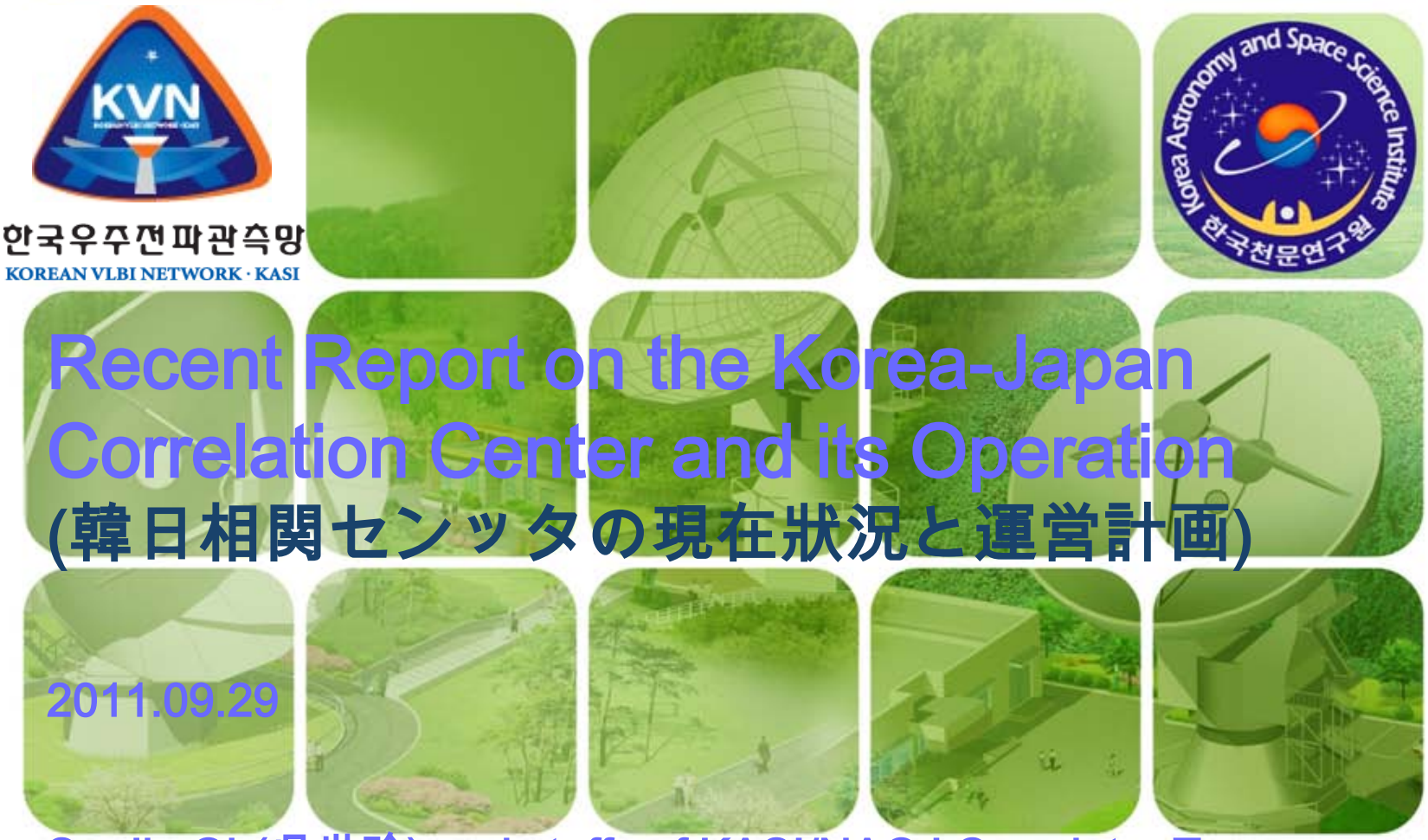


Recent Report on the Korea-Japan Correlation Center and its Operation
(韓日相関センッタの現在狀況と運営計画)

2011.09.29

Se-Jin Oh(吳世珍) and staffs of KASI/NAOJ Correlator Team

VERA User's Meeting, 2011. 9.28-29, Mitaka, Japan

Contents

- Outline of KJJVC
  - Status of HW/SW
- Operational Plan of KJCC
- Future Plan

Outlook of KJCC

- For KVN, KVN+VERA, EAVN
- It is able to process the correlation for 16 stations with 8 Gbps.
- 2005→ 2010 (for 6 years)

Developed and responsible for NAOJ

Developed and responsible for KASI

KASI 한국천문연구원 Korea Astronomy & Space Science Institute

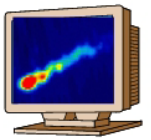
Korea-Japan Joint VLBI Correlator(KJJVC)

Specifications

# of Antennas	16
# of Inputs / Antenna	4 bands (4Fx1P, 2Fx2P,1Fx2P+2Fx1P)
Max. # of Correlations / Input	120 Cross + 16 Auto
Subarray	2 case (12 + 4, 8 + 8)
Bandwidth for each Input	512 MHz
Digitization for each Input	1 Gsps by 2bits/sample
Data Rates per antenna	8 Gbps VSI-H (32 parallels, 64 MHz clock)
Max. Delay compensation	±36,000 km
Max. Fringe Tracking	1,075 kHz
Architecture	FX type, with FPGA and DSP chips
Word length in FFT	16+16 bits fixed point for real & imag.
Integration	25.6 msec ~ 10.24 sec
Data compression (Flexible Binning)	8,192 channels

Korea-Japan Joint VLBI Correlator (KJJVC)

Data Flow and related Hardware/Software



Mark5B

VERA2000

VSI cable

VSI cable

Raw VLBI Data Buffer(RVDB)

VSI cable

VLBI Correlation Subsystem(VCS)

Optical cable

Peta-scale Epoch Data Archive(PEDA)

File System Share(NFS)

CODA Server

FITS-IDI

AIPS

Analysis Software

-Re-ordering & Plotting tools (KASI)

Hardware

OCTADISK

TBD

Optical Fiber (e-VLBI)

TBD

Software

Playback Control SW

Mark5B Ply control SW
-Consol SW (KASI/MIT)
-Control GUI (KASI/NAOJ)

VERA2K Ply control SW
-DMS24 control SW(NAOJ)
-Consol SW (NAOJ)
-Control GUI (NAOJ)

Data Input SW (DB)
-Control GUI (KASI)

RVDB control SW

-Consol SW (Elecs/NAOJ)
-Control GUI (NAOJ)
-Mk5B, VERA2K control GUI(KASI/NAOJ)

Correlation Control SW(CCS)

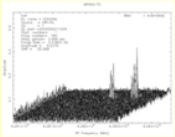
-Consol SW1(Elecs tool) (Elecs)
-Consol SW2(CCS) (KASI)
-Delay control SW (KASI)
-CCS GUI (KASI)

-VCS Output Speed new FPGA new Firmware applied

DA Control SW(DACS)

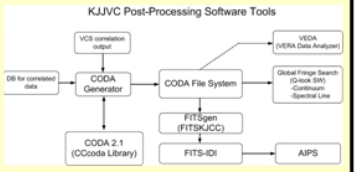
-DACS (KASI)

Control and Operation Software



Corr. Post-Processing SW

CODA File System
-CODA generator(Kanya)
-uvw, delay parameter re-calculation SW(KASI)
-FITSgen(FITSKJCC)(Kanya)
QL GFS SW(Kagoshima) : Continuum, Spectral-line



Post-Processing SW

Data Line

Control Line

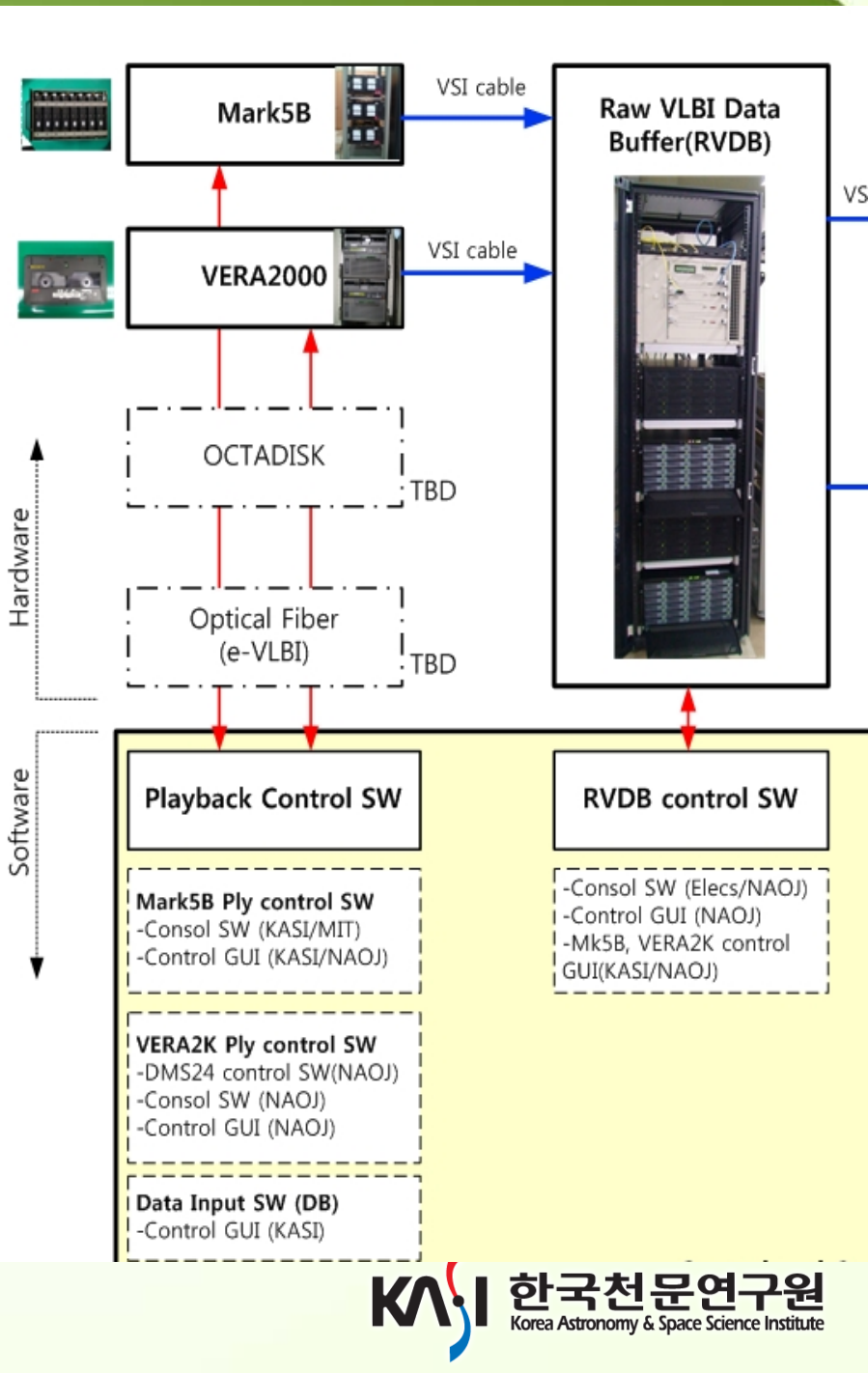
TBD

Blue Color Character : in progress

RVDB : Raw VLBI Data Buffer
VCS : VLBI Correlation Subsystem
PEDA : Peta-scale Epoch Data Archive
CODA : Correlation Output Data Analysis
QL GFS : Quick Look Global Fringe Search
GUI : Graphical User Interface
CCS : Correlation Control Software
DACS : Data Archive Control Software
NFS : Network File System
AIPS : Astronomical Image Processing System
FITS-IDI : Flexible Image Transport System Interferometry Data Interchange

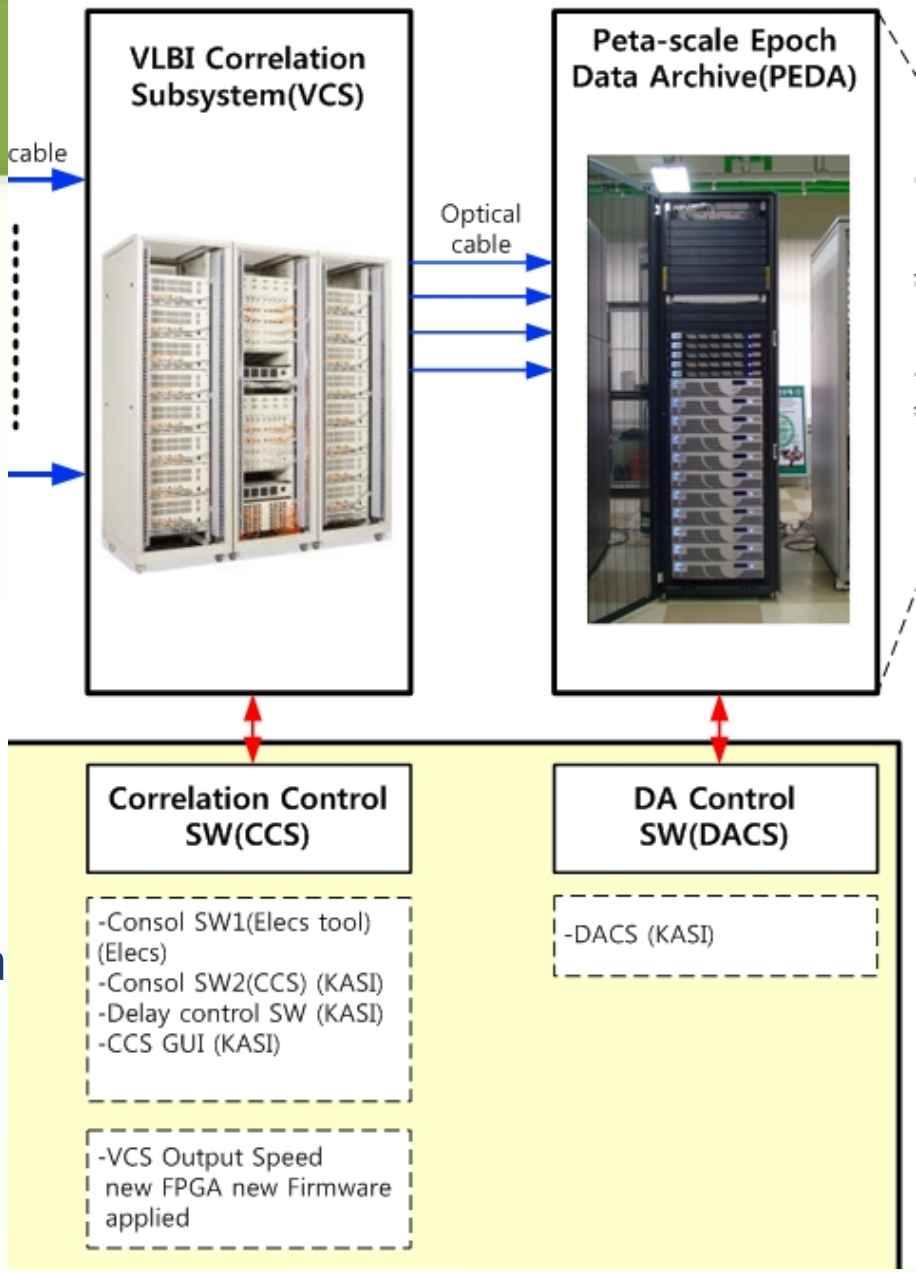
Playback/RVDB

- **Mark5B**
  - We modified the Mark5B playback SW and succeeded to playback the observation data without error in KJCC.
  - Copied and delivered SgrA* obs. data to Mitaka
- **RVDB**
  - 3 sets DIO and DDB of RVDB system was changed to OCTAVIA and OCTADDB for compatible with Mitaka.
  - The remained 1set will be upgraded within next month.
  - 3 RVDB :
    - 1DDB : 2TB x 24 = 48 TB (~96 hrs, 1Gbps) x 4 DDB = 192 TB
    - Total : 192 TB x 3 set = 576 TB
  - The FPGA firmware was successfully installed and system is now well operating and it is very stable compared with previous DIO and DDB.
  - It can support the VDIF data format as directly adopting eVLBI.



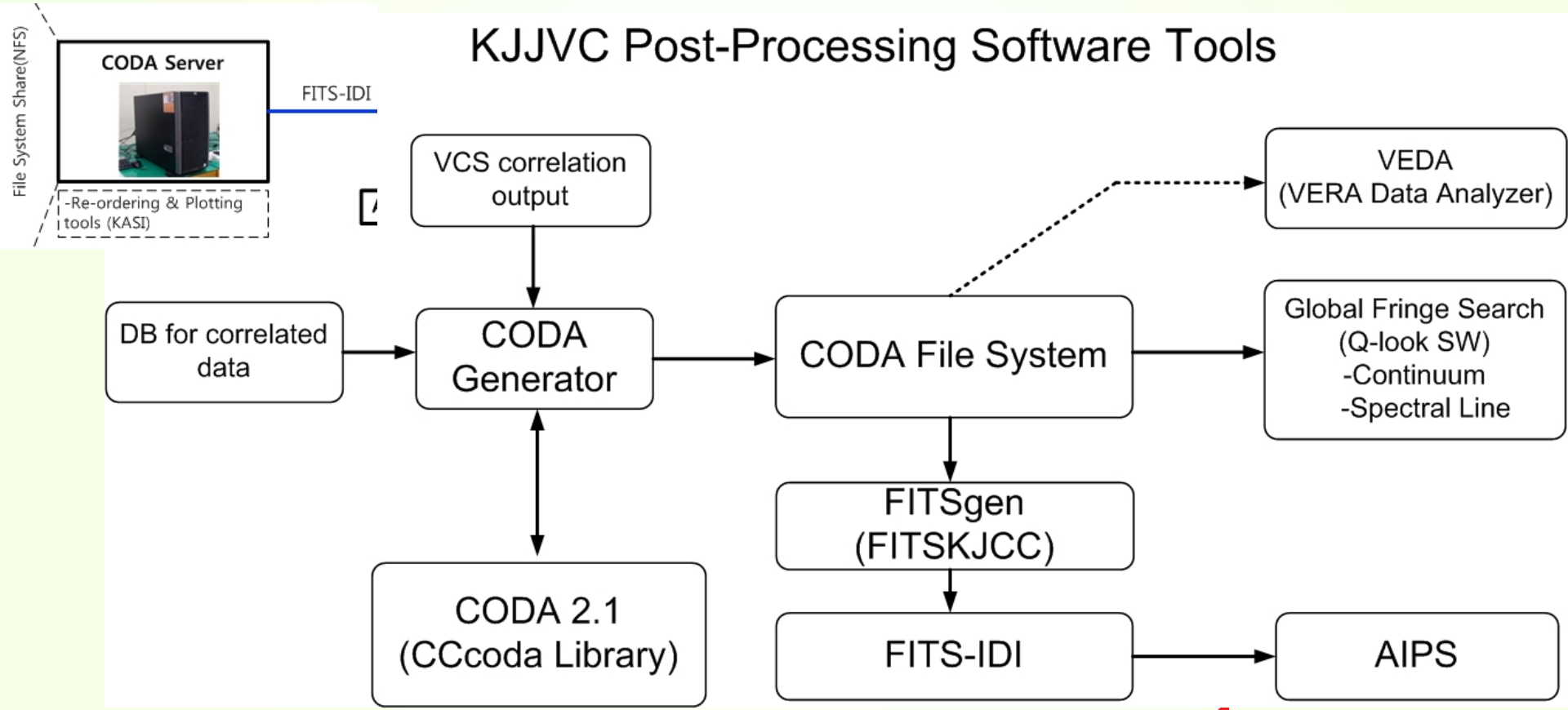
VCS/PEDA

- **Delay parameter SW**
  - New UVW, delay parameter SW development was completed by KASI, it will be tested to compare with Mitaka delay SW.
- **PEDA extension**
  - Now 100 TB storage, it will be filled with 2 or 3 month for normal operation.
  - To extend the storage and support 16 stations correlation, the design and discussion will be perform from this autumn.



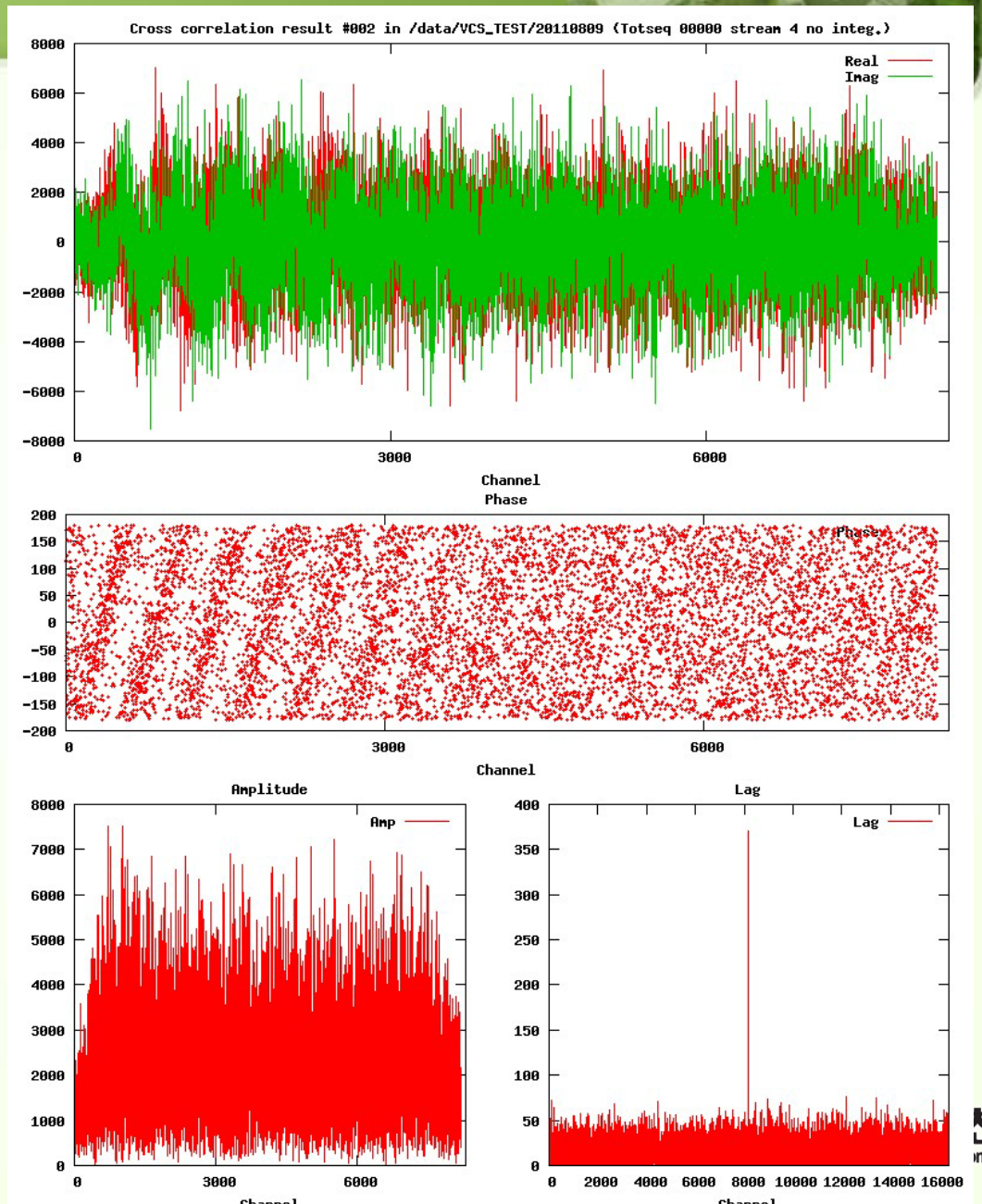
Post-Processing SW configuration

- Developing with Japanese colleagues, NAOJ(CODA) and Kagoshima Univ.(GFS)
- CODA file system (CCcoda ver2.1), FITSgen : Kan-ya san
  - ➢ to reduce the developing efforts & cost, and to have compatibility with FX

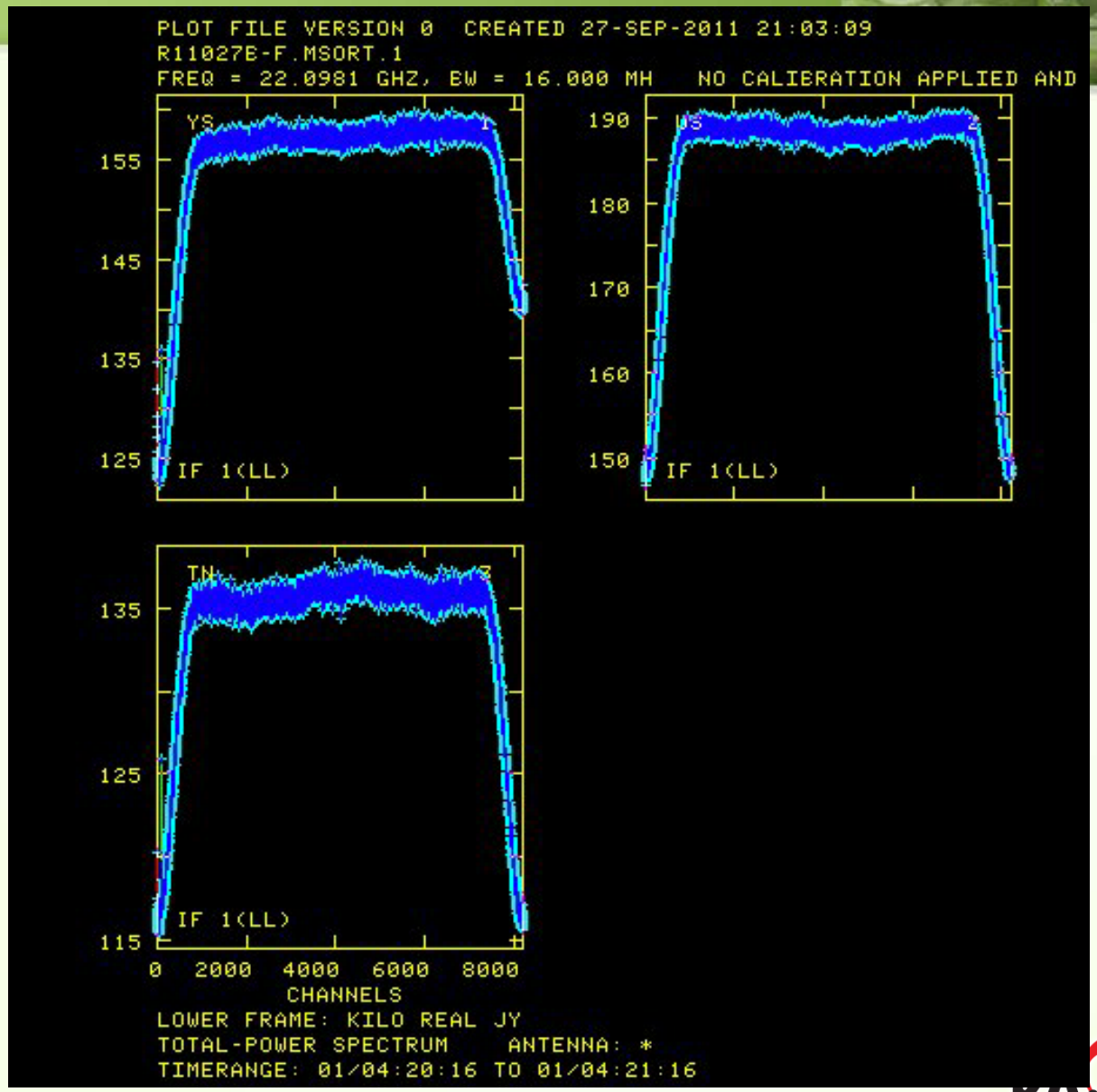


VCS Correlation Result

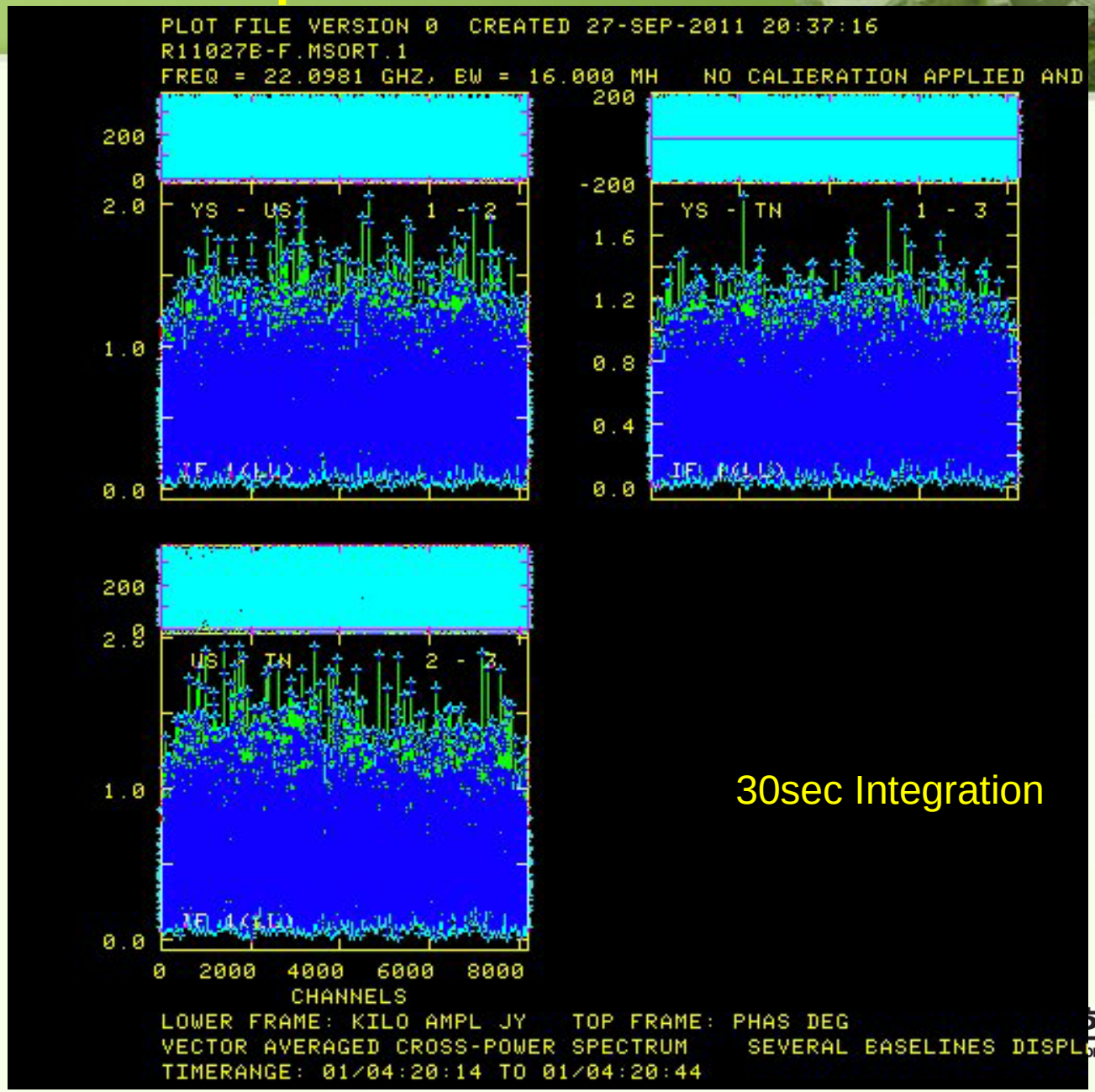
- R11027b, scan267
- 3C454.3
- YS-US baseline



Auto Correlation

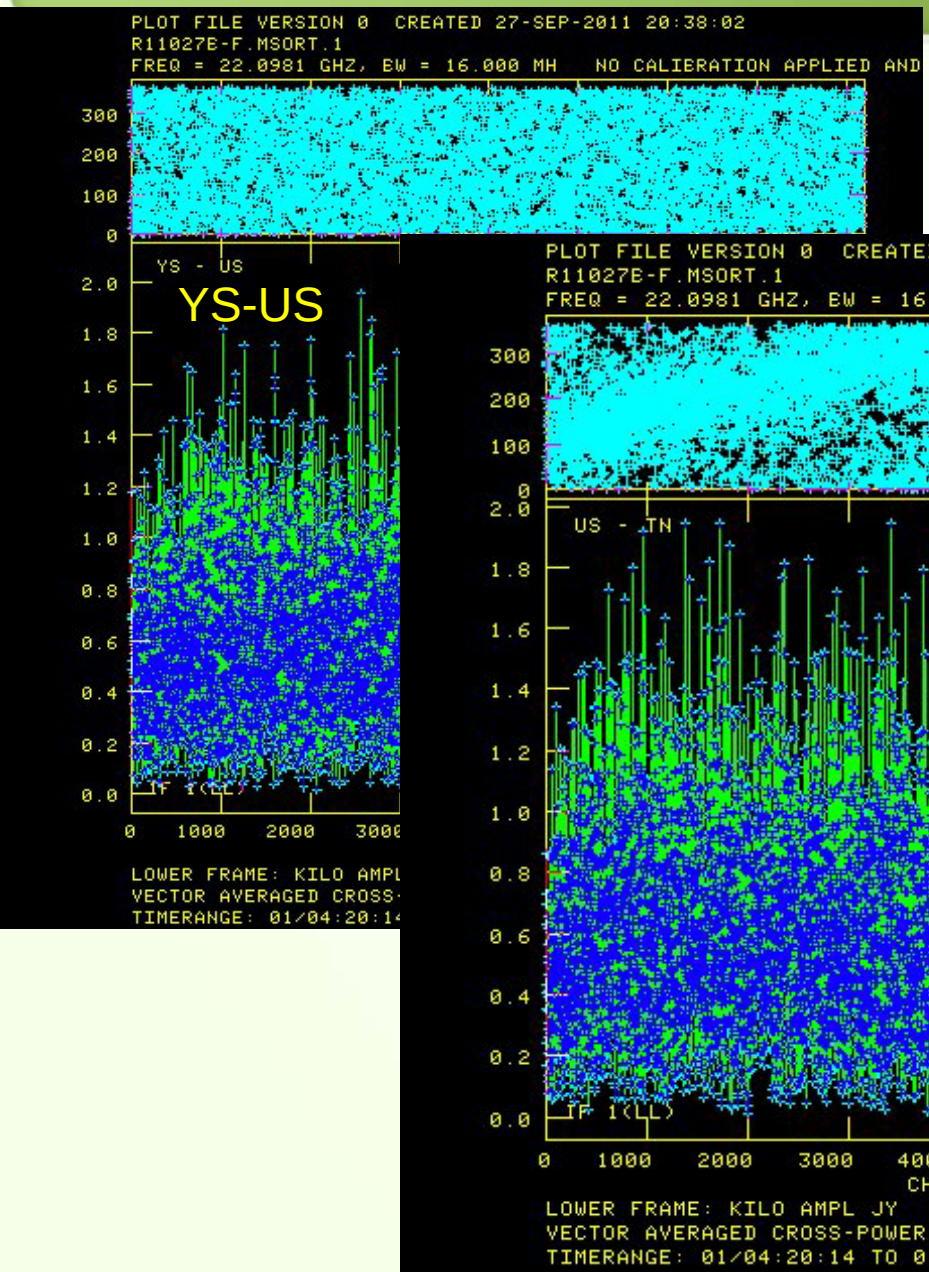


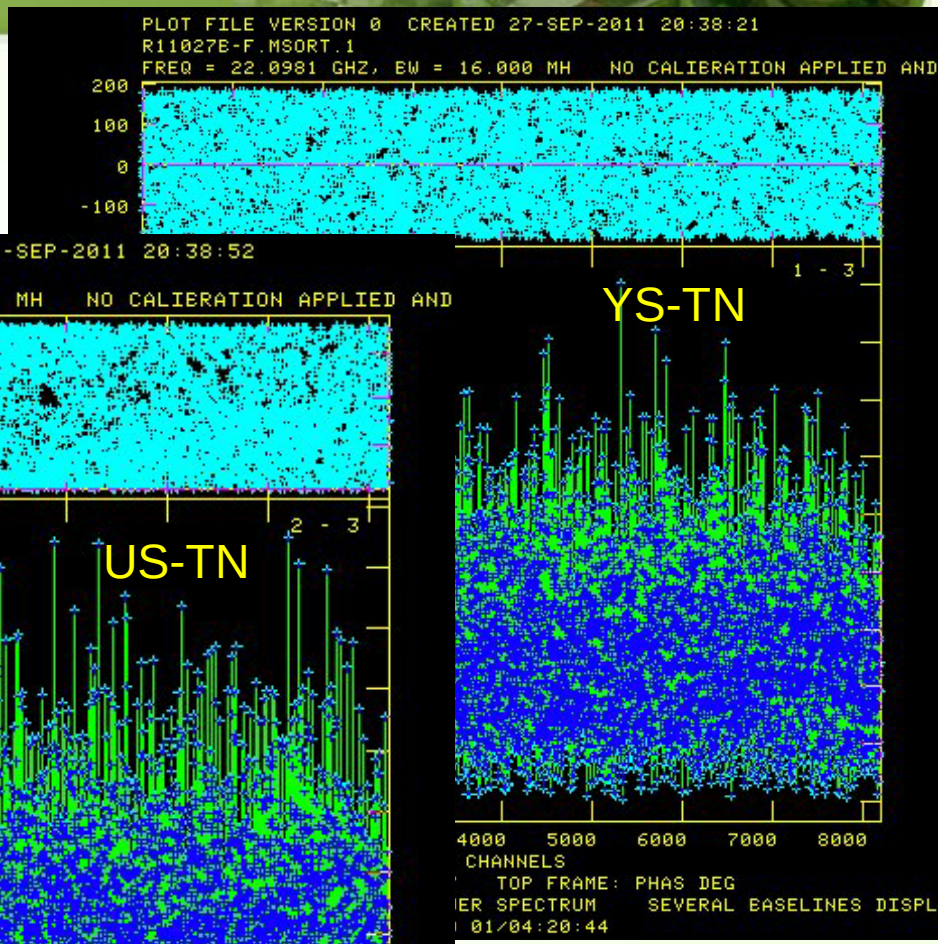
Cross Power Spectrum1



30sec Integration

Cross Power Spectrum2





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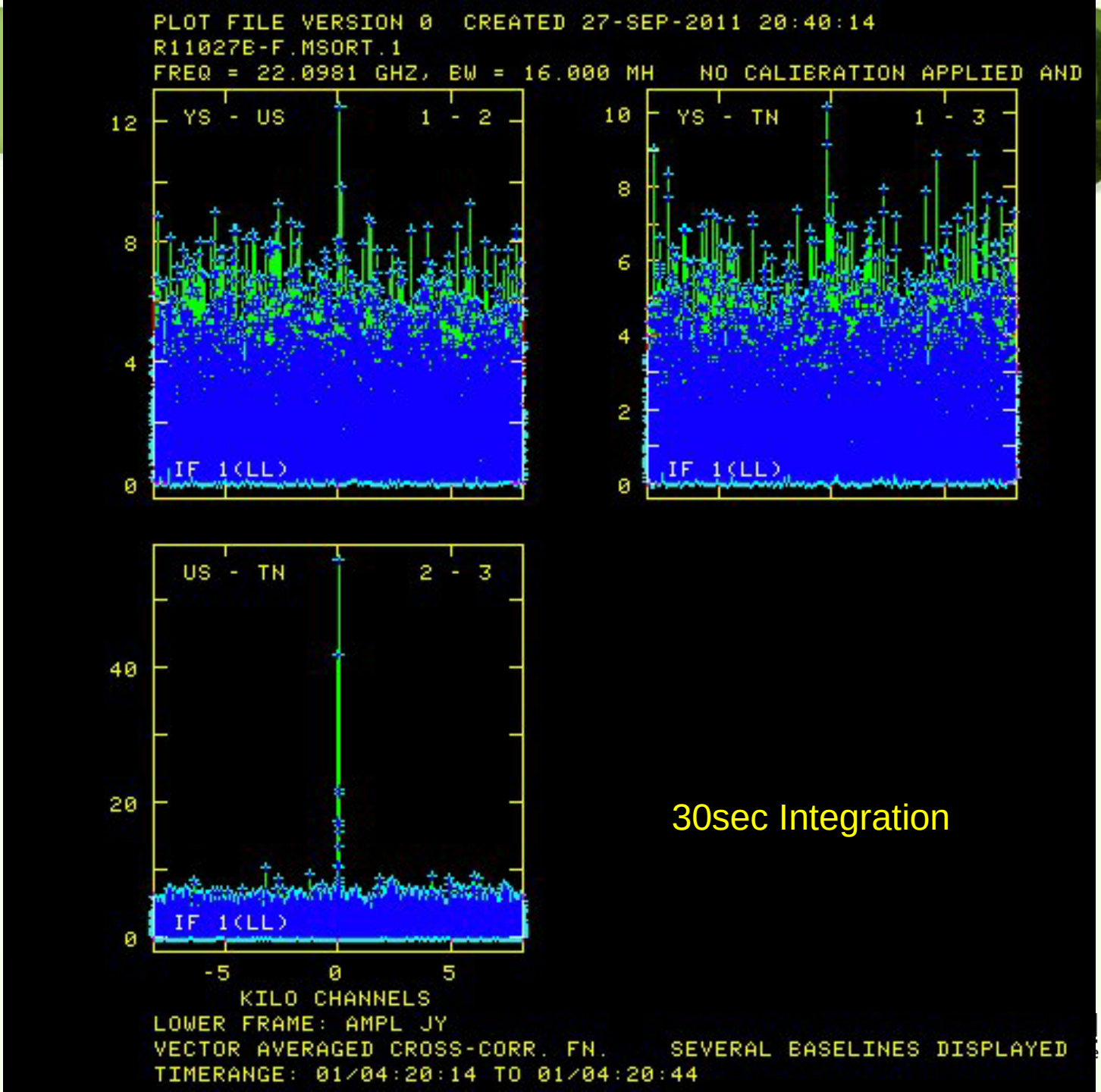
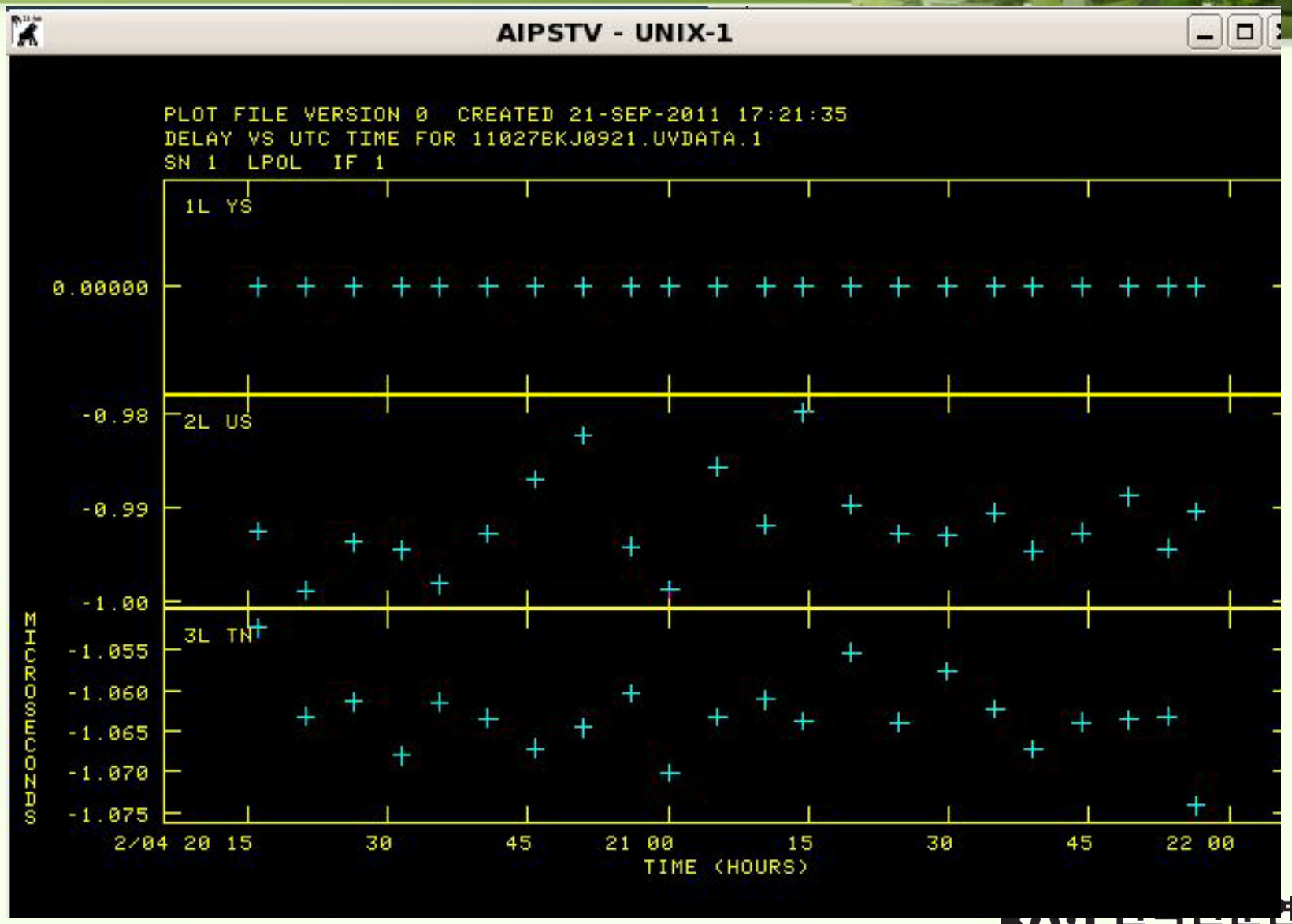
Fringe

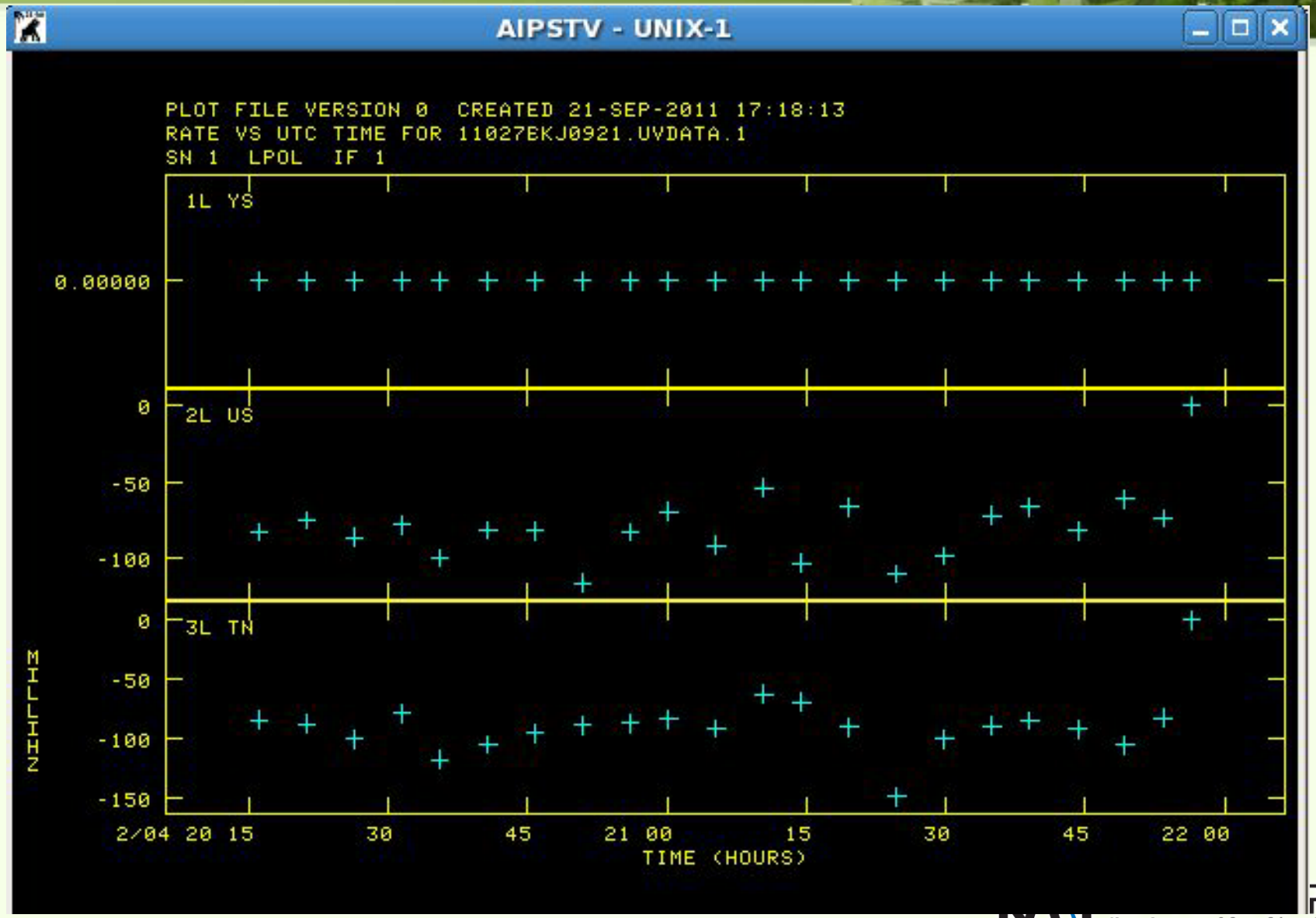


30sec Integration

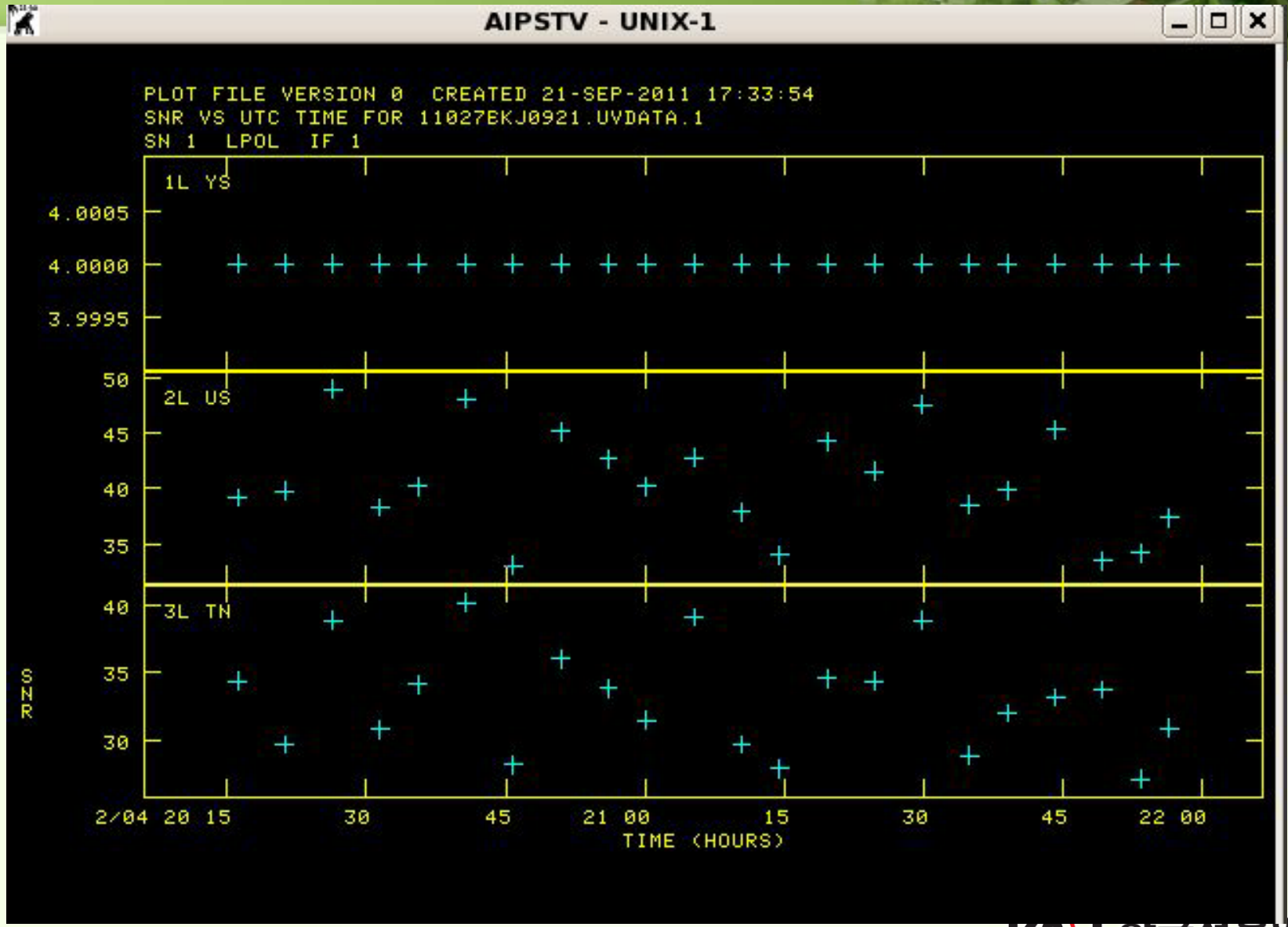
Delay


AIPSTV - UNIX-1
PLOT FILE VERSION 0 CREATED 21-SEP-2011 17:21:35
DELAY VS UTC TIME FOR 11027BKJ0921.UVDATA.1
SN 1 LPOL IF 1
1L YS
0.00000
2L US
-0.98
-0.99
-1.00
3L TN
-1.055
-1.060
-1.065
-1.070
-1.075
MICROSECONDS
2/04 20 15
30
45
21 00
15
30
45
22 00
TIME (HOURS)

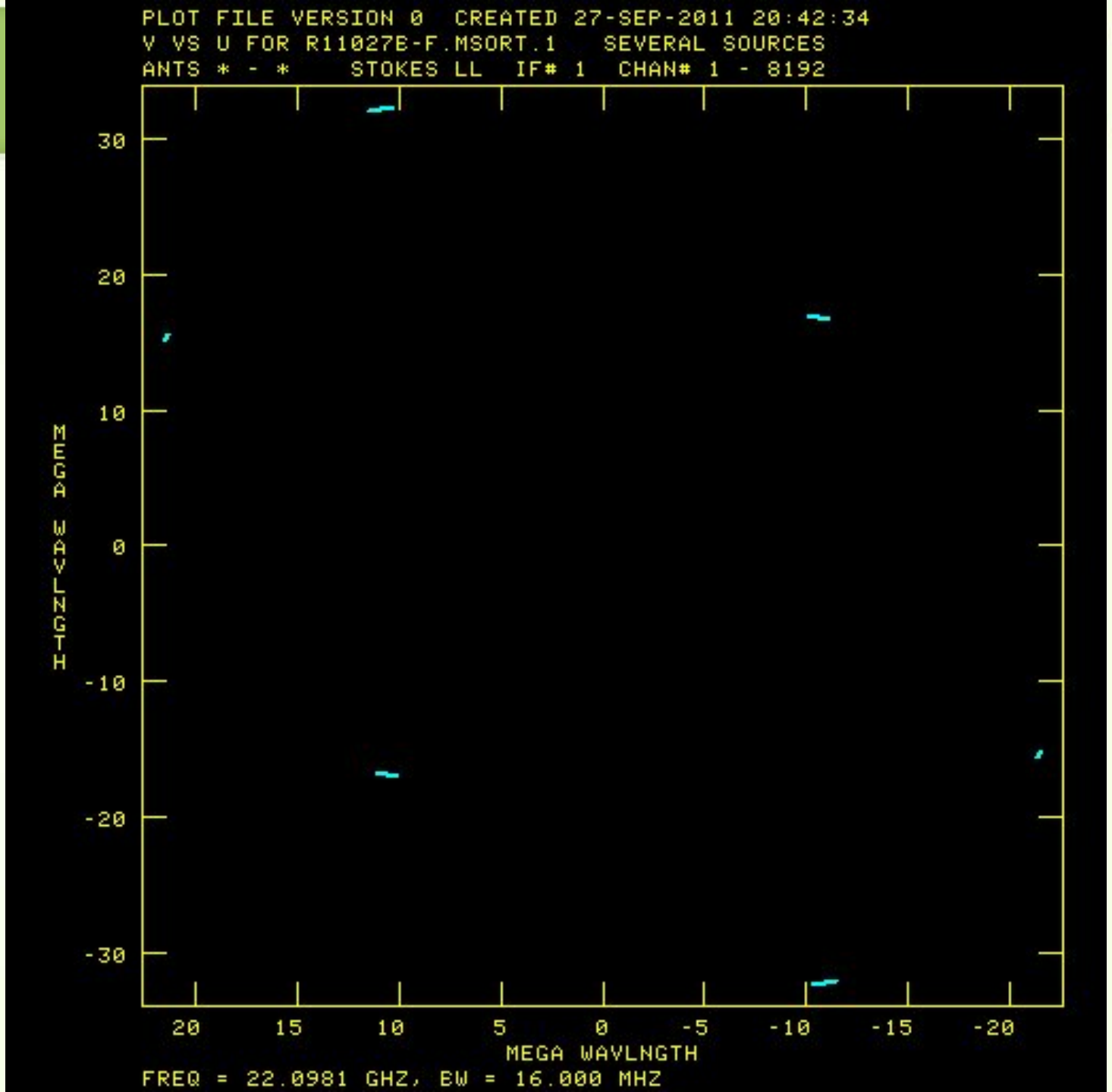
Rate


AIPSTV - UNIX-1
PLOT FILE VERSION 0 CREATED 21-SEP-2011 17:18:13
RATE VS UTC TIME FOR 11027BKJ0921.UVDATA.1
SN 1 LPOL IF 1
1L YS
0.00000
2L US
0
-50
-100
3L TN
0
-50
-100
-150
MILLIHZ
2/04 20 15
30
45
21 00
15
30
45
22 00
TIME (HOURS)

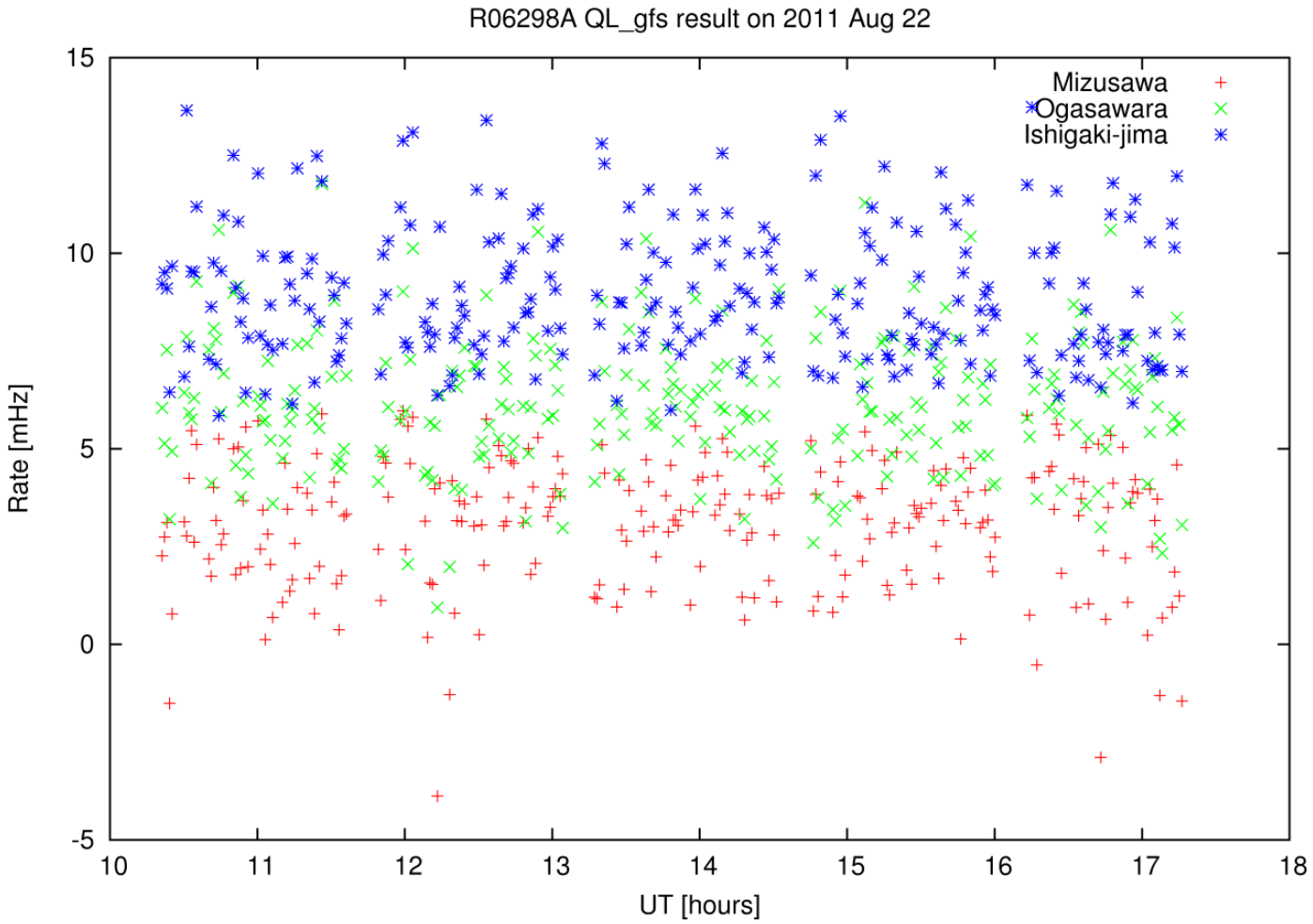
SNR



UV plot


PLOT FILE VERSION 0 CREATED 27-SEP-2011 20:42:34
V VS U FOR R11027E-F.MSORT.1 SEVERAL SOURCES
ANTS * - * STOKES LL IF# 1 CHAN# 1 - 8192
30
20
10
0
-10
-20
-30
MEGA WAVLNGTH
20
15
10
5
0
-5
-10
-15
-20
MEGA WAVLNGTH
FREQ = 22.0981 GHZ, BW = 16.000 MHZ

QL_GFS spectral line(for VERA data)



KJCC Operation Phase

When	Phase	Item
2011~	Evaluation Operation Phase	•Evaluation Operation(KVN & KJJVN correlation) •VSI optical adapter development •Data Archive Upgrade Design will be Started
2012~	Normal Operation Phase	•Normal Operation •~4000hours/year operation is expected •Move to Daejeon(2012 autumn) •Upgrade Data Archive
2014~	Ripe Phase	•Maximum 16stations operation •~6000hours/year operation is expected •Update observation data rate to 8Gbps •Implement Back-up system

Organization Structure for KJCC

Memorandum of Agreement
for Korea-Japan Correlation Center Joint Operation
President of KASI, Director General of NAOJ

Executive Board
Director of Radio Astronomy Division(KASI)
Director of Mizusawa VLBI Observatory(NAOJ)
Manager of RA Project Center(KASI)
Chair of East Asian VLBI Network(international)
Correlator Manager(KASI)
System Engineer(KASI, NAOJ)
System Scientist(KASI, NAOJ)

Operation Group (KASI)

Operation Group (NAOJ)

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MoA for KJCC joint operation('11.7.20.)

Structure of the EB

- **Korean Side**
  - Director of Radio Astronomy Division: Dr. Kim Hyun-Goo
  - RA project center Manager: Dr. Kim Bong-Gyu
  - Operation Manager: Dr. Roh Duk-Gyoo
  - System Scientist: Dr. Cho Se-Hyung, Dr. Lee Sang-Sung
- **Japanese side**
  - Director of Mizusawa VLBI Observatory: Dr. Kawaguchi Noriyuki
  - EAVN Chair: Dr. Kobayashi Hideyuki
  - System Engineer: Dr. Shibata Katsunori
  - System Scientist: Dr. Honma Mareki
- **Secretary**
  - Dr. Oh Se-Jin
- **Chairmanship**
  - Entrusted to a Korean or Japanese Director depending to the meeting place.

Operation Group

1. Korean Operation Group
    1. Network Interface
        Dr. Oh Chung-Sik, Dr. Miyazaki Atushi
    2. Hardware Interfce
        Mr. Yeom Jae-Hwan
    3. Correlator Operator
        Two employee in commissioning phase, 3 or more in future
2. Japanese Operation Group
    1. Network Interface
        Dr. Sawada-Sato Satoko, Dr. Kim Mi-Kyoung
    2. Hardware Interface
        Dr. Oyama Tomoaki, Dr. Kono Yusuke

Operation Structure

KJCC

Executive Board

KVN + VERA(+ EAVN)

Joint Correlation Center

	now	future
Project manager	1 ,	1
Operation manager	1 ,	1
System Engineer	2 ,	3
Operator	2 ,	6
Data quality analyzer	2 ,	4

Oper. Support Group

- KVN
- VERA
- EAVN
- Mitaka Correlator

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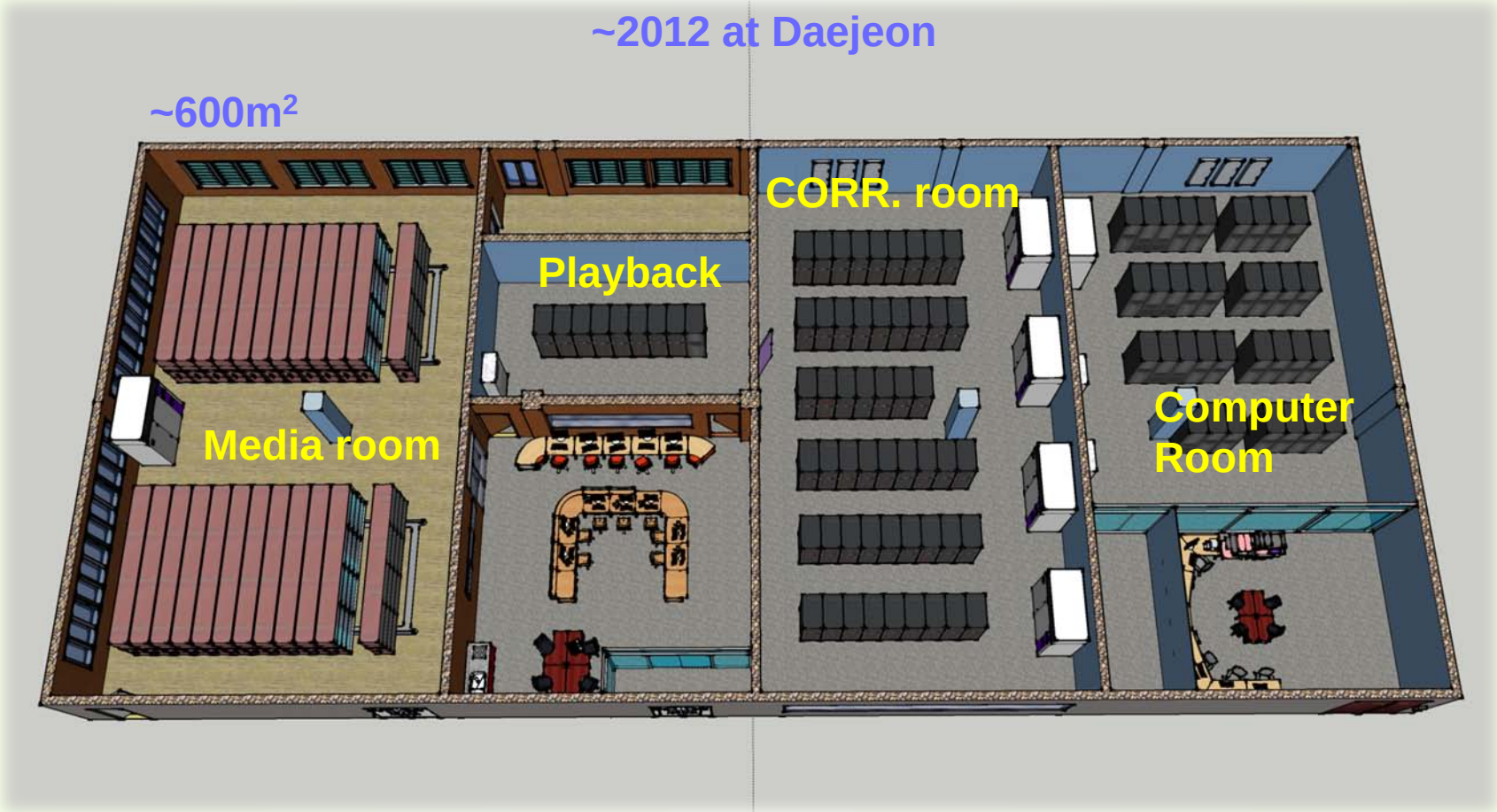
Schedule

2010	2011	2012	2013	2014	2015
KJCC	Eval. Operation	Normal Operation		Ripe Op. Phase (16st)	
	MoA				
		DA extension		Backup System	
		Move to Daejeon			

Future Plan

- 2011.10~12 :
  - Will finish the correlation post-processing SW development and commissioning work until this year.
  - Will finish the KJJVC evaluation until this year.(from November, KJJVC will be evaluated compared with FX corr.)
  - Will perform many experiments for optimizing the correlation results.
- 2012.01~ : Normal operation of KJCC
- 2011~2012 : Data Archive system extension for 16 stations and maximum data rates
- ~2012 : Move to Daejeon for New correlation center

Bird's-eye view of KJCC



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