Preliminary results of KaVA observations on M81

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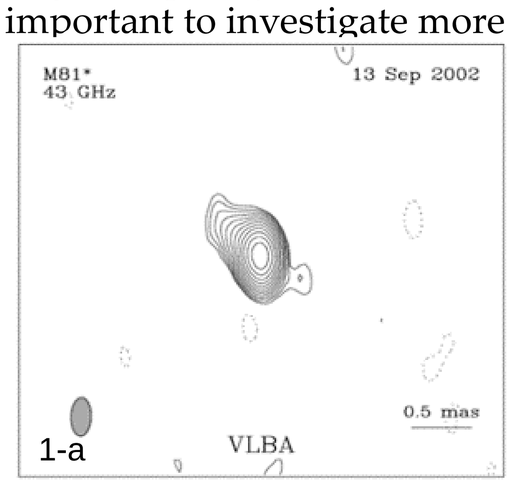
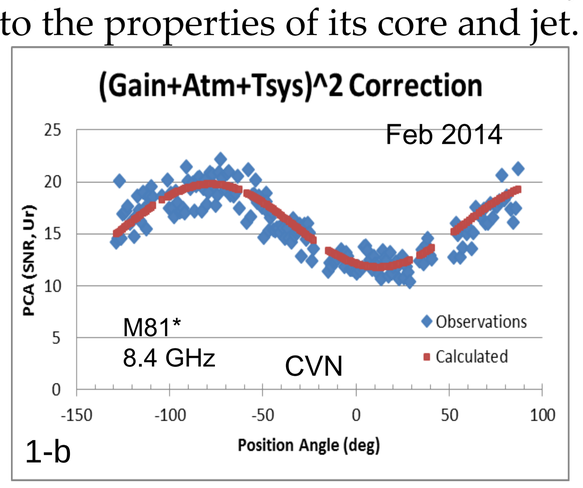
Introduction

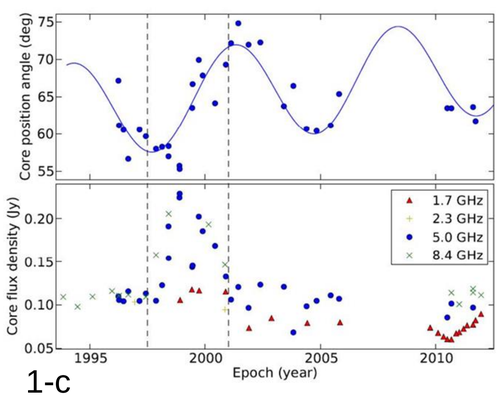
M81* is a low luminosity (120 mJy@5GHz, a=+0.3) AGN located at the core of the nearby galaxy M81. It is confirmed with a core and one side jet by previous observations (Fig. 1-a, 1-b). Some studies on the jet shows a precession phenomenon vs time (Fig. 1-c). The position angle of core-jet is also frequency dependent (Fig. 1-d). High frequency (mm-wavelength) observation on M81* are very important to investigate more into the properties of its core and jet.



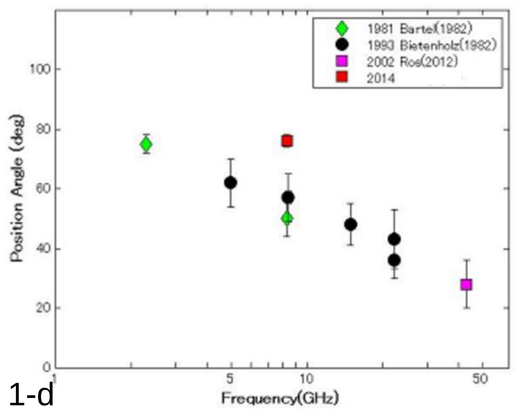
1-a



1-b



1-c



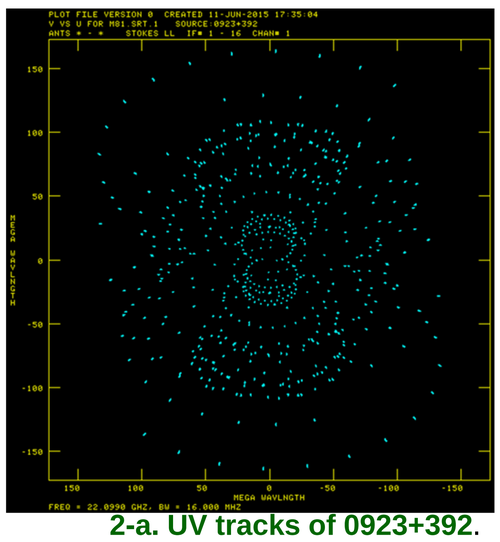
1-d

Observations

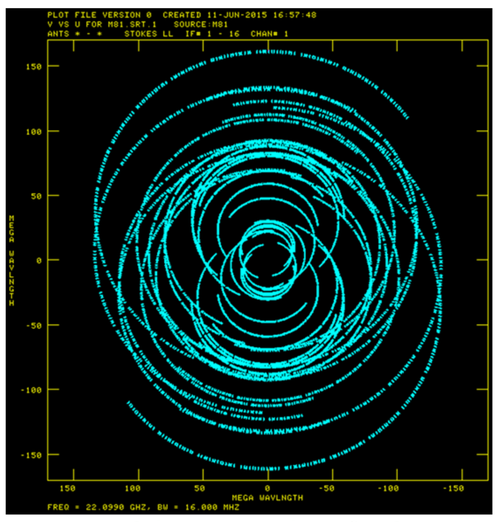
A set of KaVA common open use observations (r15069a/r15080a) were conducted on 20, 21 March 2015, under very clean weather. Including the scientific target M81*, two other AGN sources 0923+392 (4C39.25) and 1044+719 were also observed as the fringes finder and phase referencing source separately (see Table 1). All seven stations participated and K/Q band receivers were used, it was recorded with 256MHz bandwidth and 1 Gbps data rate in total. Correlations were done by KJCC in May, except Yonsei station in Q band, all other fringes were detected in K/Q band.

Table 1: Source list.

Object	Flux	Separation Angle	Scan distribution	Calibration code
M81*	0.2 Jy	0	10 x 240 sec/hour	target
1044+719	1.1 Jy	5.2 deg	11 x 60 sec/hour	Phase reference source
0923+392	5.5 Jy	~ 15 deg	1 x 180 sec/ hour	Fringe finder



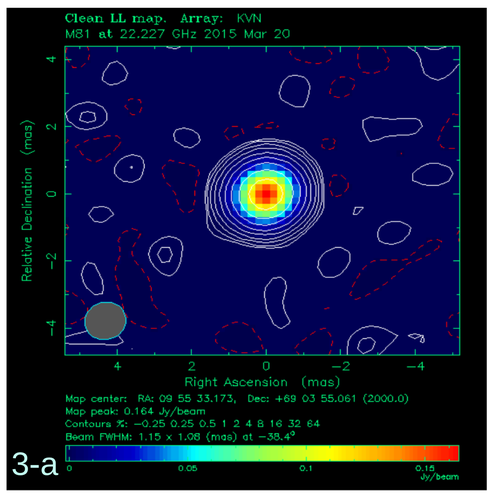
2-a. UV tracks of 0923+392.



2-b. UV tracks of M81*.

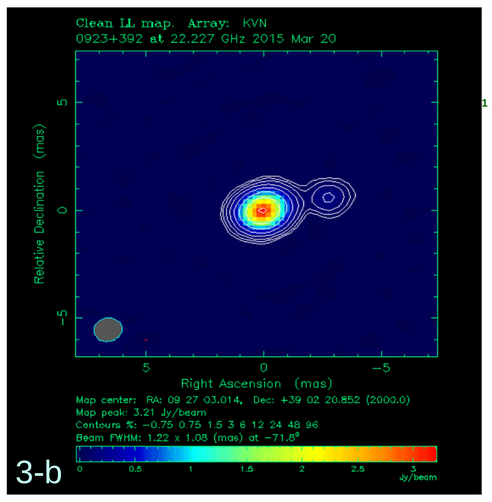
Preliminary results

M81*



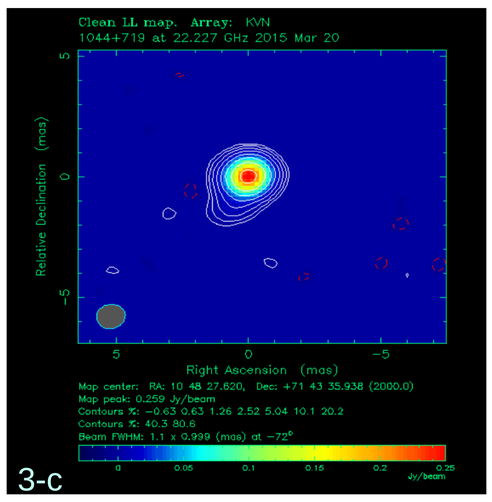
3-a

0923+392

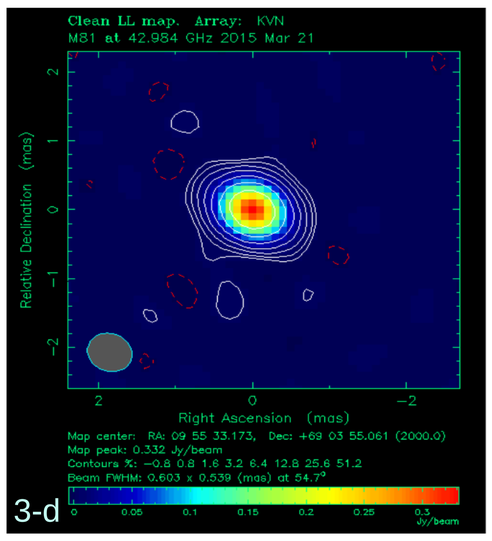


3-b

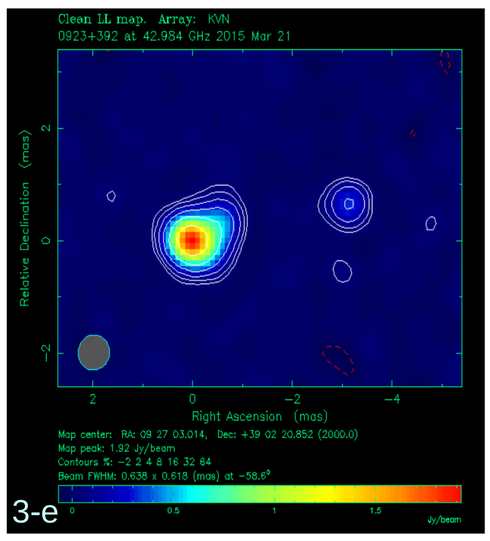
1044+719



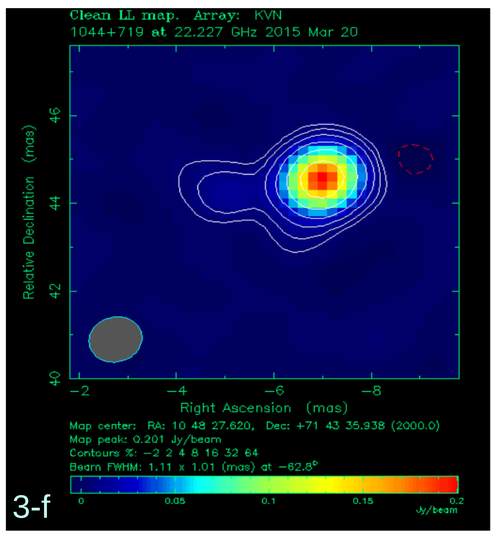
3-c



3-d



3-e



3-f

Two AGN sources inclusive of 1044+719 and 0923+392 were detected obvious core-jet structure (Fig. 3-b, 3-c, 3-e). Unfortunately, no jet component was found in M81* through the directly imaging processing both in K and Q bands (Fig. 3-a, 3-d). It is also not possible to derivate the frequency dependency of the position angle. Through pseudo closure amplitude analysis, it implied the calibration was not quite good. A possible reason was from the poor corrections of the atmospheric influences. In the case of LLAGN, the structure information was contaminated by the atmospheric fluctuations. An 'inverse' phase referencing imaging (exchanging the target source and phase referencing source) was conducted in the K band experiment (Fig. 3-f). Besides of the jet in 1044+719 shown in the directly imaging processing (Fig. 3-c), another jet component can be found in the east-west direction. It may indicate the structure in M81*.

Discussion

The M81 observations were successfully observed by KaVA. In the data analysis part, we failed to detect the jet in M81* as expected through direct VLBI imaging. One important message we recently learn from correlator people is that the atmospheric delay is not considered during correlation. We suspect the phase fluctuations in atmosphere blur the source structure information, especially for the LLAGN M81* and a small scale jet. There are two evidences to support our suspicion. One the abnormal EW jet in 1044+719 turned out when using inverse phase referencing by M81* to cancel the atmospheric effect. The other is the position of 1044+719 shifted ~-7 mas in RA and ~44.5 mas in DEC after the phase referencing reduction.

In the future, we will compensate the atmospheric delay in the data analysis and make it clear if our suspicion is correct. The pseudo closure relation is also hoped to be implemented to evaluate the calibration quality, even to help with the self calibration in the hybrid mapping. A better image and the position angle of jet in M81* in K/Q band are expected. Simultaneously, a wide field search for Novae around M81* is also considered in the observations. We will conduct re-correlation the raw data with multi phase centers and make a further analysis.

References

1. E. Ros,et al. A&A 537, A93,2012.
2. I. Martí-Vidal, et al. A&A 533, A111,2011.
3. N. Kawaguchi, et al. submitted to the PASJ, 2014.