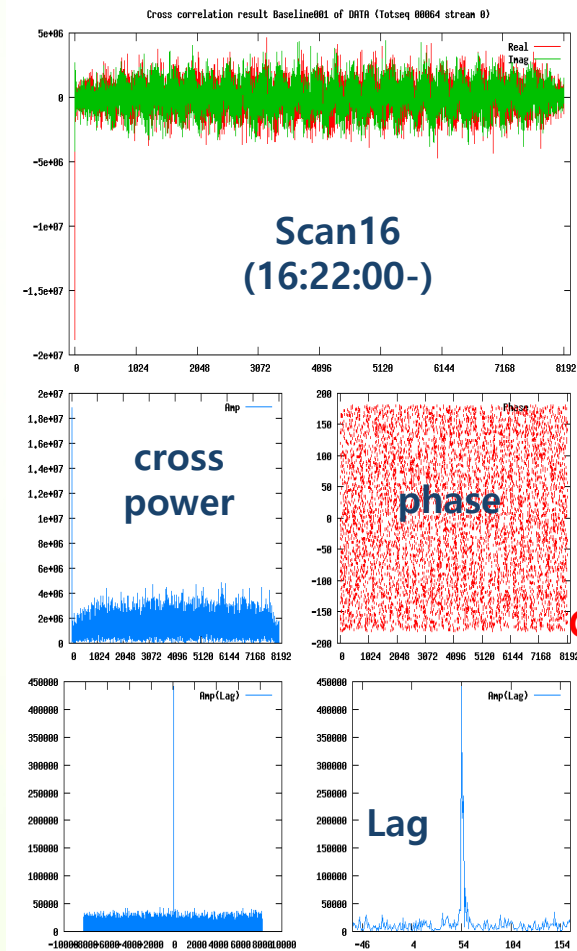
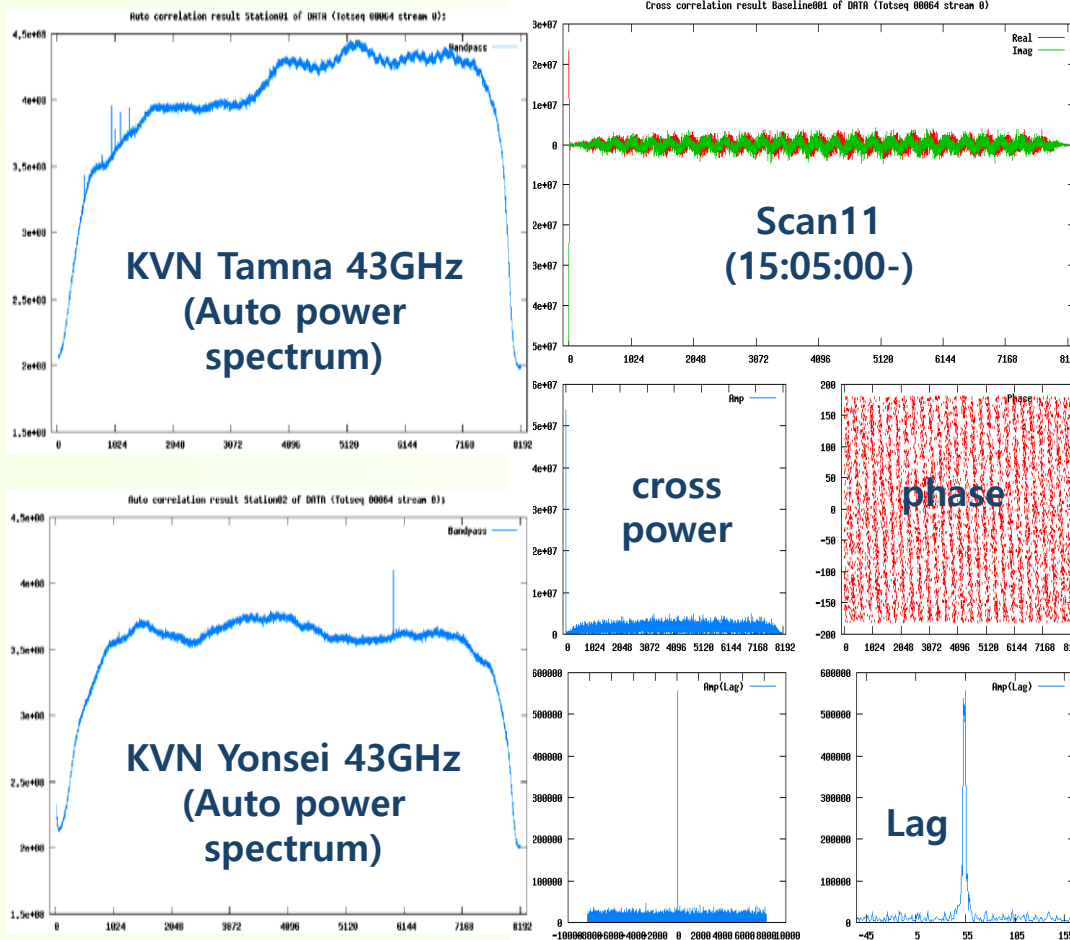
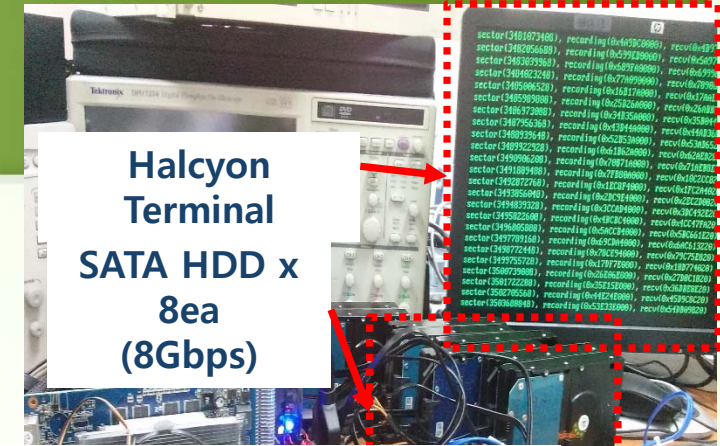
Developing KVN Halcyon recorder (Specification)

- Target processor : Intel Xeon
- Target board
 - Asrock X99 extreme11
 - DDR4 RAM 32GBytes
 - Broadcom BCM57711 NIC 10GbE PCIe
- Operating System : FirmOS(like DOS)
 - include scheduler
 - support multi-core
 - no filesystem
 - DRAM/NIC/SATA control directly
(without device driver)
- Build environment: gcc, nasm(boot code)
- can make full resources and performance
 - recording speed 8.224Gbps(VDIF UDP)
 - recordable capacity 90% of SATA HDD
- very cheap(Mainboard/CPU/RAM/NIC)
 - around \$3,000



1st Preliminary Recording Test @ KYS

- Experiment code : a17094a(EAVN), 3C273
- Recording time
 - UT. 12:35:00 – 17:35:00 (5hours)
 - 3.7TByte/hour at 8.224Gbps



DjROY Software Correlation

2nd KVN new recorder(Halcyon) test @ KYS



- ❖ **Observing method** : in 8 hours observing time, Halcyon KVN recorder was used for first 4 hours, then Mark6 recorder was used last 4 hours. After finished, the correlation result was compared between Halcyon and Mark6.

- ❖ **Observation info**

*s17tj03a : 1/8Gbps simultaneous recording test

May 24 08:00 UT - May 24 16:29 UT

Sources : 3C273, 3C279, M87

Frequency : 22L 43L 86L 129L (Freq4x512MHz)

Recorder : Mark5B(1G) / [(Halcyon) /Mark6(8G)]

Recording Time : 28200 (sec)

Disk Size : 28876.0 (GB)

- 22/43/86/129GHz simultaneous observing (Apply each IF 1/2/3/4)
- SNR comparison was done by performing Fringe fitting(30sec) as reference antenna of KYS

KYS-KTN baseline

1Gbps SNR (MK5)

8Gbps SNR (Halcyon + MK6)

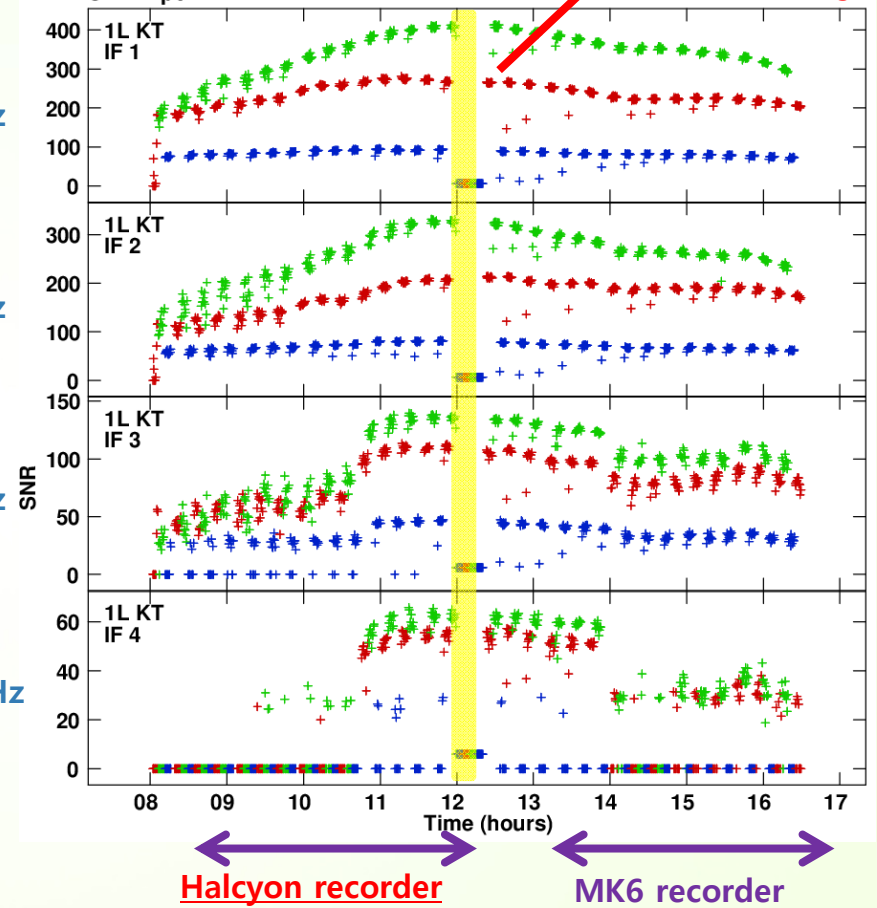
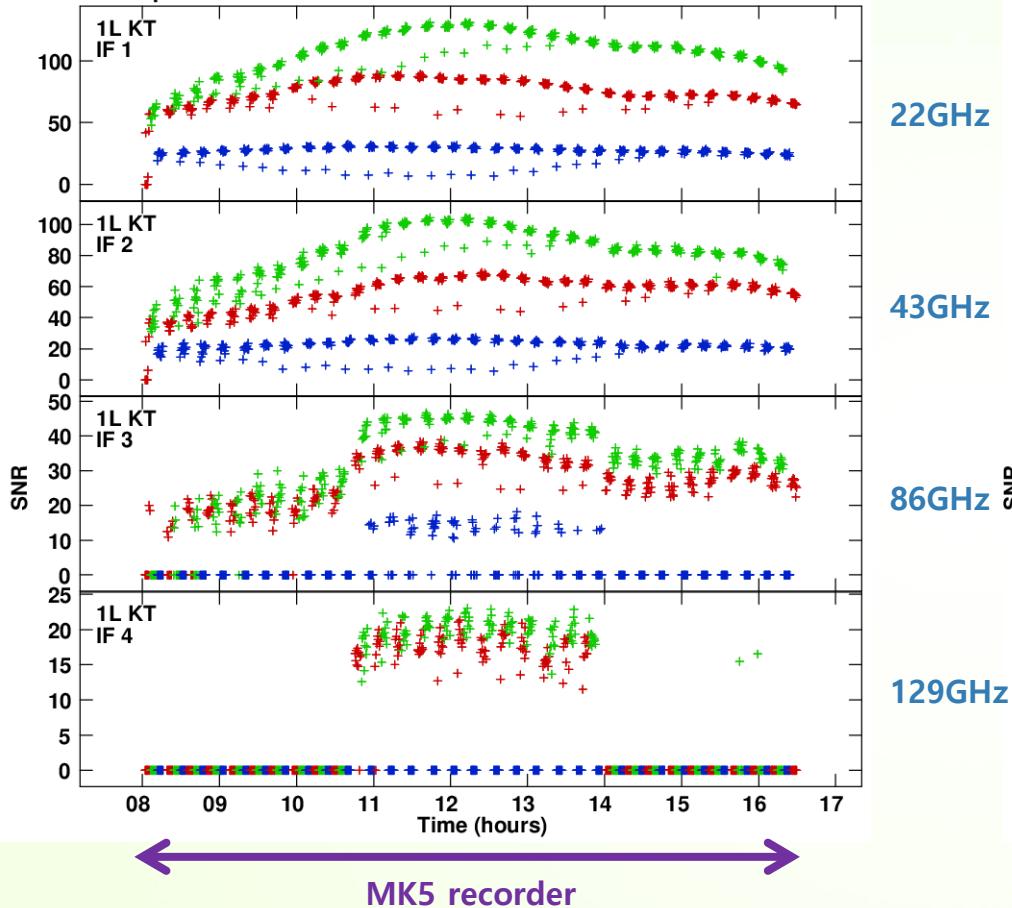


Plot file version 1 created 15-JUN-2017 14:07:52
SNR vs UTC time for S17TJ03A-1G.UVDATA.1
SN 1 Lpol IF 1 - 4

3C273, 3C279, M87

Plot file version 1 created 15-JUN-2017 14:07:59
SNR vs UTC time for S17TJ03A-8G.UVDATA.1
SN 1 Lpol IF 1 - 4

Empty period according to recorder change

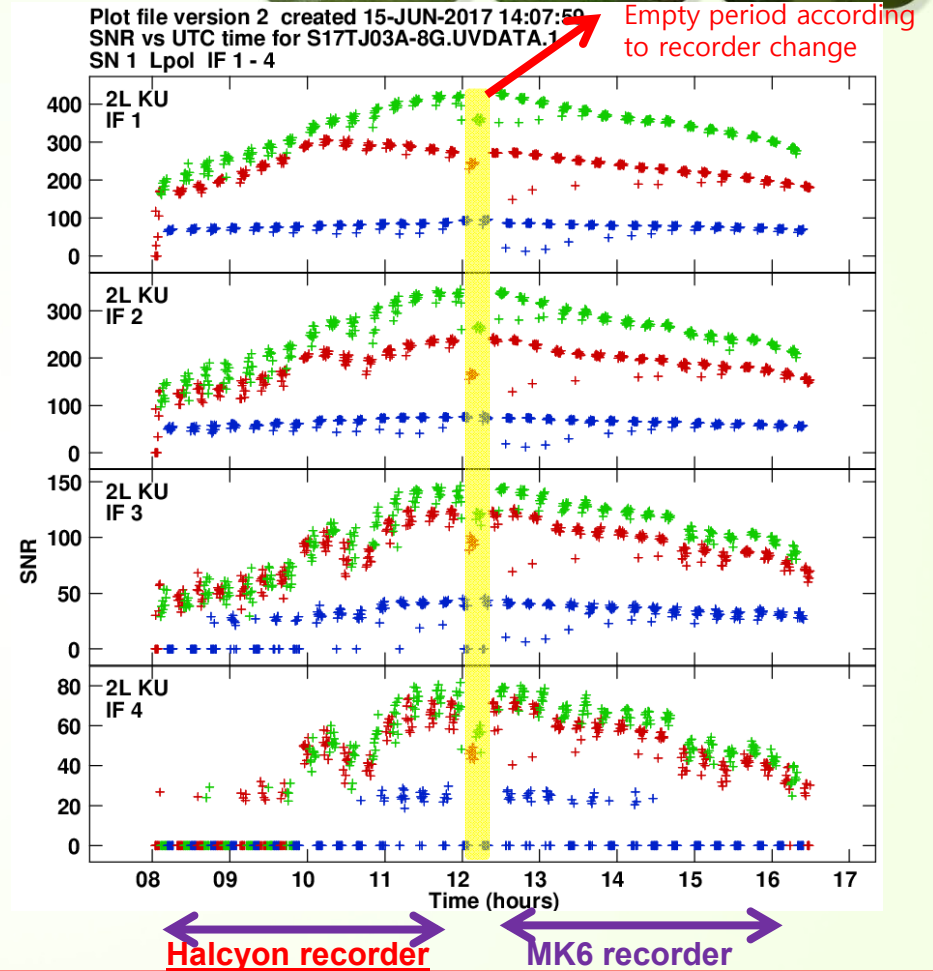
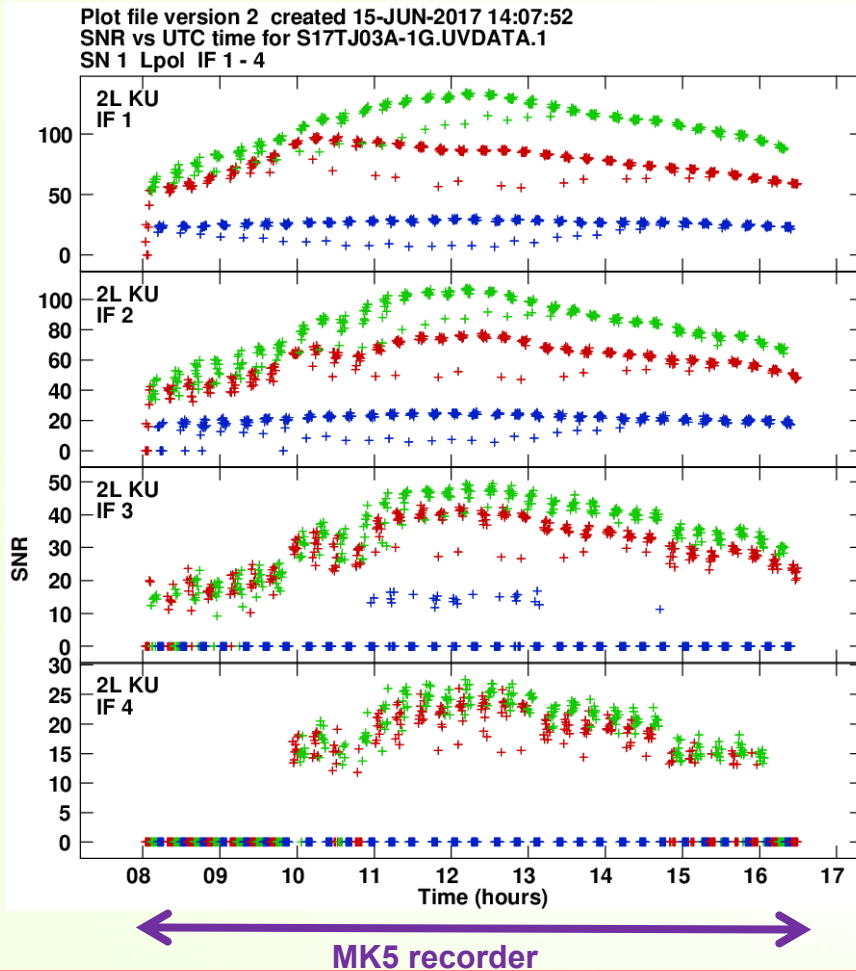


※ SNR comparison: 1Gbps(64 MHz BW/4IF) and 8Gbps(512MHz BW/4IF)
Expected value of theoretical sensitivity increment (about 3 times) is well followed according to the bandwidth increase (8 times).
The results of Halcyon are almost same as those of KYS Mark6

KYS-KUS baseline

1Gbps SNR (MK5)

8Gbps SNR (Halcyon + MK6)



※ SNR comparison: 1Gbps(64 MHz BW/4IF) and 8Gbps(512MHz BW/4IF)
Expected value of theoretical sensitivity increment (about 3 times) is well followed according to the bandwidth increase (8 times).
The results of Halcyon are almost same as those of KYS Mark6

Summary and Future Work



- ❖ 1Gbps correlation
 - Normally operated for KaVA and EAVN
 - Dual-pol correlation is available
- ❖ 2/4/6/8 Gbps normal operation
 - correlation is possible to support
 - Dual-polarization correlation for wideband is also possible
- ❖ KVN Halcyon recorder was developed
- ❖ E-transfer from EA area will be performed