KVN+VERA Test Observations and Evaluation Studies

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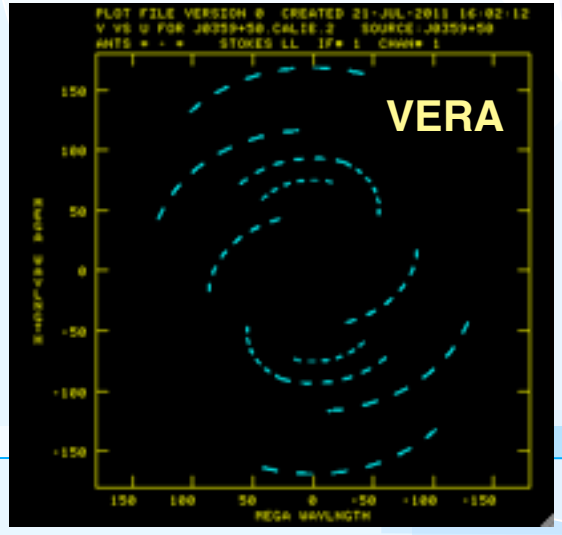
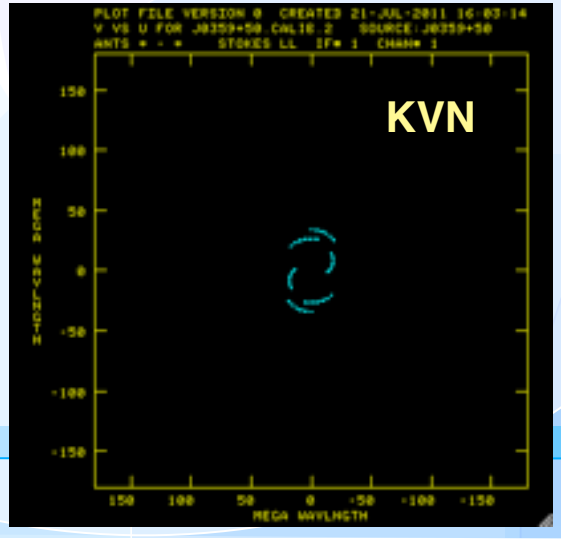
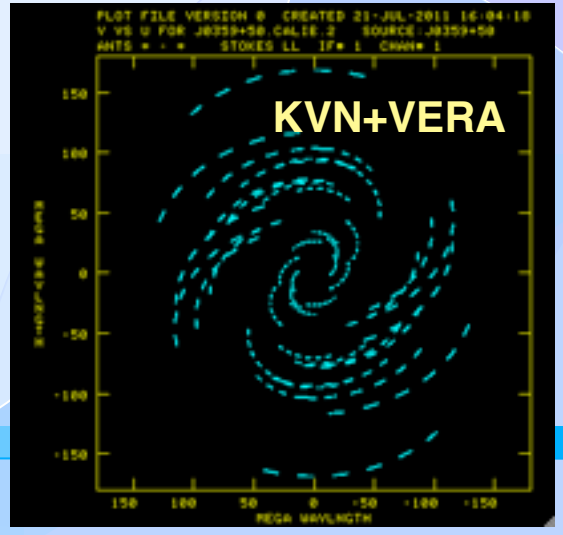
The KVN+VERA Combined Array

- Consist with 7 antennas
- Baseline length range : 300-2300 km
  - Good uv coverage achieved
- Compatible / Common system
  - Compatible data acquisition system
  - Korea-Japan Joint VLBI Correlator (KJJVC) to enable to correlate a few-Gbps sample data between KVN Mk5 and the VERA terminals.



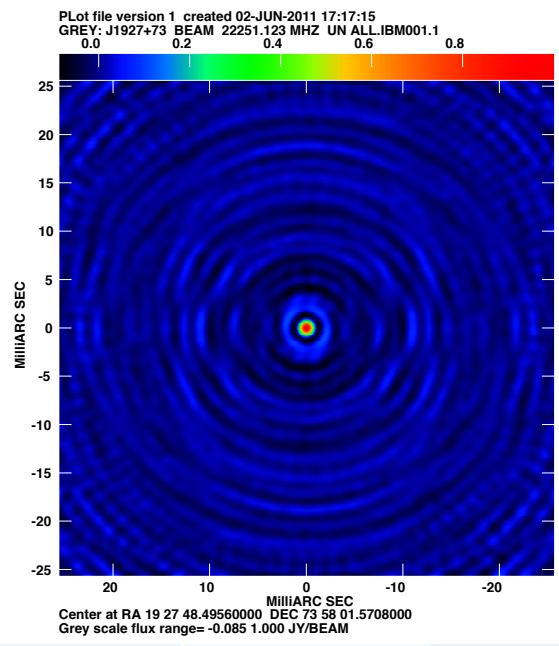




Evaluation of Imaging Ability (1928+738)

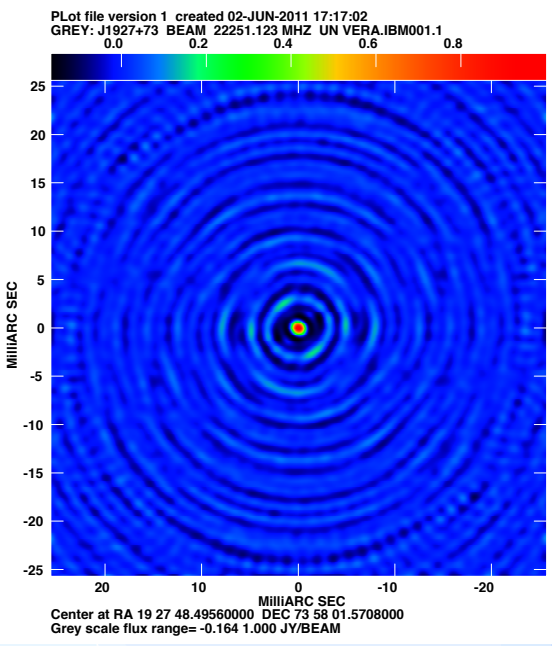
- 1928+738: enough high DEC for the 24-hr track
- Beam pattern of the KVN+VERA is much better than that of the VERA only.

KVN+VERA



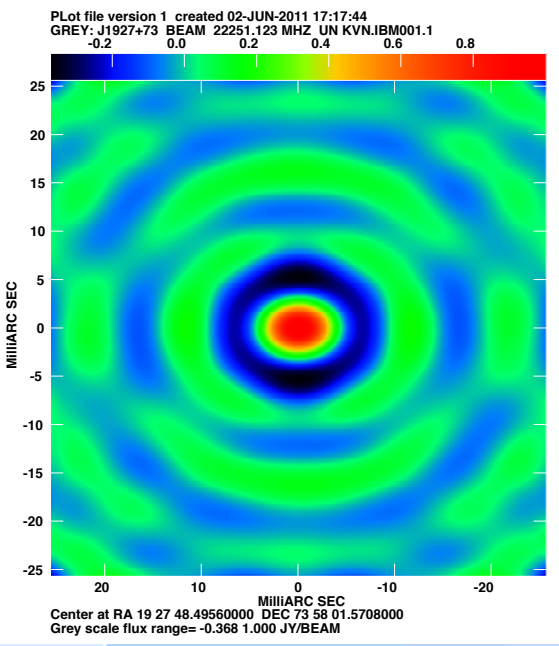
1.19 x 1.14 mas^2
PA = -83 deg

VERA



1.09 x 0.96 mas^2
PA = 67 deg

KVN

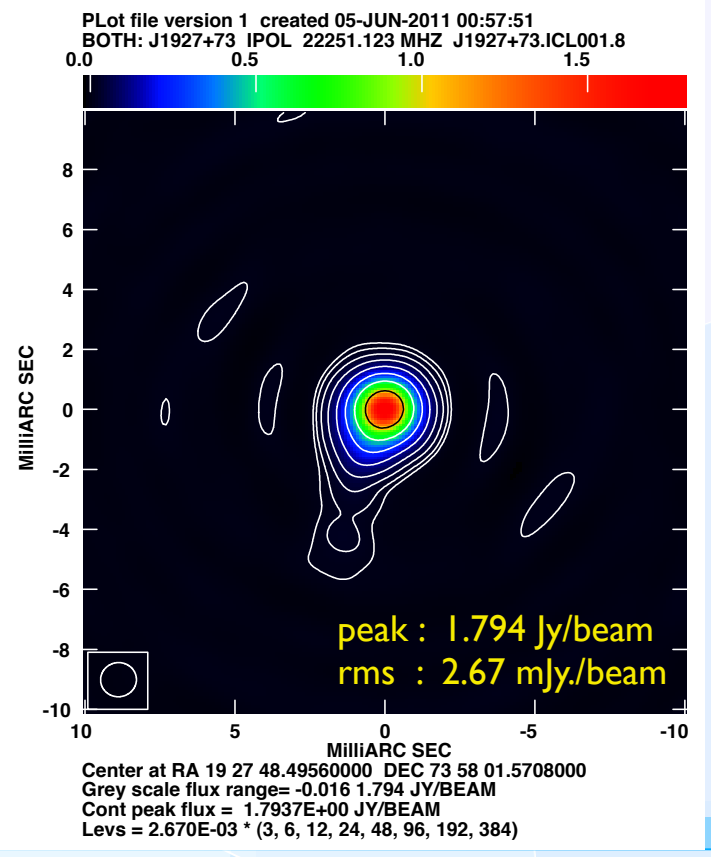


5.99 x 4.52 mas^2
PA = -89 deg

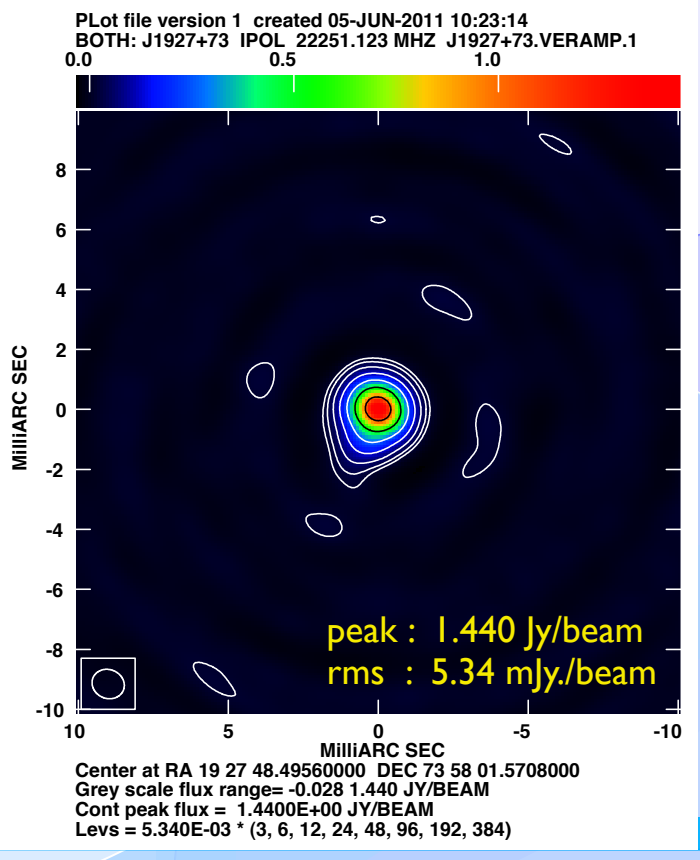
Evaluation of Imaging Ability (1928+738)

- The KVN+VERA image succeeds to detect a weak and extended jet component.

KVN+VERA

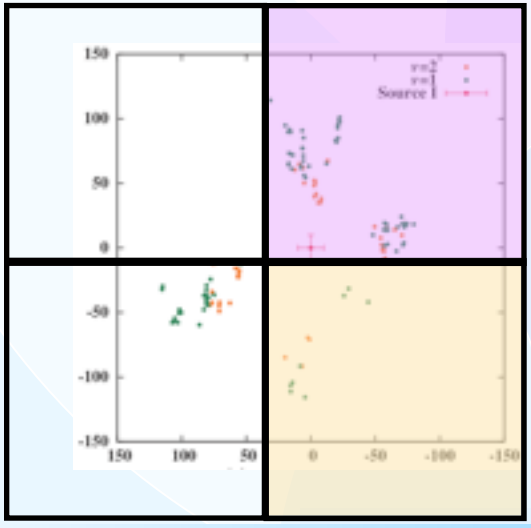


VERA only



Evaluation of Imaging Ability (Ori KL SiO)

- Imaging for each spectral channel & check manually, to avoid the side-lobe effect for strong maser spots.
  - CLEAN => Check the residual map => CLEAN => ...
- For SiO v=1, set four fields of 200x200 mas, to cover all SiO v=1 spots, which should be distributed widely.
- Spots higher than 10 sigma are picked up.



Four imaging fields of Ori KL SiO v=1

Imaging finished

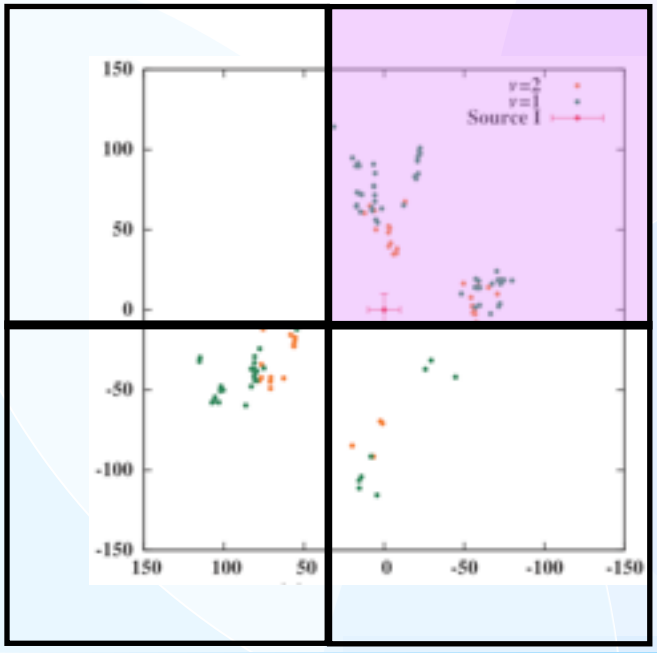
Imaging ongoing

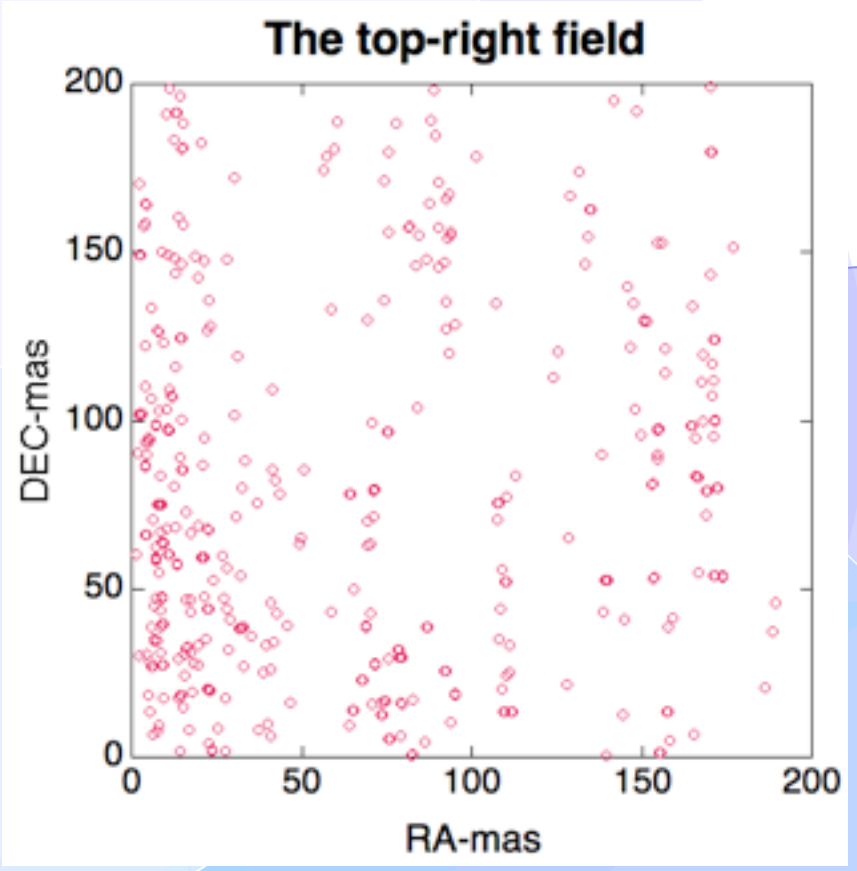
Kim et al. 2008

Evaluation of Imaging Ability (Ori KL SiO v=1)

- Rough image of the top-right quarter
  - All detected spots (> 10 sigma) are shown
  - 495 spots detected.

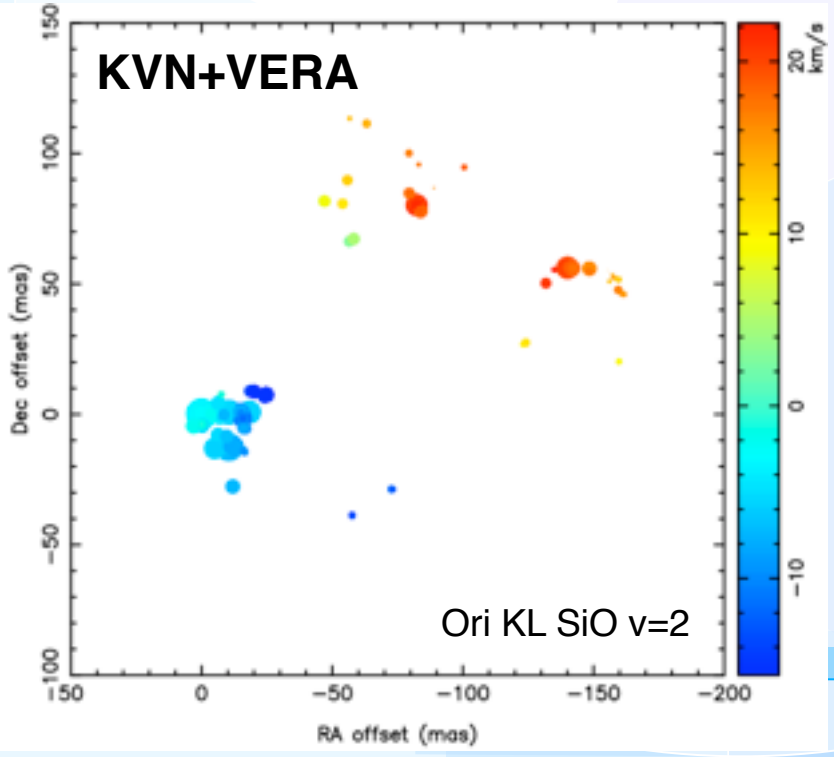
The other fields will come soon.

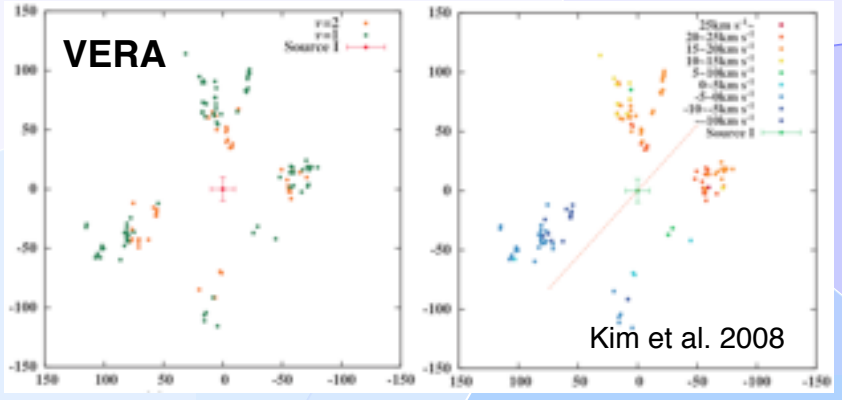




Evaluation of Imaging Ability (Ori KL SiO v=2)

- Detected more than 250 maser spots. twice more.
- Distribution and velocity field of maser spots are consistent with the image in 2008 with VERA.
- Achieved image rms agrees well with the expected image rms.





	KVN+VERA	VERA
On-source time	2 hrs	8 hrs
Bandwidth of 1ch	31.25 kHz	31.25 kHz
Achieved rms	0.06 Jy/beam	0.3 Jy/beam
Expected rms	0.06 Jy/beam	N/A

Evaluation of Amplitude Calibration

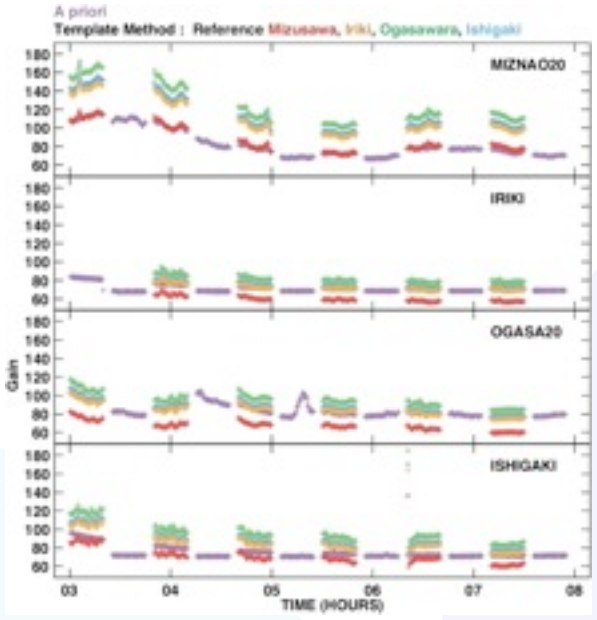
- A-priori amplitude calibration method is used for VERA and KVN.
- Requirement for accurate a-priori calibration
  - Accurate gain curves for each telescope at each observation frequency
  - Frequent Tsys measurements made during observations.
  - However, VERA gain information into FITS data have not been updated since 2004. KVN gains have been assumed to be 13.28 at K and Q bands, which means that antenna efficiency of 60 %.
- Evaluated amplitude calibration of the KVN+VERA
  - Comparing with amplitude calibration solutions with template method using SiO maser emission of Ori KL.

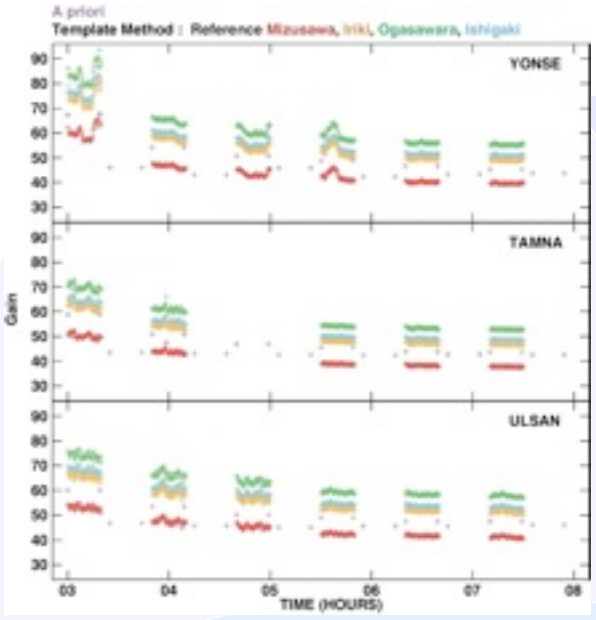
Evaluation of Amplitude Calibration

Observations

Date	Apr19, 2010
Time	UT 03:00 - 08:00
Band	Q (for SiO maser)
Antenna	Yonsei, Ulsan, Tamna, Mizusawa, Iriki, Ogasawara, Ishigaki
Correlator	Mitaka FX
Backend	K4/VSOP DIR1000
Source	Orion KL, J0359+50

Evaluation of Amplitude Calibration





Antenna	Reference Antenna for Template Method			
	Mizusawa	Iriki	Ogasawara	Ishigaki
Mizusawa	coincidence	25% more	40% more	30% more
Iriki	25% less	coincidence	20% more	10% more
Ogasawara	20% less	coincidence	15% more	5% more
Ishigaki	10% less	10% more	25% more	15% more
Yonsei	15% less	5% more	20% more	10% more
Ulsan	15% less	5% more	20% more	10% more
Tamna	10% less	10% more	25% more	15% more

Evaluation of Amplitude Calibration

- For all antennas, trend of time variation for gains agrees well between the a-priori calibration and the template methods.
- Gains obtained from the template method < 40% according to reference antenna.
- Mizusawa : lower than others (?)
- The KVN antennas show 5-25 % differences. Recently, KVN gains have been updated. Should be improved now.

Summary

- Imaging ability of the KVN+VERA is good to detect:
  - extended jet components
  - maser spots in nearby Galactic sources
- The detailed map of Ori KL SiO v=2 with the KVN +VERA observation is obtained.
- Antenna gains obtained from two different methods are compared.
  - Max difference is 40% on Apr19 2010. It indicates that estimation of gain curves could have a-few-ten % errors.
- Trend of time variation for gains agrees well between the two different method. Current Tsys measurement system seems to be successful.