Status Report of KJCC

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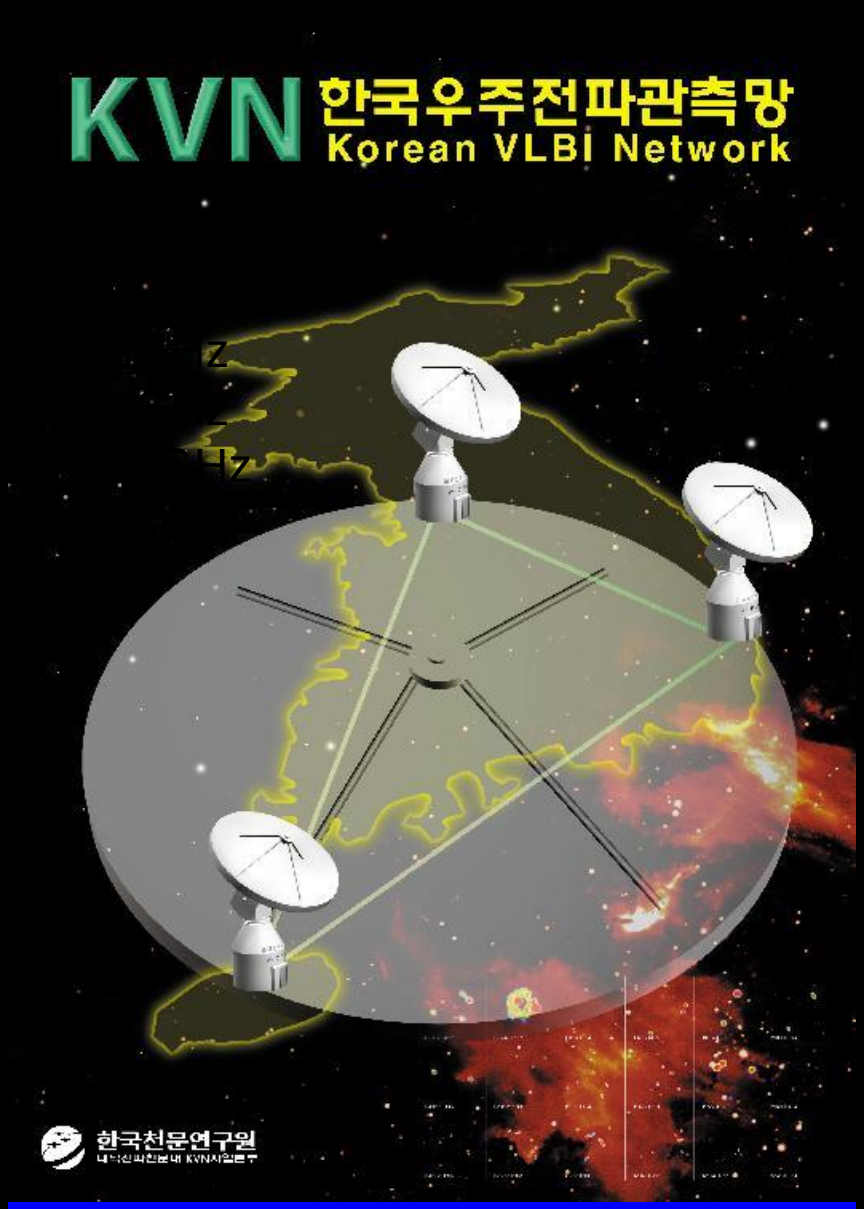
-- Correlator team of KASI/NAOJ --

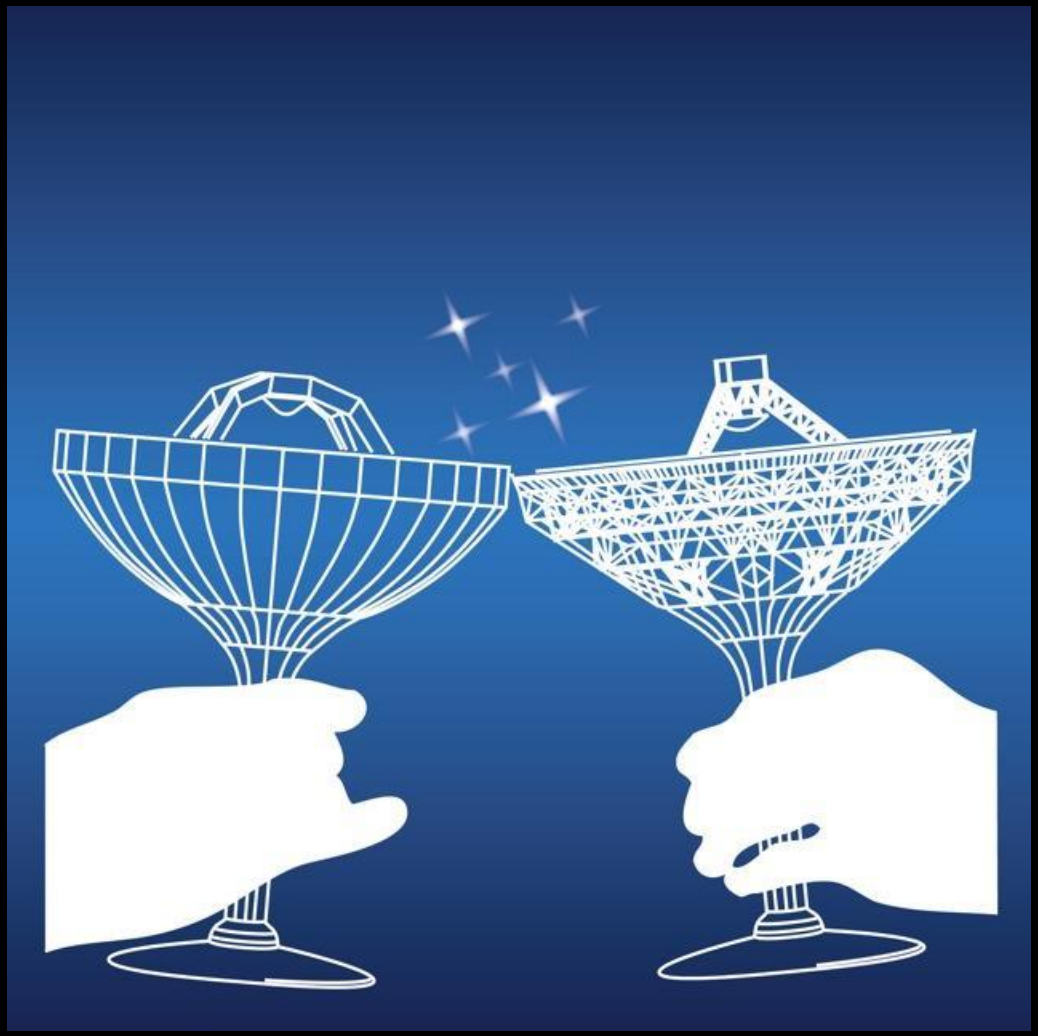
2013 VERA-UM, NAOJ Mitaka, 2-3, Oct. 2013



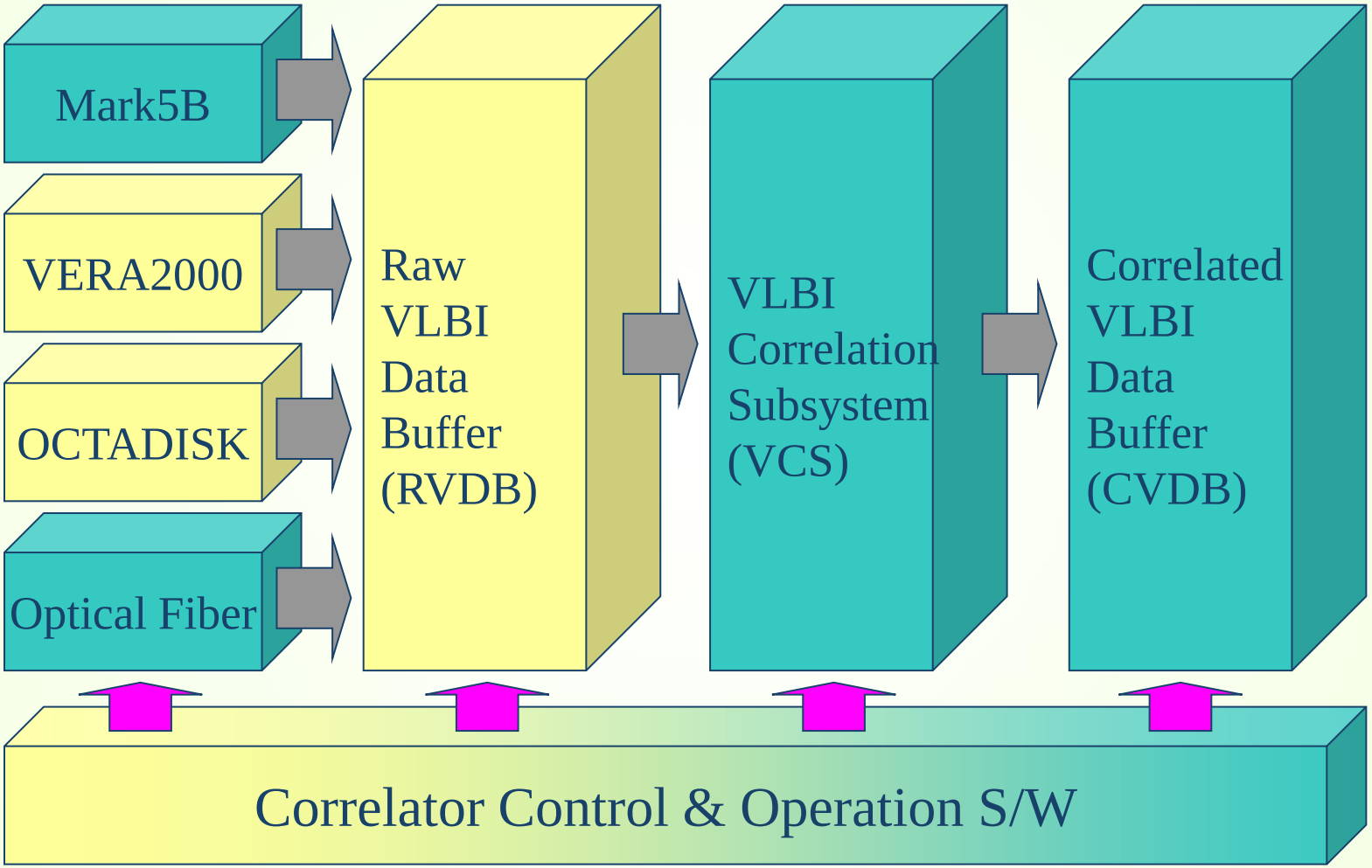
Simultaneous Multi-Frequency Obs. - Phase Compensation, mm-VLBI

Dual beam – Phase Compensation, Differential VLBI

KaVA



KJJVC Framework



Joint Development started from 2005. 7. 7.

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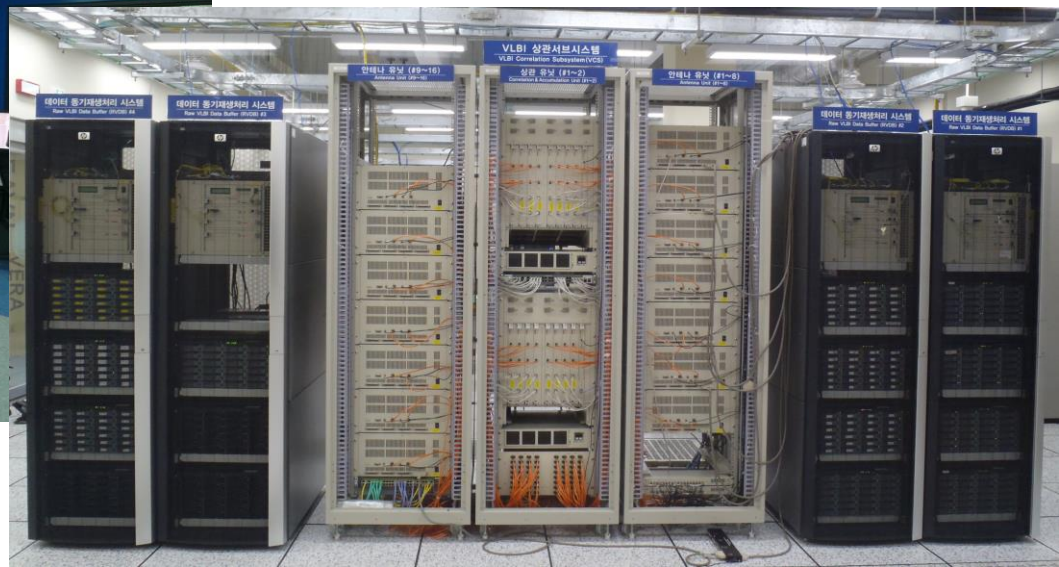
KJCC

한일상관센터

Korea-Japan Correlation Center


Memorandum of Agreement
Between KASI and NAOJ
Date : July 20, 2011 Venue : KASI
国立天文台
NAOJ
National Astronomical
Observatory of Japan
Korea Astronomy and Space Science Institute


KASI
NAOJ
한일상관센터
Korea-Japan Correlation Center
WELCOME to KJCC
KJCC


VLBI 상관서브시스템
VLBI Correlation Subsystem(VCS)

Organization of KJCC

Joint Operation started from 2011. 7. 20.

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

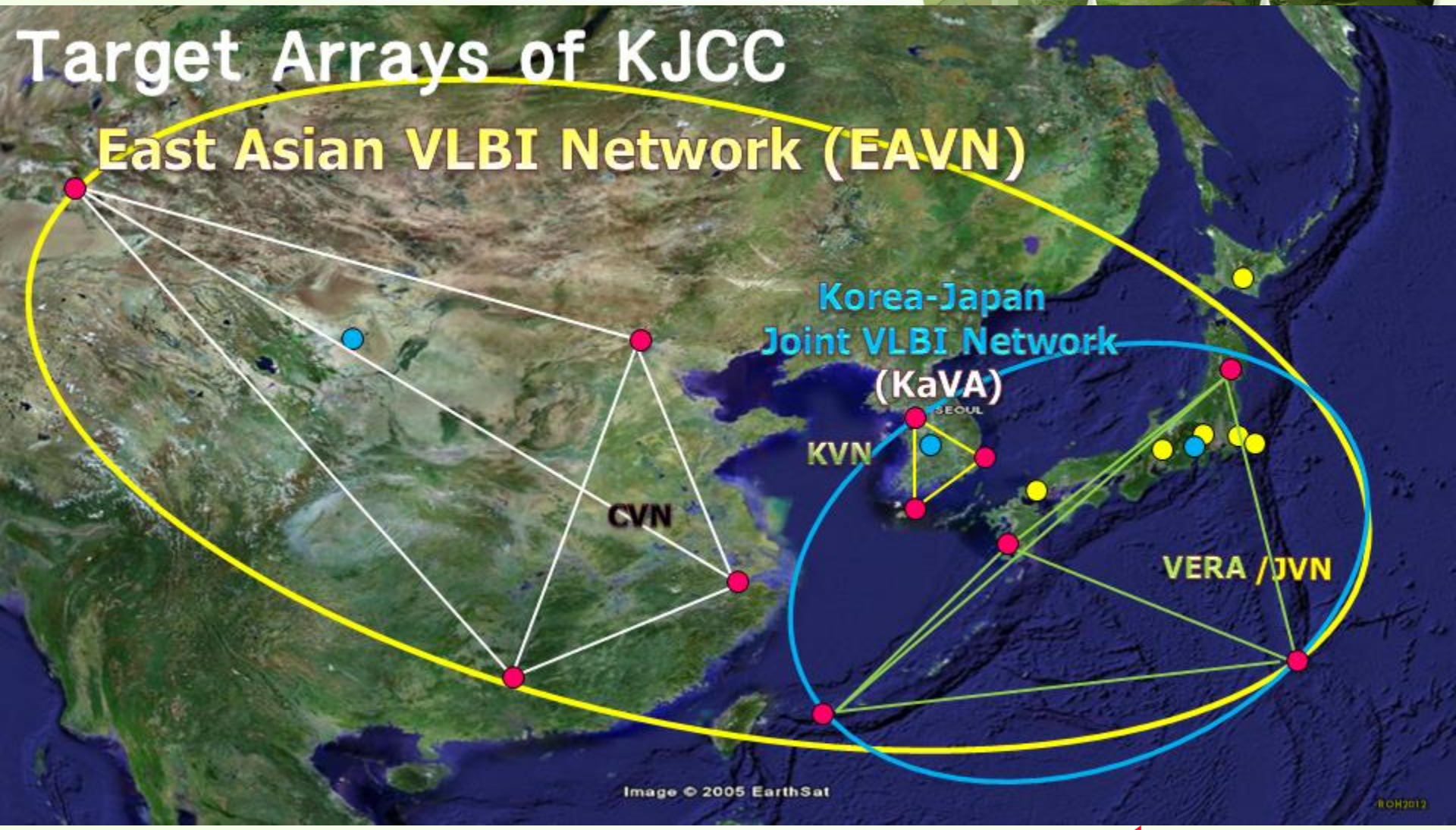
Executive Board
Director of Radio Astronomy Division(KASI)
Director of Mizusawa VLBI Observatory(NAOJ)
Manager of RA Project Center(KASI)
Chair of East Asian VLBI Network(international)
Correlator Manager(KASI)
System Engineer(KASI, NAOJ)
System Scientist(KASI, NAOJ)

Operation Group (KASI)

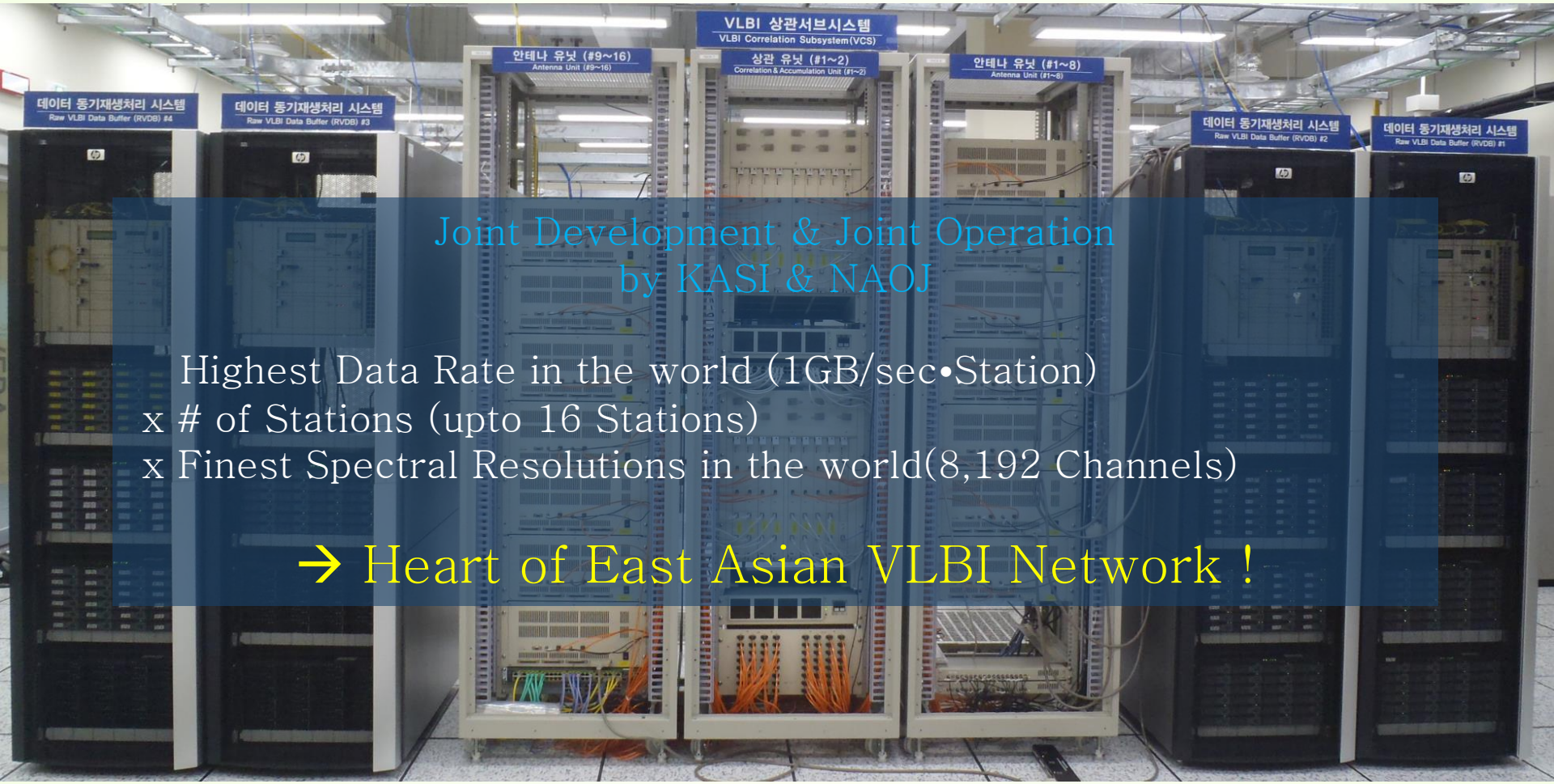
Operation Group (NAOJ)

한일상관센터
Korea-Japan Correlation Center

한국천문연구원
Korea Astronomy & Space Science Institute


Target Arrays of KJCC
East Asian VLBI Network (EAVN)
Korea-Japan
Joint VLBI Network
(KaVA)
SEOUL
KVN
CVN
VERA /JVN
Image © 2005 EarthSat

Deajeon Correlator



Joint Development & Joint Operation
by KASI & NAOJ

Highest Data Rate in the world (1GB/sec•Station)
x # of Stations (upto 16 Stations)
x Finest Spectral Resolutions in the world(8,192 Channels)

→ Heart of East Asian VLBI Network !

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Debug & Regulation

- **Overcome the Differences between KVN and VERA**
  - Different recorder/playback equipment
  - Different sub-stream assignment
  - Different observation log format
- **Initial bugs in firmware**
  - Delay tracking
  - Fringe rotation (phase calculation)
  - Data pollution at FFT segment border
  - Underflow/overflow at FFT butterfly process

Debug & Regulation

- **Post-correlation Software**
  - CODAgen, FITSgen, GFS
  - Complex algorithm for heterogeneous array
  - Speed up (8H KaVA observation, 16x16MHz)
    - CODAgen: 3~4H
    - FITSgen: ~1H
- **Now, KJCC can serve for usual 1Gbps (16MHz x 16 Channel) observation.**
- **At Sep 24, there was the first EAVN fringe test observation.**

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Operation Modes

Recording Mode	Data Rate	Oper. Speed	Service Status
16MHz x 16Chan	1Gbps	double	2013~
32MHz x 8Chan	1Gbps	double	
64MHz x 4Chan	1Gbps	double	
128MHz x 2Chan	1Gbps	double	2014~
256MHz x 1Chan	1Gbps	double	2014~
512MHz x 1Chan	2Gbps	normal	2014~
512MHz x 2Chan	4Gbps	normal	
512MHz x 3Chan	6Gbps	normal	
512MHz x 4Chan	8Gbps	normal	

Correlation Status

Exp.	Object	Correlation	Status	Others
R11027B	KVN+VERA Evaluation for KJCC	Finished	In Analyzing	
K12098C	KVN 4channel simultaneous obs	Finished	In Analyzing	
R11025A	KVN+VERA 22GHz	Finished	In Analyzing	
R11026A	KVN+VERA 43GHz	Finished	In Analyzing	
R12280A	KVN+VERA 43GHz survey	Finished	In Analyzing	
R11088B R11089B R11090B R11091B R11093B R11095B	KVN+VERA SgrA* campaign	Finished	In Analyzing	
R11094A,B	22/43 GHz KVN+VERA	Finished	In Analyzing	
R13082B R13083B R13084B R13085B R13086B R13102A	KVN+VERA SgrA* campaign	Waiting for correlation	Data copy finished	

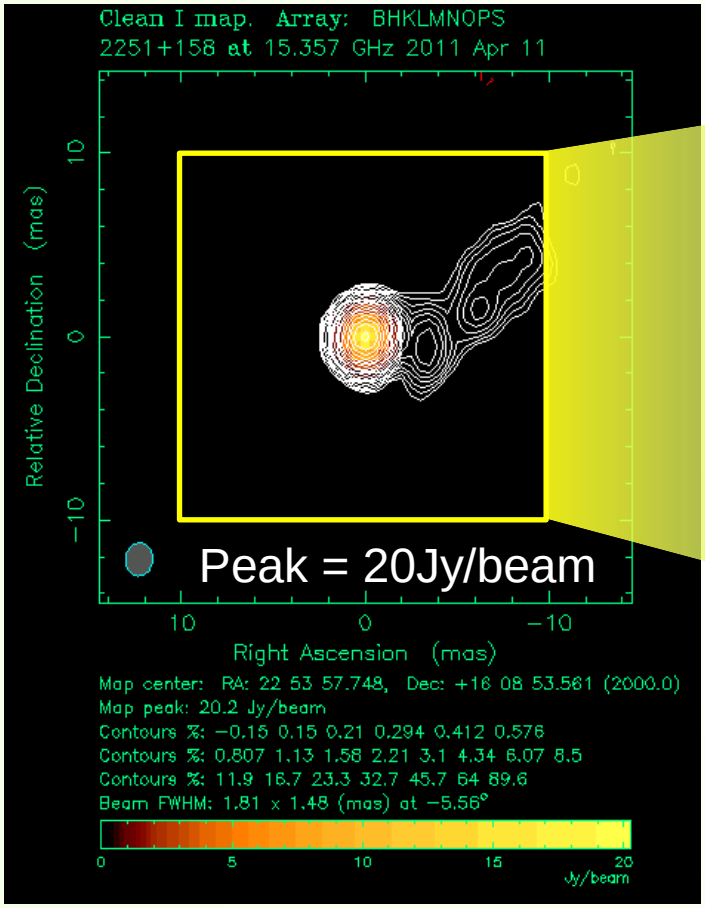
Web

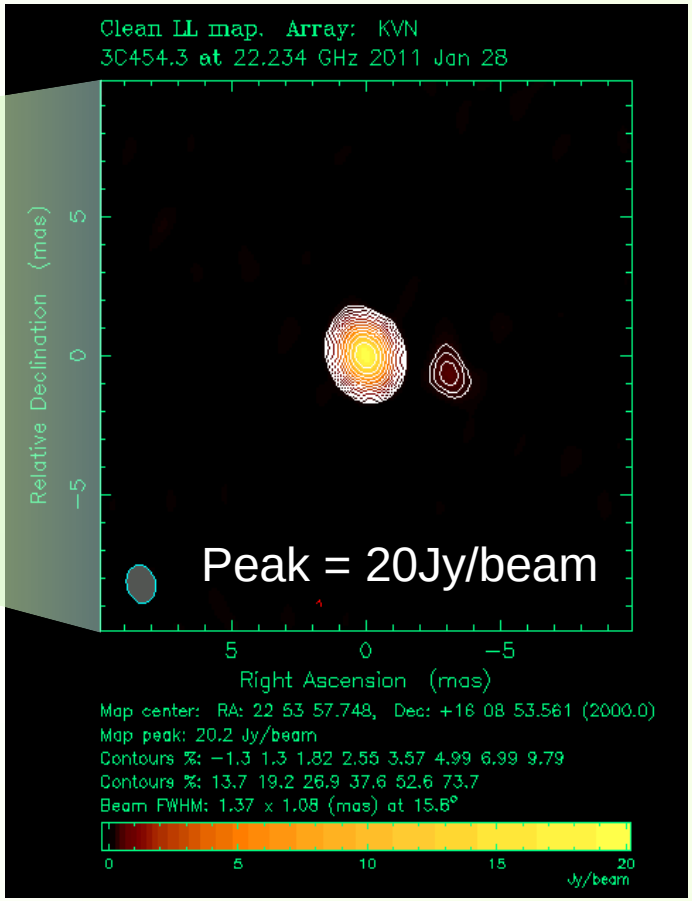
❖ **http://kjcc.kasi.re.kr/ is initiated.**

Obs Date	Obs Code	VERA				KVN			JVN			CVN			
		MIZ	IRK	ISH	OGA	KYS	KUS	KTN	YAMAG	TAKA	NOBE	SHAO25	SHAO65	KUNMING	U
2011.01.25	r11025a	O	O	O	O	O	O	O	x	x	x	x	x	x	
2011.01.26	r11026a	O	O	O	O	O	O	O	x	x	x	x	x	x	
2011.01.27	r11027b	O	O	O	O	O	O	O	x	x	x	x	x	x	
2011.03.29	r11088b	x	O	O	O	O	O	O	x	x	x	x	x	x	
2011.03.30	r11089b	x	O	O	O	O	O	O	x	x	x	x	x	x	
2011.03.31	r11090b	x	O	O	O	O	O	O	x	x	x	x	x	x	
2011.04.01	r11091b	x	O	O	O	O	O	O	x	x	x	x	x	x	
2011.04.03	r11093b	x	O	O	O	O	O	O	x	x	x	x	x	x	
2011.04.04	r11094a	x	O	O	O	O	O	O	x	x	x	x	x	x	

Recent Results : 3C454.3

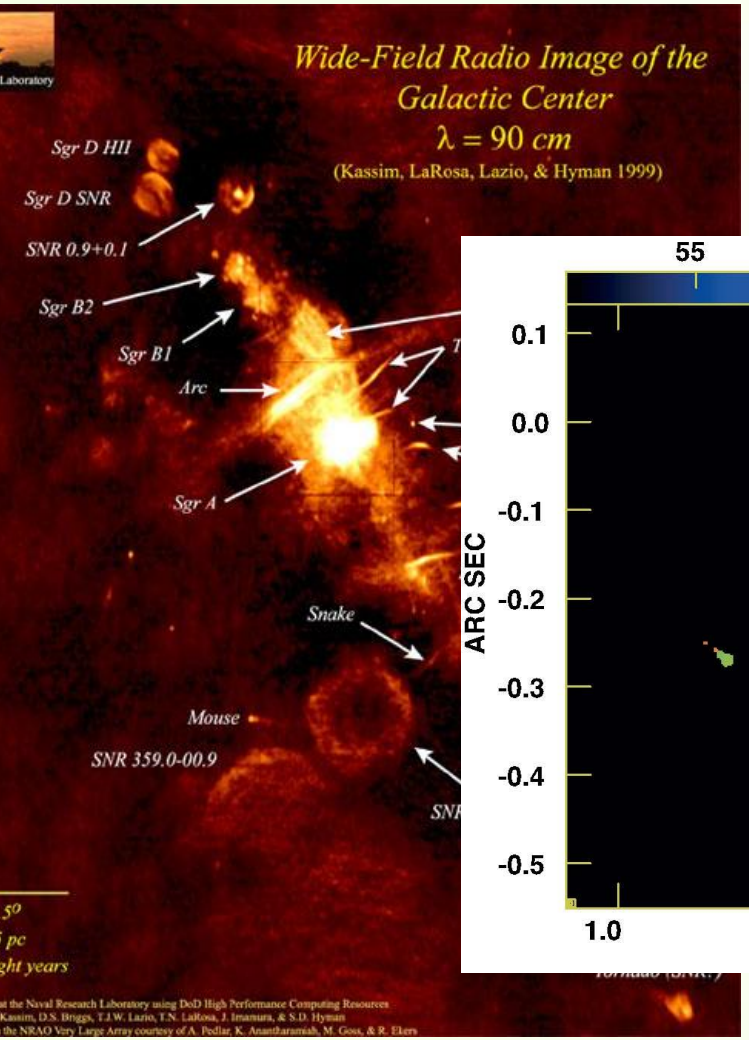
VLVA 15GHz Snap shot (30min)



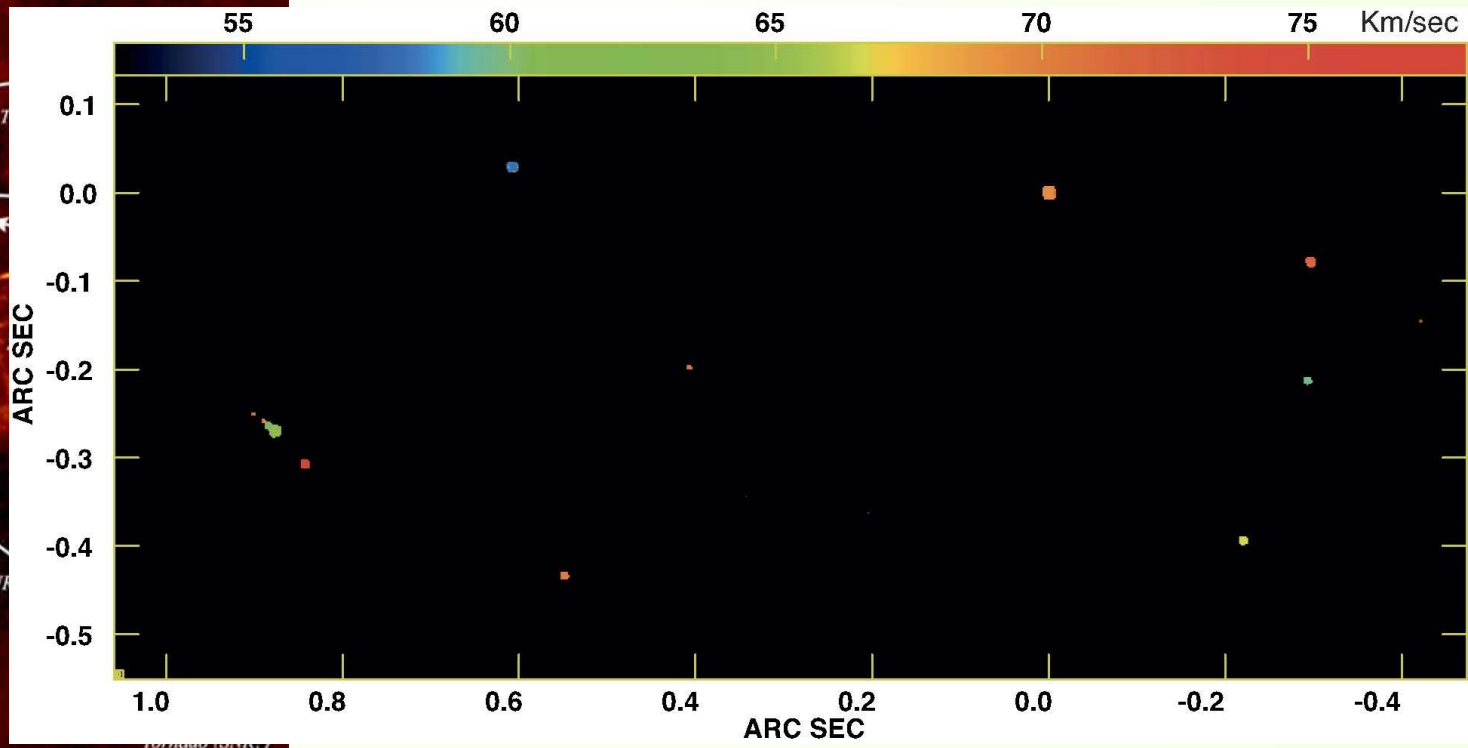


KaVA 22GHz Snap shot (10min)

Recent Results : Sgr B2 N



KaVA, H_2O Maser (22GHz)



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Near Future

- **RVDB upgrade (~2013)**
  - OCTADDB → OCTADISK (3 ea)
  - New OCTADISK2 (2 ea)
- **Setup other observation modes (~2013)**
  - 128MHz x 2 Channels (1Gbps)
  - 256MHz x 1 Channel (1Gbps)
  - 512MHz x 1 Channel (2Gbps)
  - Dual polarization (~2014)
- **New recorder for 4~8Gbps (2014~)**
  - Mark6 / OCTADISK2

Summary

- Joint development of Daejeon correlator
- Joint operation of KJCC
- KJCC is now in service for usual 1Gbps (16MHz x 16 Channel) observation.

Specification (1)

Items	Specifications
Number of Antennas	16
Number of Inputs / Antenna - Input Interface - Maximum Data Rates	4 - 2Gbps VSI-H (32parallels, 64 MHz clk) - Total of 8,192 Mbps
Digitization for Each Inputs - Number of Bits - Quantization Levels - Sampling Rates - Input Bandwidth - Sub-stream Specification	 - 2 bits/sample - 4 levels - 1,024 Msamples/sec - 512 MHz - Logically Associated Sub-streams
Maximum Delay Compensation (Largest Baseline Length)	±36,000 km
Maximum Fringe Tracking (Fastest Phase Drift Cancellation)	1,075 kHz
Architecture	FX type, with FPGA and DSP chips

Specification (2)

Items	Specifications
FFT Processing - Freq. Resolution - Size of FFT points - Word length in FFT - Scaling - Re-quantization	 - 0.05km/sec @ 22GHz - 256k/128k/64k/32k/16k/8k Adjustable - 20+20 bits fixed point for real & imaginary - Yes - 16+16 bits fixed point for real & imaginary
△W Correction	Yes
Correlations - Number of Correlation Outputs/Input - Total Number of Correlation Outputs - Polarization Mode - Data compression(Binning) - Word length - min. max Integration Time	 - Max. 120 Cross- and 16 Auto-correlations - Max. 480 Cross- and 64 Auto-correlations - RR or LL ; Full Operation for 16 antennas RR and LL ; Full Operation for 16 antennas RR, RL, LR and LL : Full Op. for 8 antennas - Yes, 8,192 channels / correlation output - 32+32 bits Fixed Point for R & I - 25.6msec ~ 10.24sec
Data Output to Archive (Max.)	1.4 GBytes/sec
Subarray Operation	2 cases (12 + 4, 8 + 8)

Recorder/Playback Systems

- **Mark5B for KVN, CVN, VSOP-2**
- **VERA2000 for VERA**
  - **Playback only version of DIR-2000**
- **OCTAVIA for some JVN sites (Yamaguchi, …)**
- **Optical Fiber for some on-line sites (1~2Gbps, upto 8 Gbps for near future)**

- **OCTAVIA/OCTADISK**
  - Modified from RVDB
  - Currently 4Gbps, but 8Gbps coming soon.
  - New high speed recorder as Next generation of DIR-2000, Mark5B
  - And also the replacement of RVDB and VERA2000/ Mark5B playback at KJCC

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