The Kinematics of 4C 21.35 from KaVA observation

Taeseok LEE
-Seoul National University-

with KaVA LP M87 team
4C

- Gamma ray bright flat spectrum radio quasar
- Ra : 12 24 54.46
- Previously went through two major Gamma ray flares in 2010 and 2014.
- Redshift = 0.433
- Few-Jansky-bright
- Monitored by MOJAVE and BU
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Quasar 1222+216 at z=0.4

18 years of observed jet evolution

(3600 years in the quasar frame)
• 2 major bursts in 2010 and 2014.
• Many works have been done these two major flaring events till 2015.
• The source has been quiet since the end of 2014. (so have been the papers)
• Observed as a part of KaVA Large Program of M87 intense monitoring:
  biweekly observation at 22 and 43GHz separation)
• 2014. 5. ~ 2016. 6. (mostly in 2016)
• Most of data in good quality
• Data are processed with AIPS + DifMAP
KaVA

- Point source model circular Gaussian model fitting
- 5 jet components (3 in inner jet, 2 in outer jet)
- New jet component ejection the early 2016.
- Peak flux drop between 2015 and 2016
- N angle variation only radial distance of the jet components
3 inner jet components tracked.

In the 2D map, components move.

Bending feature at ~4 mas.

All three components constantly

Since jet 3 is newly ejected from the core, we tracked down the ejection date.
The Gamma-ray flare at the end of 2014 was before our intense monitoring started.

The ejection time of the jet component 3 coincides with the Gamma-ray burst in the end of 2014. (consistent with Gamma-ray originating SOMEWHERE inside the parsec scale core region)

The jet components seem to accelerate as moving away
Jet blob at 10 mas shows clear outward+transverse movement as it has been following.

Apparent radial speed is 6.5c

Fluxes of the two jet components slightly dropping down
• 4 jet components were identified (22G blob at 10mas is too faint)
• Peak flux drop between 2015 and 2016
• Trajectories are linear components
• Jet 1, 2, 4 flux cooled down, jet 4 being the fastest. Jet 3 flux alone went slightly up.
- Jet component 1 and 3 are constantly moving out.
- Jet component 2 and 4 seem to show messy movements, probably due to blending effect with unresolved near components.
• Jet component 1 and 3 are constantly moving out.
• Jet component 2 and 4 seem to show messy movements, probably due to blending effect with unresolved near components.
• Still, the jet components seem to accelerate within several parsec scale.
KaVA observations

22G

43G
• Monthly monitoring at 43GHz
  ‘the more the merrier’
• Here, 3 epochs in mid 2015 are shown.
• Many point model components.
  like jet component
• Note that core-region is quite crowded component too.
• 4 circular Gaussian models constructed as close to the KaVA model components.

• Jet components moving at constant apparent speed. 5c ~ 15c. 
  ➢ at <10 pc region, it’s slower than Jorstad et al 2016 & still twice faster than KaVA results.
• To investigate if the discrepancy is due to the resolution effect.
• By taking the BU data and restricting the uv coverage as KaVA
• The images quite alike KaVA’s, with few more jet components. (no need to sorting out or averaging)
• The location of the jet components : consistent with the original BU data
• 3 components nearest to the KaVA’s are tracked
• 4 epochs in 2015.
• Apparent jet speeds range 6.6 ~ 7.7
  ➣ comparable/faster than KaVA results
KaVA and BU data

- Overall, BU original data show almost faster movement.
- BU with KaVA UV coverage show similar apparent speed with both BU original and KaVA but in each different location…
- **Suspects**
  - jet component identification, resolution effect of KaVA.
Preliminary results

- From 2014 to 2016, 4C21.35 had one Gamma-ray flare in late 2014 only. Radio peak flux got fainter.

- At jet component ejected at the time of Gamma-ray flare. seemed to occur little sooner than Gamma-ray active phase. The blob at 10 mas continued

- At components are
Upcoming works

- More epochs of BU data to be analyzed for robustness with error estimation
- MOJAVE images of 15G, 8G, 1.4G …
- Future observations to trace the bending point of the jet at 43G: the structure may be different from Gamma-ray active phase?
Thank you