Annual meeting of Japanese VLBI Consortium
October 29-31, 2014@Tsukuba

The methanol VLBI observation in the EAVN with Tian Ma 65m in C-band (~~and developments toward 22-GHz~~)

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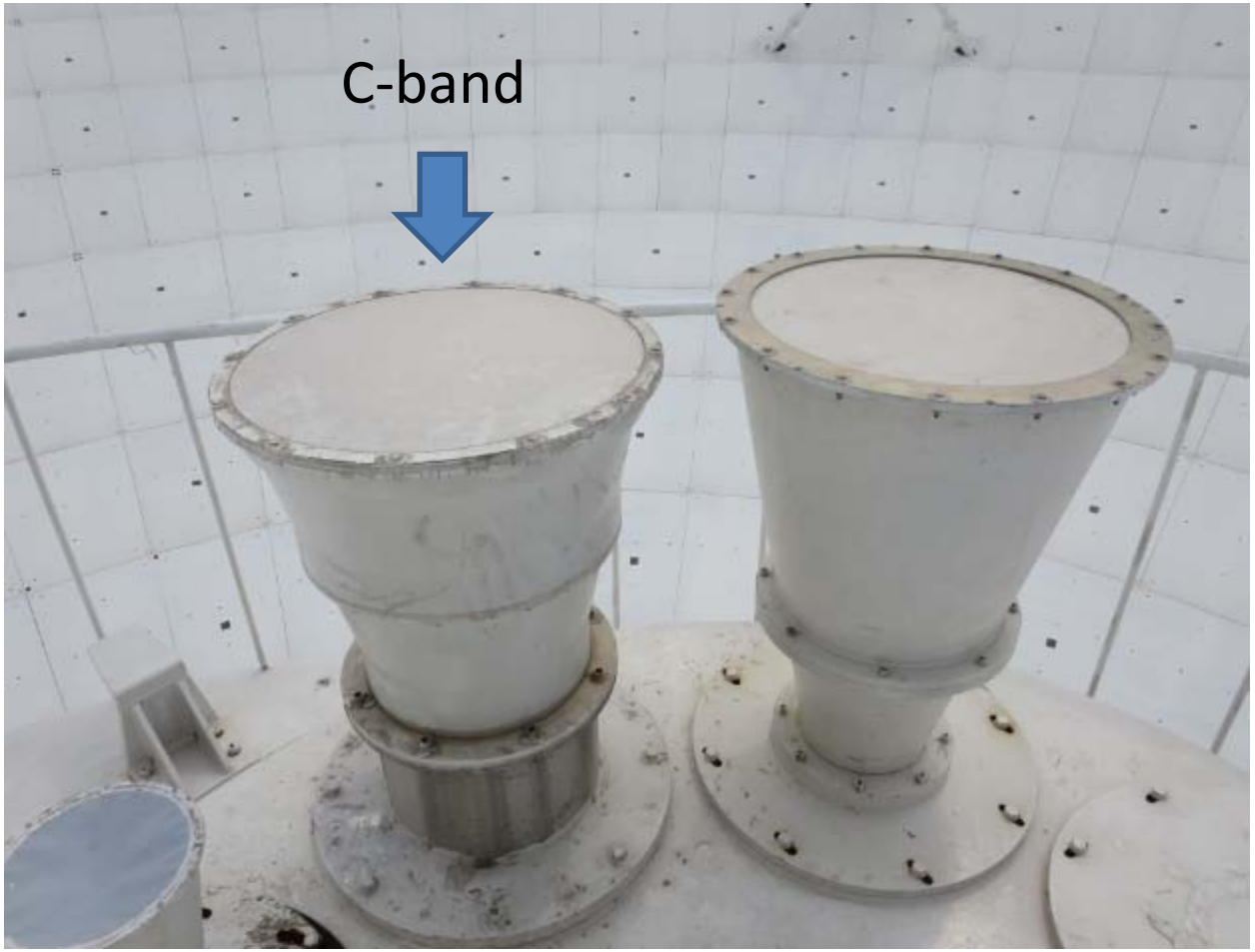
Tian Ma 65-m Telescope

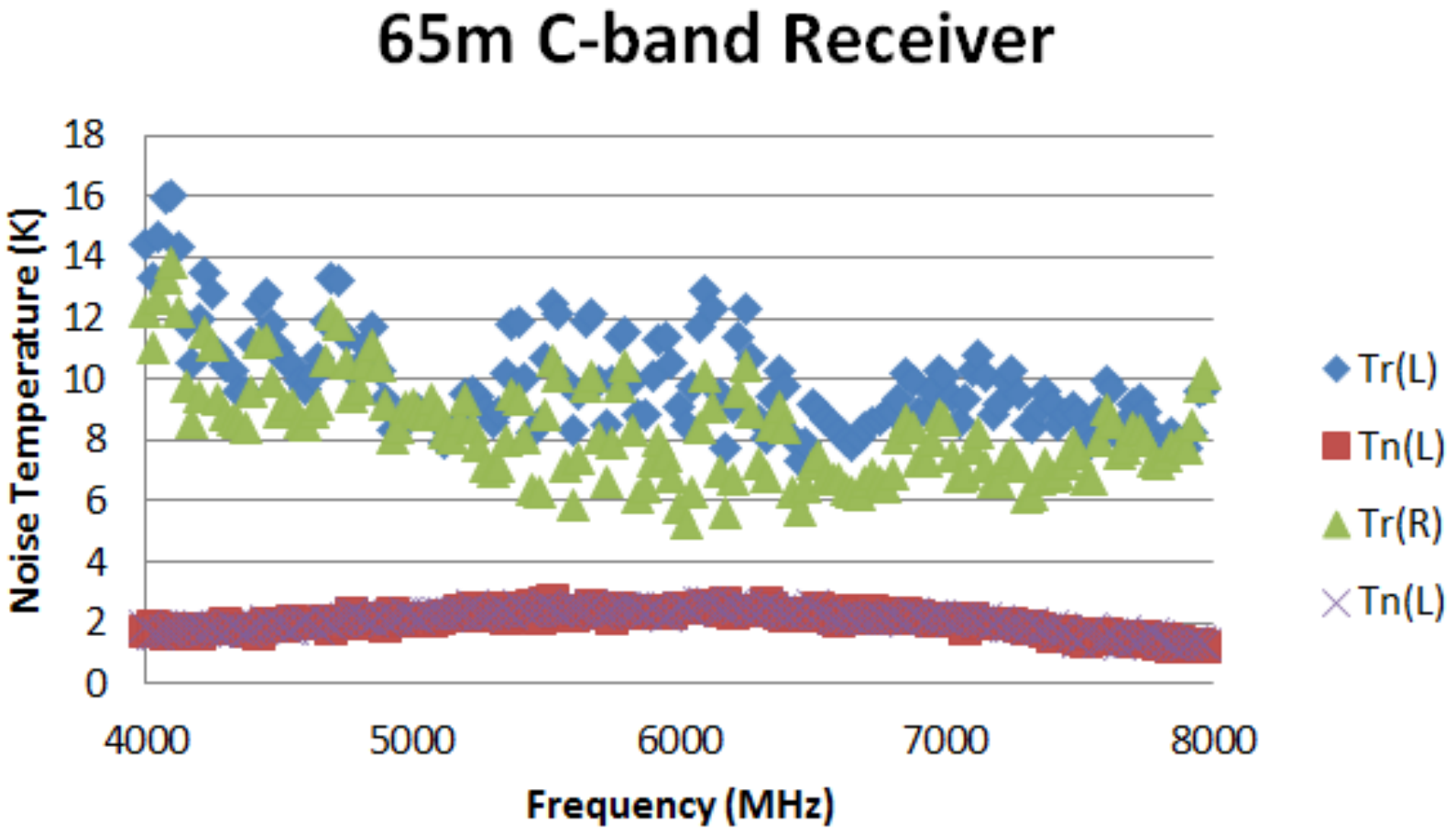
Photo by Kawaguchi at a time of FT in May 27.

Feed Horns of 65m

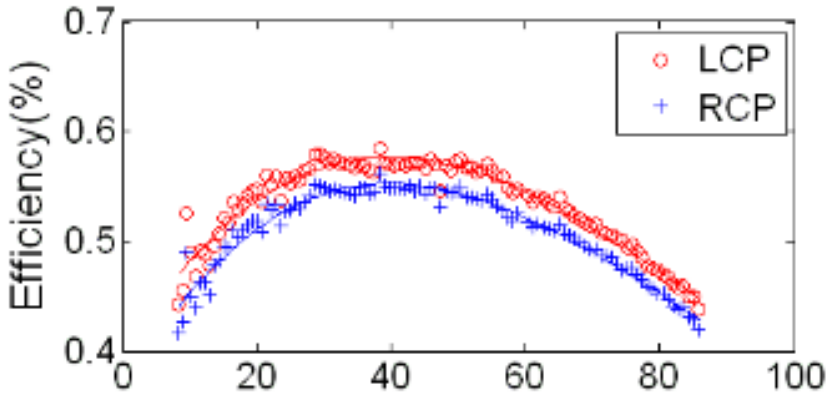


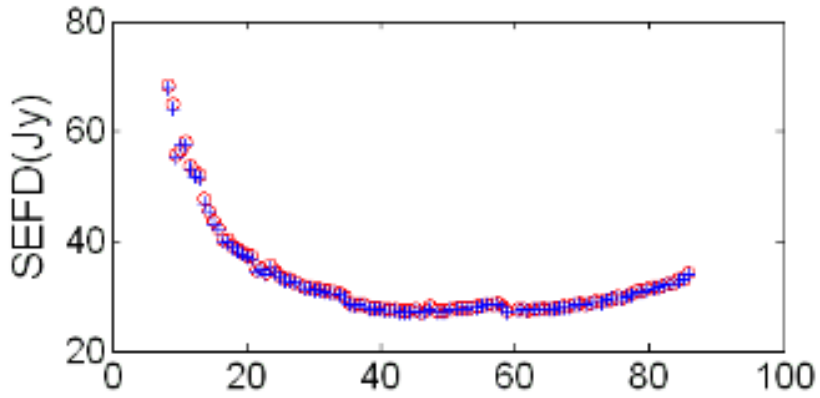
C-band Cooled Receiver

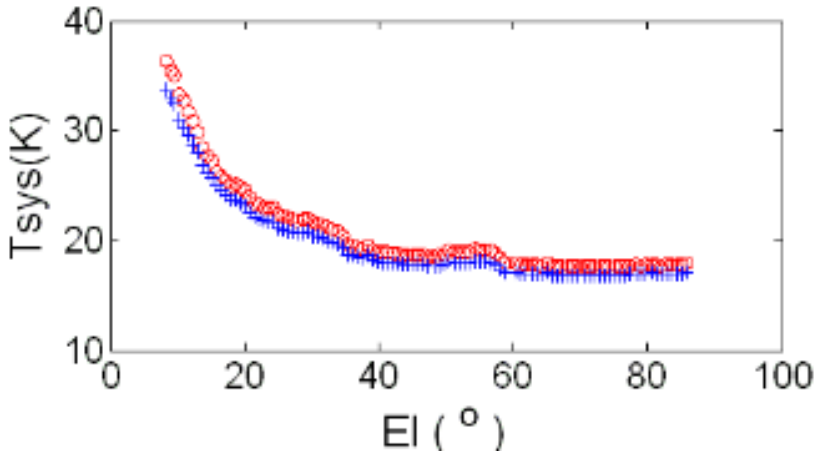
C-band Receiver Performance

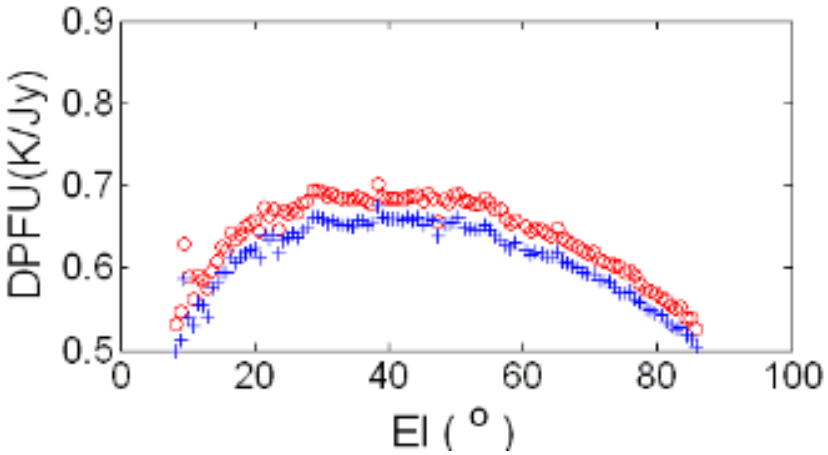


Telescope Sensitivity



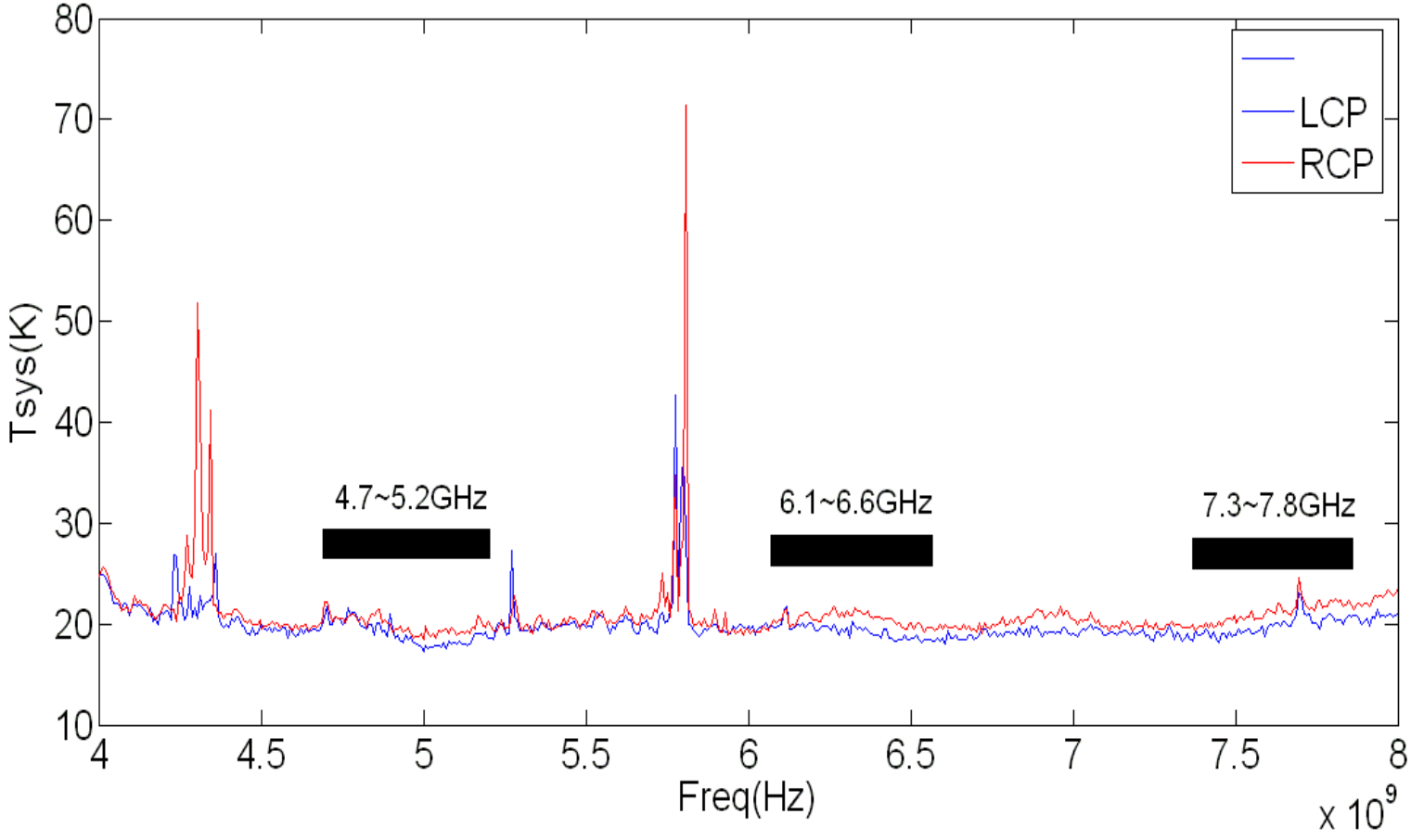






EMI

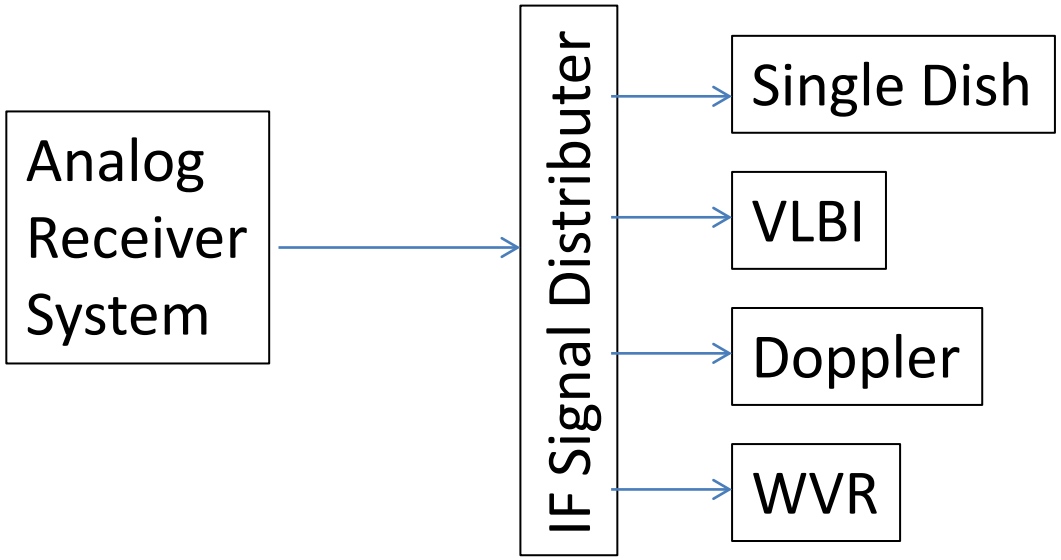
The Methanol frequency band, 6.7GHz is quiet enough.



65-m Backend

Single Dish
DIBAS (For Pulsar and Spectral line)
DRM (For Continuum)
VLBI
CDAS + Mark5B
DBBC2 + Mark5B

From HP of SHAO



Methanol Observations with the Sheshan 25m

Shanghai 25m participated in two sessions in the EAVN observation.

Proper Motion of the 6.7 GHz Methanol Maser in G 006.79−00.25

Table 1. Parameters of VLBI observations using the EAVN for G 006.79−00.25.

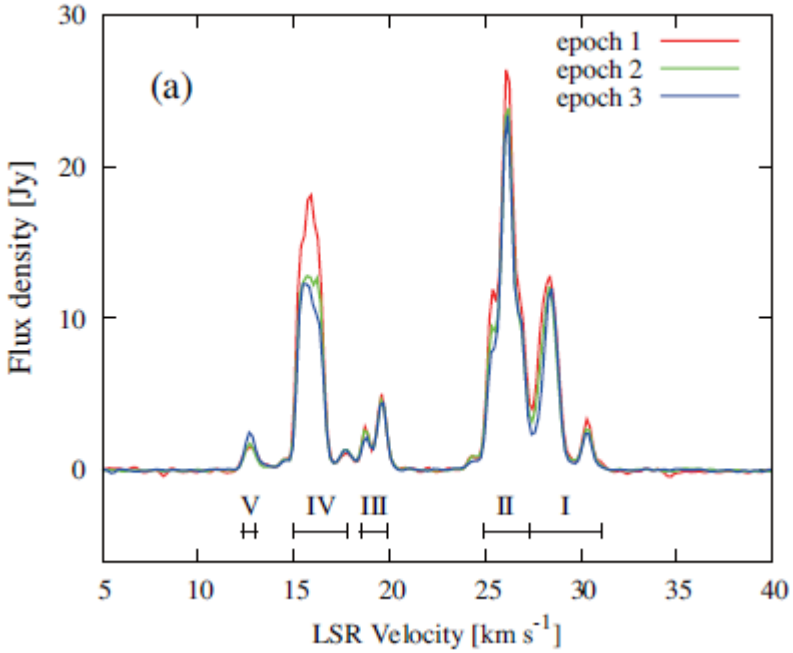
Epoch	Date and Time	Telescopes*	1 σ	Synthesized beam		N_{spot}
				$\theta_{maj} \times \theta_{min}$	PA	
	(yyyy/mm/dd, UT)		(Jy beam^{-1})	(mas×mas)	(°)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	2010/08/29, 08:50−13:30	M, R, O, I, H, S	0.046	7.4×2.9	+3	92
2	2011/10/05, 06:20−11:10	M, R, O, I, Y, H	0.039	7.2×4.0	−9	106
3	2012/09/23, 07:00−11:50	M, R, O, I, Y, H, S	0.029	7.7×3.4	−4	118

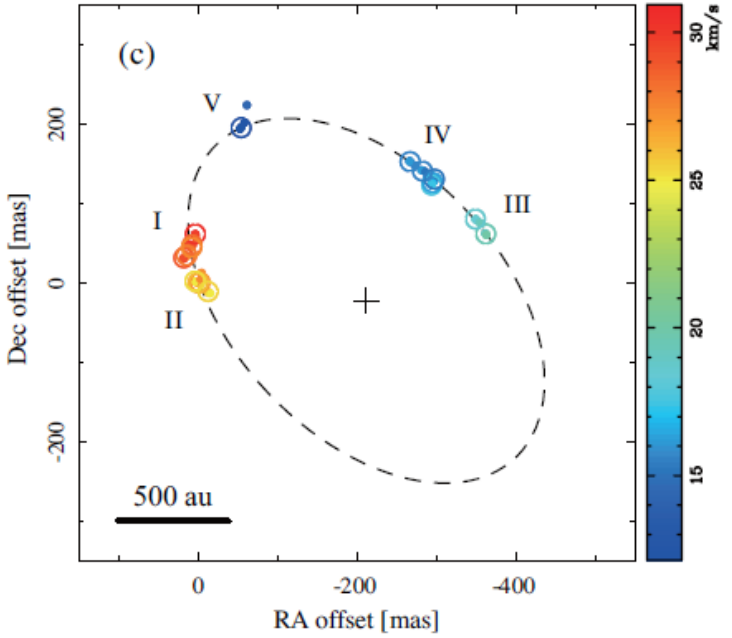
Notes. Column 1: epoch number; Col. 2: observational year/month/day, and universal time; Col. 3: telescopes used; Col. 4: image rms noise in a line-free channel obtained with total on-source time of 1.0 hr; Cols. 5–6: FWHM of major and minor axes, and position angle of synthesized beam made with natural weighting; Col. 7: number of detected maser spots.

* Telescope code — M: VERA-Mizusawa, R: VERA-Iriki, O: VERA-Ogasawara, I: VERA-Ishigaki, Y: Yamaguchi, H: Hitachi, S: Shanghai.

Sugiyama et al. (submitted in Sep.9, 2014)

The 6.7 GHz methanol masers in G 006.79+00.25





Sugiyama et al. (submitted in Sep.9, 2014)

The large dish telescope to get better array sensitivity

- The Tian Ma 65m telescope started the science operation in 2013.
- The change in the sensitivity due to gravitational deformation of the large main dish is a subject under concern to be carefully calibrated.

Pseudo Closure Amplitude

$$PCA_j = \left|\frac{\rho_{ij}\rho_{jk}}{\rho_{ik}}\right| = \frac{\left(S_0\sqrt{S_iS_j}\right)\left(S_0\sqrt{S_jS_k}\right)}{\left(S_0\sqrt{S_iS_k}\right)} = S_0S_j$$

$\rho_{ij}, \rho_{jk}, \rho_{ik}$: *complex visivilities of the ij jk and ik baselines*

S_0 : *Source* Flux *Intensity*,

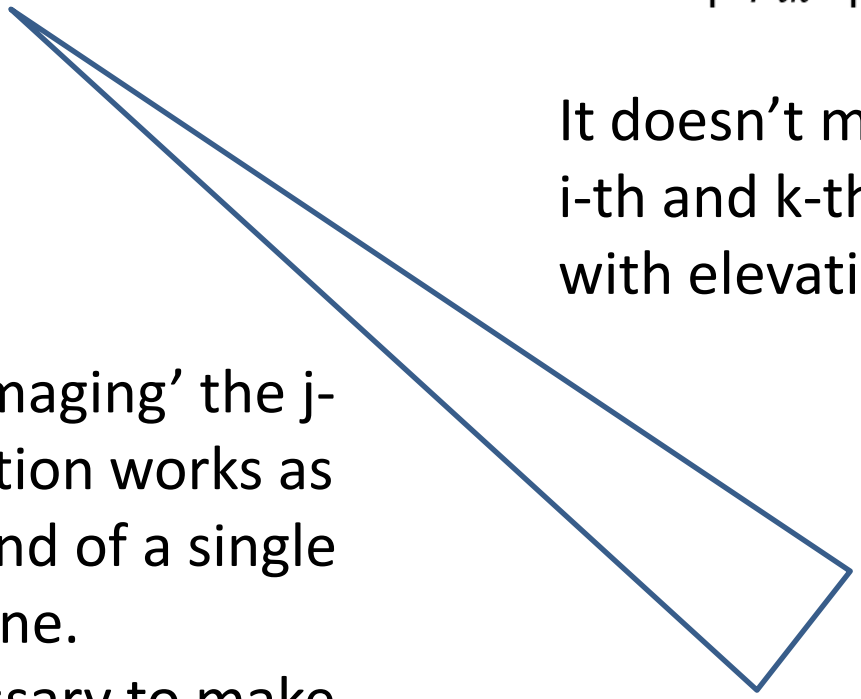
$S_{i,j,k}$: *Telescope Sensitivity*

Sharp triangular baselines

j-th station

$$PCA_j = \left|\frac{\rho_{ij}\rho_{jk}}{\rho_{ik}}\right| = \frac{\left(S_0\sqrt{S_iS_j}\right)\left(S_0\sqrt{S_jS_k}\right)}{\left(S_0\sqrt{S_iS_k}\right)} = S_0S_j$$

It doesn't matter if sensitivities of the i-th and k-th stations largely changes with elevation angles.



For 'imaging' the j-th station works as one end of a single baseline.
Necessary to make calibration for the j-th station as usual.

k-th station

i-th station

Importance of a short baseline

In the Sheshan campus of SHAO, the large dish and the medium size telescopes are possible to operate in the same time.

Optical fiber connected

6.1 km

Sheshan 25m

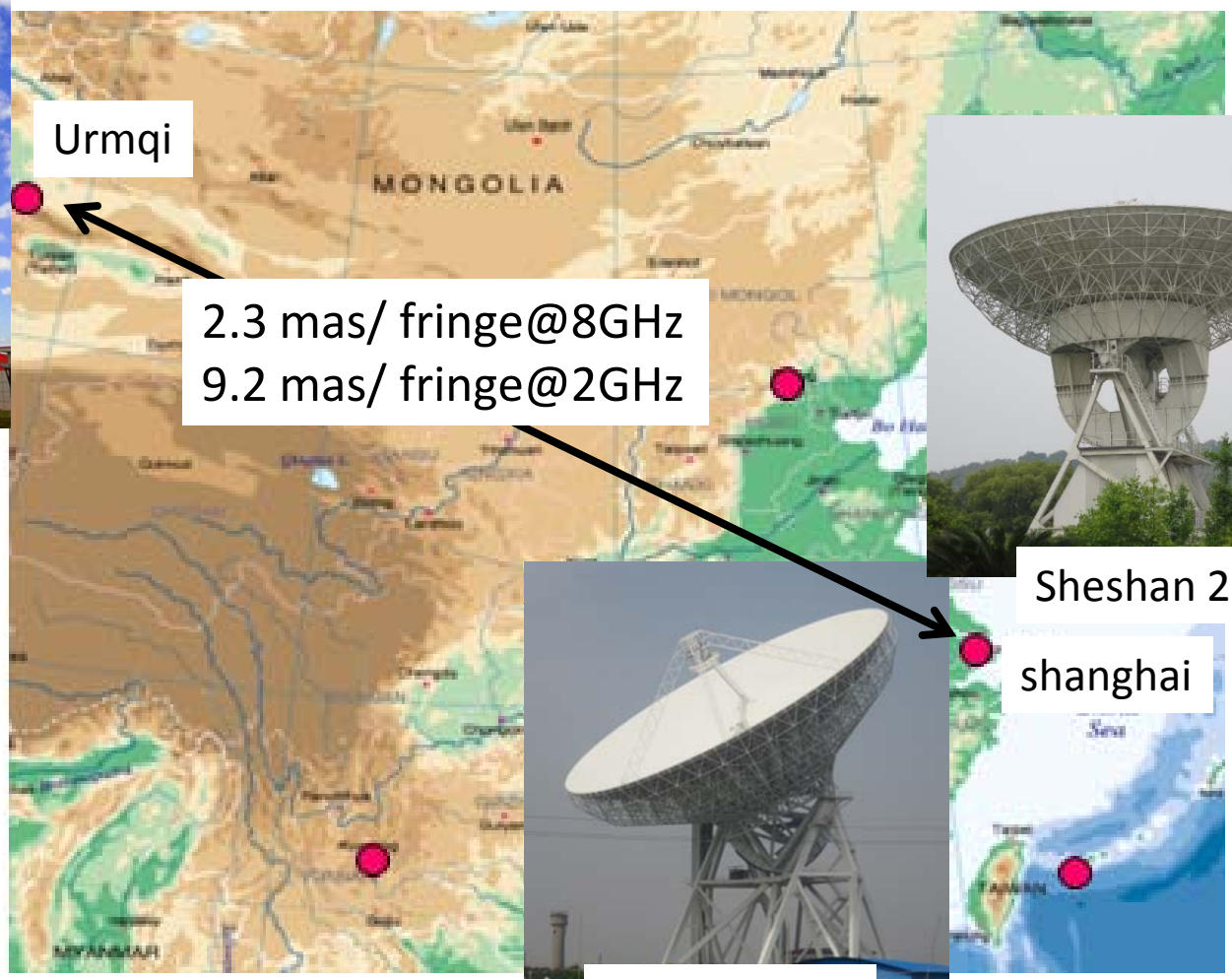
Tian Ma 65m

A Calibration Assistant

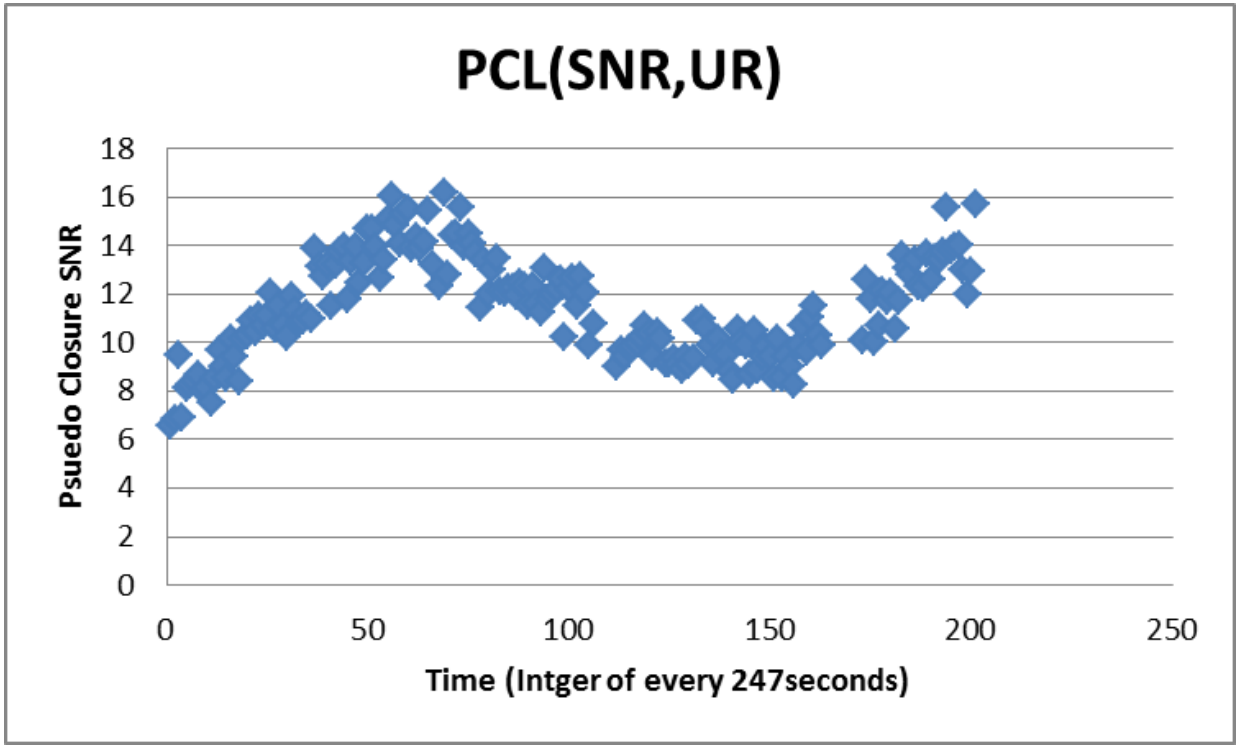
A Sensitivity Booster

X-band observation (PI, An Tao) on M81 with three stations of CVN

The Sheshan-TianMa Baseline is unique for the short baseline and the connection by an optical fiber cable, which is good for a near realtime fringe detection and a PCA analysis.



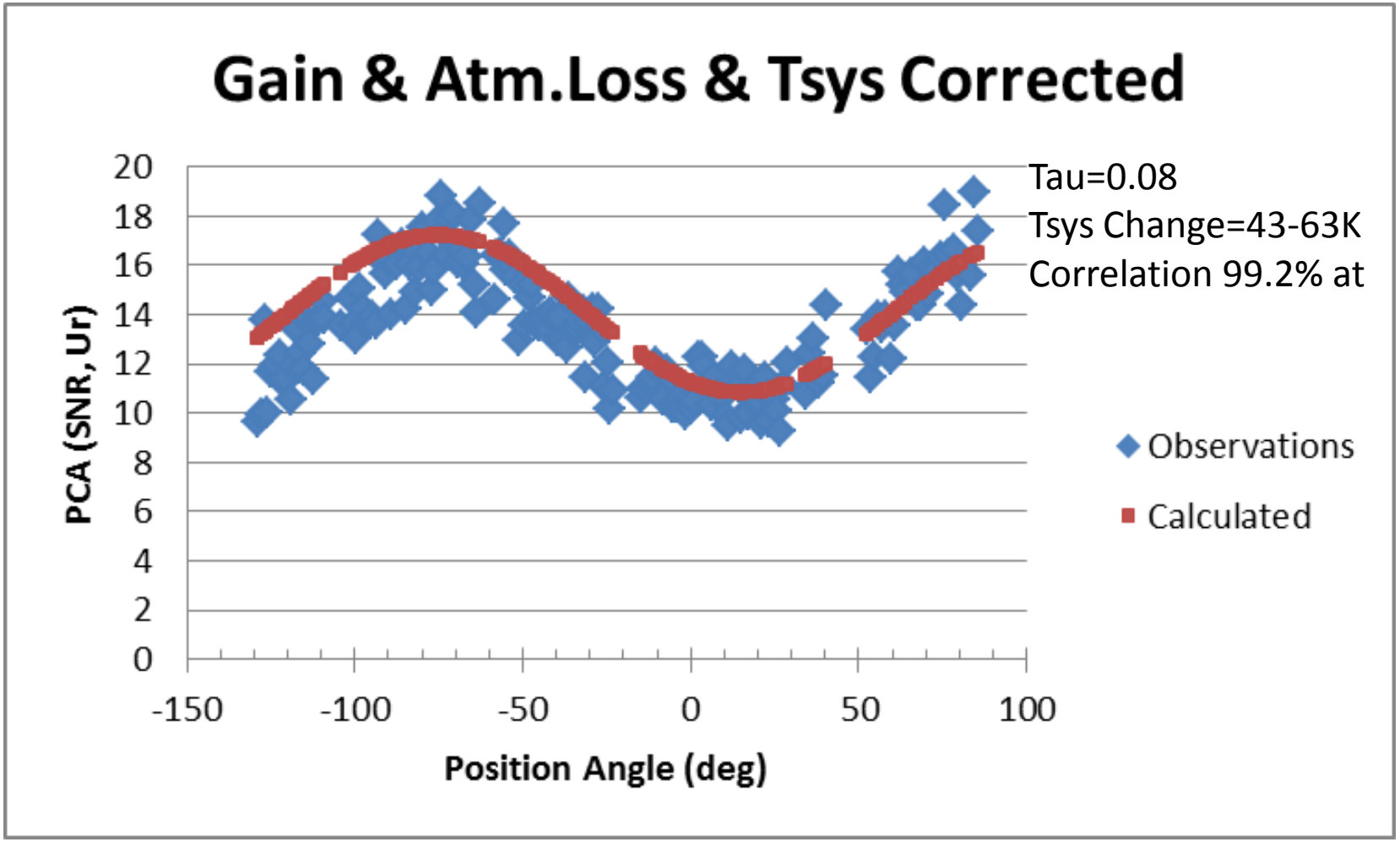
Pseudo Closure Analysis and Sensitivity of Ur25m



$$SEFD(Ur) = \frac{q \cdot S(M81)\sqrt{2BT}}{PCA(SNR, Ur)} = \frac{0.86 \times 0.17 \times (1.07 \times 10^5)}{(14.5 \pm 0.9)} = \mathbf{1078 \pm 70\ [Jy]}$$

(The SEFD(Sh) is 1050 Jy obtained in the EAVN fringe test in May, 2014)

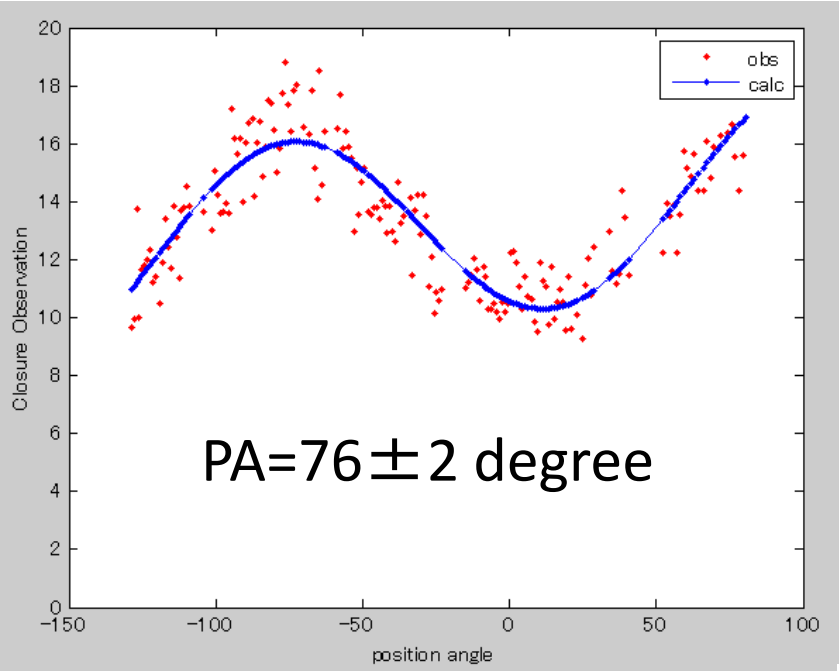
Tow point source model



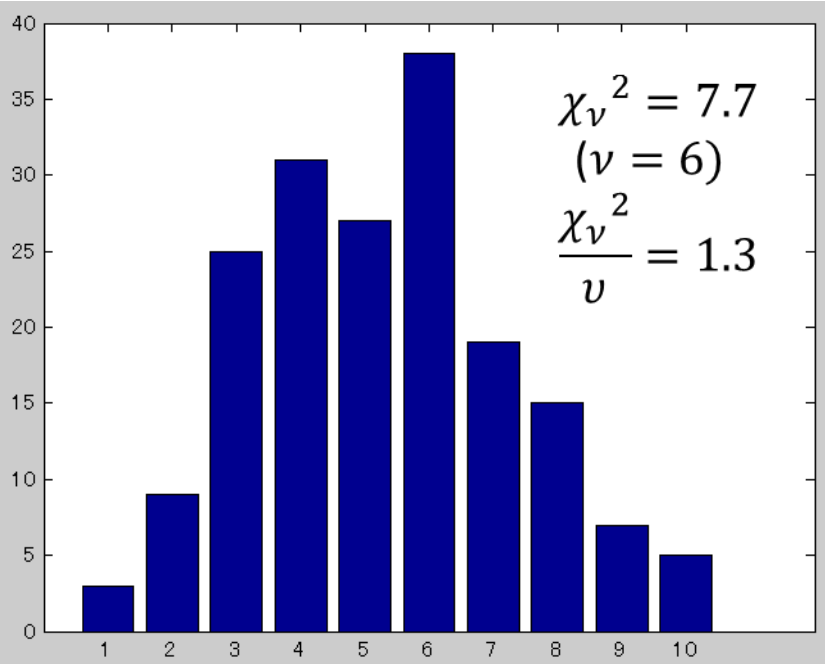
Evaluation of good-of-fitness

- VLBI data correlated by Jiang Wu was fitted to a two-point component model.
- A linear change of the sensitivity is removed.

Fitting to a two-point component model

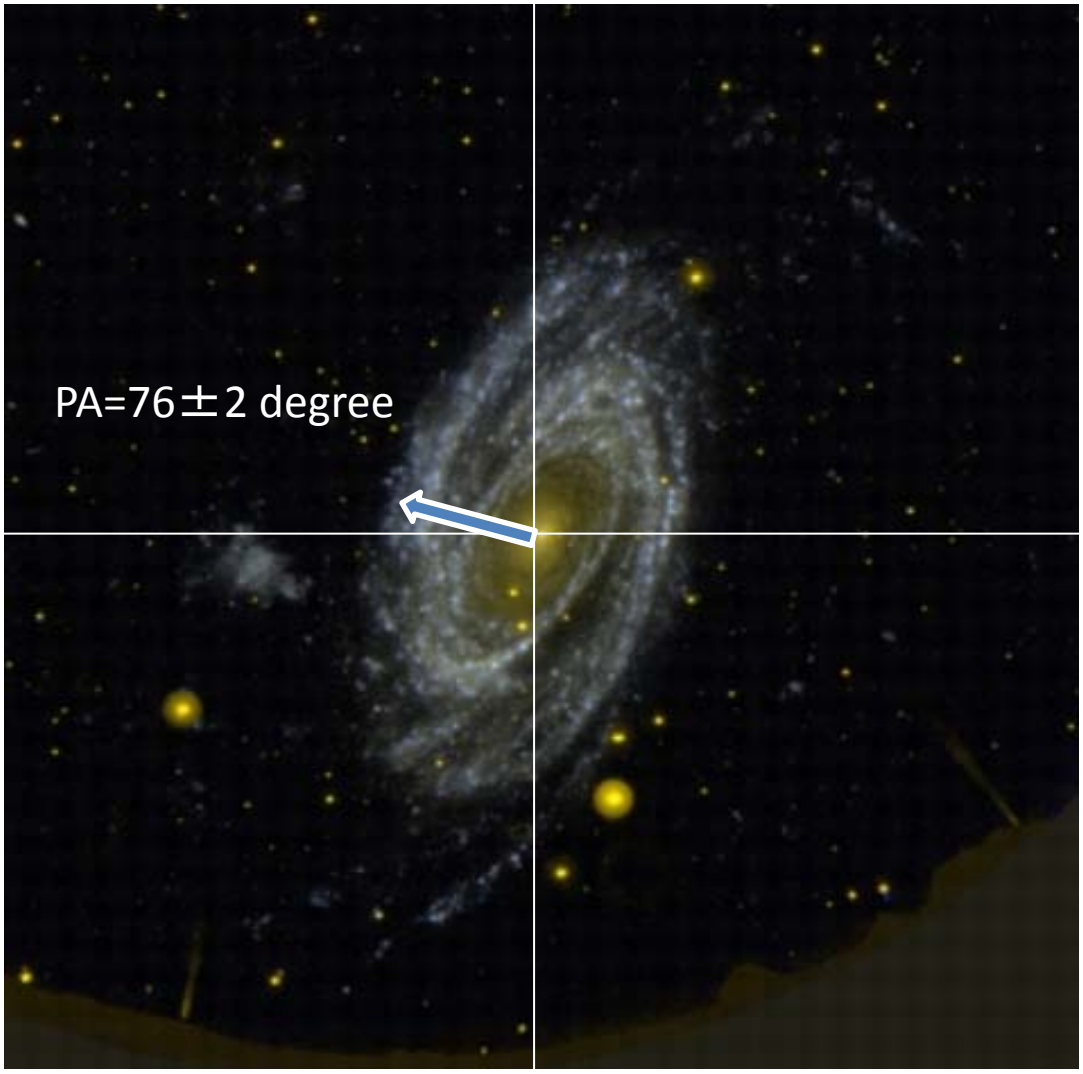


Residual distribution and the χ^2 *test*



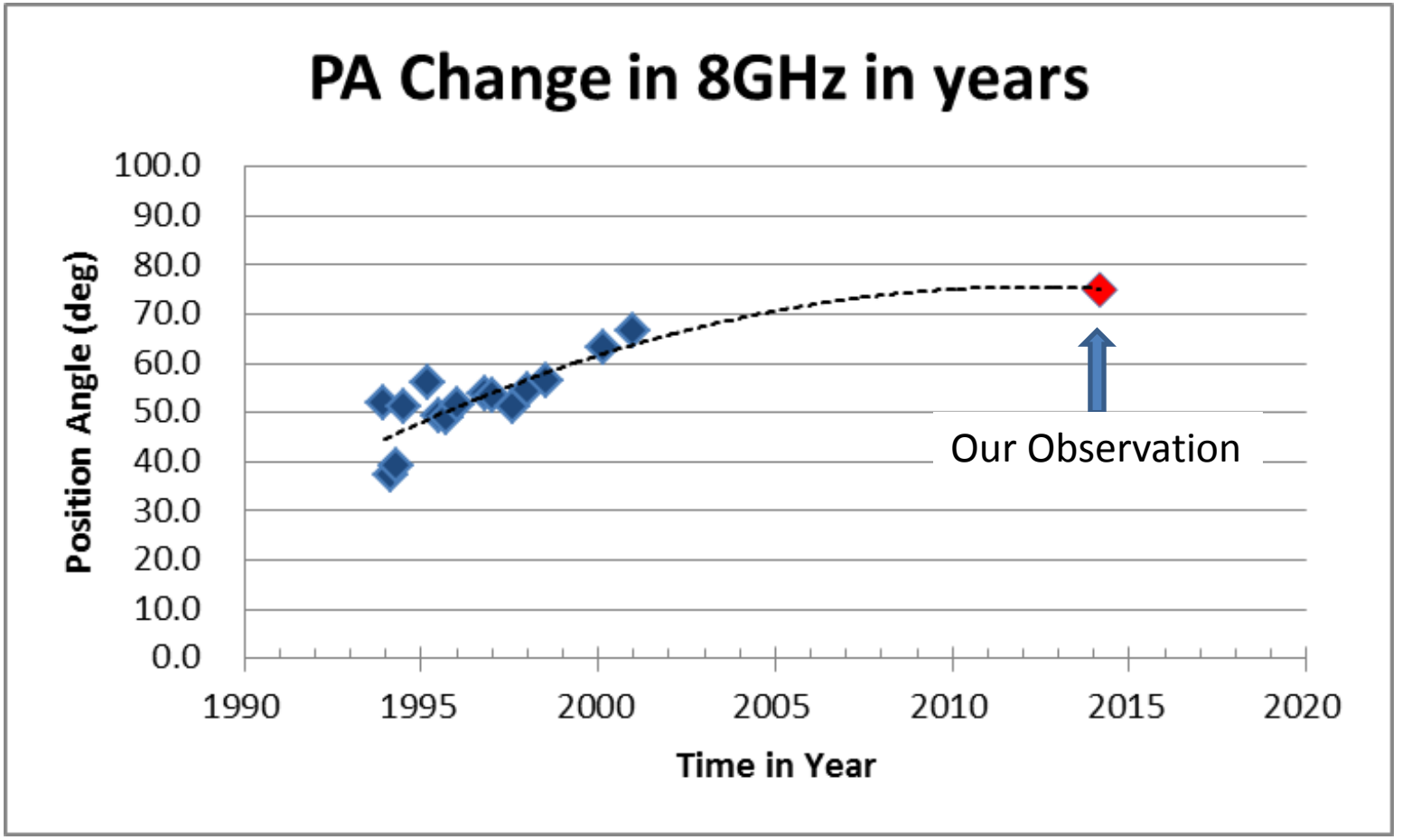
A fine good-of-fitness was confirmed with the $\chi_\nu{}^2/\nu$, almost unity that does mean the two-point component model Is valid and the derived position angle of the Jet direction is reliable enough.

Position Angle of Jet observed in X-band



- We can give a two-point-component model to the change of PCA with the correlation coefficient of 99% as seen in the previous slide.
- We got a peak PCA at the position angle of 76 degree.
- The Jet component is located at almost perpendicular to the galactic plane.

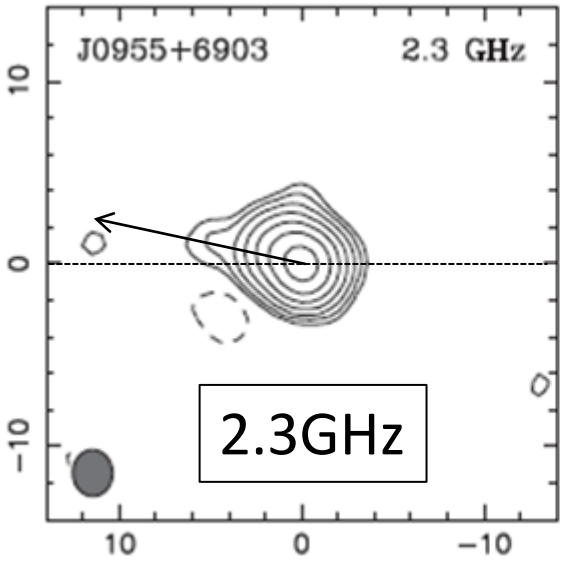
PA change in time in a 8GHz band



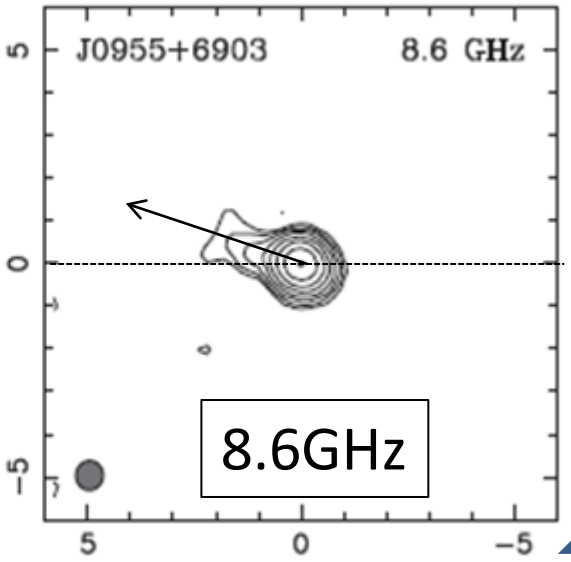
Is the position angle changing with frequency?

Our observation confirms this in X-band.

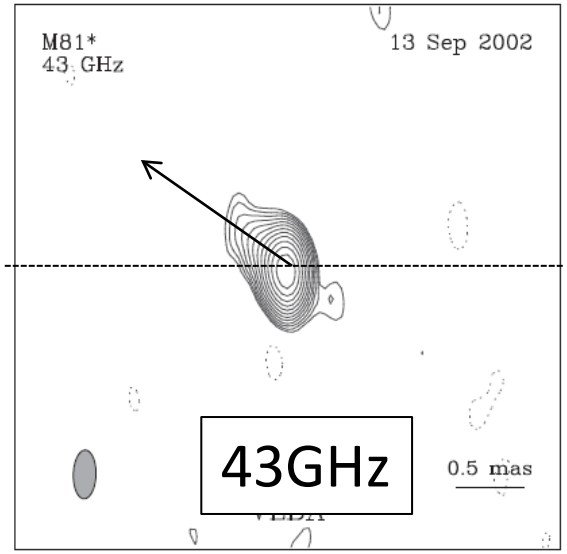
Ref[1]



Ref[1]



Ref[2]



g. 1. Contour image of M 81* obtained by hybrid mapping on the lf-calibrated data set. Contours are logarithmic, separated by a fac- √2, with the lowest level set at 1.8 mJy/beam, that is, three times the root-mean-square noise of the image. The peak of brightness is n. The interferometric beam, shown in the bottom left cor- of 0.361 × 0.168 mas and a position angle −1.6°.

22GHz?

References

[1] I. Martí-Vidal, et al., A&A 533, A111 (2011)
[2] E. Ros and M. Á. Pérez-Torres, A&A 537, A93 (2012)

Concluding Remarks

- The receiving system of the Tian Ma 65-m and the Sheshan 25-m telescopes are presented.
- Methanol maser observations on a sharp triangular baseline are proposed.
- The Tian Ma 65m works for the large sensitivity.
- The Sheshan 25m works for assisting the precise calibration on a large sensitivity change probably suffered on a large dish.

Data

SUPPLEMENT

C-band Receiver Performance (2)