PAGaN II: Monitoring AGN jets in mas scales

Junghwan Oh Seoul National University
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S. Trippe, S. Kang, D. Kim, M. Kino, SS. Lee, T. Lee, J. Park, B. Sohn
SNU AGN GROUP

Prof. Sascha Trippe

Students (from left)

Dae Won Kim iMOGABA

Jong-ho Park KVN polarimetry

Junghwan Oh KaVA imaging

Taeseok Lee KVN intraday variability
PAGaN

Plasma-physics of Active Galactic Nuclei understanding the formation, the structure, the internal conditions, and the evolution of AGN jets

Spatial structure and kinematics

Optical Depth

Magnetic fields

Deep high resolution imaging

Spectral index map

Polarimetry
PAGaN

Plasma-physics of Active Galactic Nuclei
understanding the formation, the structure, the internal conditions, and the evolution of AGN jets

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KVN Polarimetry

Dual polarization
High frequency
4ch. simultaneous obs.

KaVA mapping

Dual frequency
High resolution
More baselines

JH Park’s talk coming up next
### Observations

<table>
<thead>
<tr>
<th>Year</th>
<th>Season</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>Spring</td>
<td>43 GHz</td>
</tr>
<tr>
<td>2014</td>
<td>Fall</td>
<td>22 GHz</td>
</tr>
<tr>
<td>2015</td>
<td>Spring</td>
<td>22, 43 GHz</td>
</tr>
</tbody>
</table>

#### Source

- **3C111 BL LAC (2200+420)**
  - (3C84)
  - (3C120)

- **3C111 BL LAC (2200+420)**
  - DA 55 (0133+476)
  - 4C+01.28 (1055+018)
  - 4C+69.21 (1642+690)
  - 3C84
  - 3C120

- **3C111 BL LAC (2200+420)**
  - 3C345

Data analyzed by JY KIM (in his master thesis)

Iriki not available in 22 GHz obs.
**4C+01.28 (1055+018)**

Angular scale $7.78 \text{ pc} / \text{ mas}$

Jet towards north-west direction

Core dominated structure

3 model components found

MOJAVE monitoring stopped in Oct. 2012

**Clean LL map. Array: KVN**

1055+018 at 22.207 GHz 2014 Nov 03

22 GHz

Image rms = 1.9 mJy/beam

Map peak = 3.6 Jy/beam

Map center: RA: 10 58 29.805, Dec: +01 33 58.824 (2000.0)

Map peak: 3.8 Jy/beam

Contours: 0.00566 Jy/beam x (-1 1 2 4 8 16 32 64)

Contours: 128 256 512

Beam FWHM: 1.68 x 1.29 (mas) at -34.7°
DA 55 (0133+476)

Angular scale 7.7 pc / mas

Jet towards north-west direction

Core dominated structure

3 model components found

MOJAVE monitoring stopped in July 2013
Clean LL map. Array: KVN
1642+690 at 22.207 GHz 2014 Oct 22

**4C+69.21 (1642+690)**

Angular scale 7.35 pc / mas

Jet towards south-west direction

Core dominated structure

4 model components found

MOJAVE monitoring stopped in Sep. 2012

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**22 GHz**

Image rms = 0.99 mJy/beam
Map peak = 0.61 Jy/beam

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Map peak: 0.61 Jy/beam
Contours: 0.00297 Jy/beam x (−1 1 2 4 8 16 32 64
Contours: 128)
Beam FWHM: 1.34 x 1.15 (mas) at −13.7°
Clean LL map. Array: KVN
3C120 at 22.207 GHz 2014 Nov 05

22 GHz
Image rms = 0.89 mJy/beam
Map peak = 1.45 Jy/beam

3C120
Angular scale 0.65 pc / mas
Jet towards south-west direction
9 model components found
Waiting for next observation

Map center: RA: 04 33 11.096, Dec: +05 21 15.619 (2000.0)
Map peak: 1.45 Jy/beam
Contours: 0.00336 Jy/beam x ( -1 1 2 4 8 16 32 64
Contours: 128 256 512 )
Beam FWHM: 1.44 x 1.15 (mas) at -30.5°
Clean LL map. Array: KVN
3C84 at 22.207 GHz 2014 Nov 03

**22 GHz**

- Image rms = 17.4 mJy/beam
- Map peak = 10.1 Jy/beam

**3C84**

- Angular scale 0.35 pc / mas
- Jet towards south direction
- 4 model components found
- Brighter jet component

Map center: RA: 03 19 46.160, Dec: +41 30 42.105 (2000.0)
Map peak: 10.1 Jy/beam
Contours: 0.0523 Jy/beam x (−1 1 2 4 8 16 32 64)
Contours: 128)
Beam: FWHM: 1.43 x 1.04 (mas) at −60.2°
BL LAC (2200+420)

2014 | Apr. 43 GHz
---|---
Clean LL map. Array: KVN
2200+420 at 42.985 GHz 2014 Apr 17
Image rms = 3 mJy/beam
Map peak = 2.86 Jy/beam

2014 | Oct. 22 GHz
---|---
Clean LL map. Array: KVN
2200+420 at 22.207 GHz 2014 Oct 22
Image rms = 2.33 mJy/beam
Map peak = 2.54 Jy/beam

2015 | Mar. 22 GHz
---|---
Clean LL map. Array: KVN
2200+420 at 22.227 GHz 2015 Mar 31
Image rms = 2.71 mJy/beam
Map peak = 1.54 Jy/beam

2015 | Apr. 43 GHz
---|---
Clean LL map. Array: KVN
2200+420 at 42.984 GHz 2015 Apr 01
Image rms = 0.92 mJy/beam
Map peak = 1.45 Jy/beam

Simultaneous Obs.

22 GHz
43 GHz
BL LAC (2200+420)

43 GHz

Total flux = 3.41 Jy
Map peak = 2.86 Jy/beam

Total flux = 1.98 Jy
Map peak = 1.45 Jy/beam

2014 Apr. 17
350 days
2015 Apr. 1
BL LAC (2200+420)

Spectral index map (22/43)
Flat core, steep jet

Imaged with “VIMAP” - developed by JY Kim (2014, JKAS, 47, 195)
3C111

22 GHz

Image rms = 0.97 mJy/beam
Map peak = 1.7 Jy/beam

43 GHz

Image rms = 1.06 mJy/beam
Map peak = 2.54 Jy/beam

Simultaneous Obs.

Image rms = 1.6 mJy/beam
Map peak = 1.17 Jy/beam

Image rms = 1.93 mJy/beam
Map peak = 1.01 Jy/beam
3C111

Newly launched jet?

2014 Oct. 23

2015 Apr. 1

161 days
3C111

Gap between projected radial positions = 0.6 ~ 0.7 pc
Superluminal motion ~ 5c
3C111

MOJAVE
15.4 GHz

2014 Dec. 12
158 days
2015 May. 18
3C111

Newly launched jet?

43 GHz

2014 Mar. 15

384 days

2015 Apr. 2
Gap between projected radial positions = 1 ~ 1.5 pc

Superluminal motion 3 ~ 5c
Spectral index map (22/43)

Flat core, steep jet

Imaged with “VIMAP”
- developed by JY Kim
(2014, JKAS, 47, 195)
3C345

2015 Mar. 31

Image rms = 3.7 mJy/beam
Map peak = 1.91 Jy/beam

22 GHz

2015 Apr. 1

Image rms = 1.55 mJy/beam
Map peak = 1.63 Jy/beam

43 GHz
Conclusion

Successful results from our first KaVA observations
  • Deep imaging with detailed structures of the targets
  • Detection of superluminal motion of jet components
  • Variation of spectral index along the jet

More scientific results fully depend on future observations