Jet Streamline in CTA 102

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Abstract

Studies of Jet structure in active galactic nuclei (AGN) has been going on for many years to understand their formation and processes. We performed a study on the jet streamline in CTA 102, a supermassive black hole, a type of blazar with a redshift of 1.037 at a frequency of 2 GHz using VLBA archive data. This search has shown the jet streamline in CTA102 at different angles. The work is continuing and intends to search for the jet width, the geometry structure, and possible transition in CTA 102.

Introduction

CTA 102 (2230+114) is a type of quasar with its central supermassive black hole mass measured to be ~$10^{8.93}$ solar mass with a redshift of 1.037 that exhibits relativistic outflows. Based on the paper from J. C Algaba et. al.(2017) CTA 102 shows a possible jet break at 10^1 to 10^2 pc (figure 1). It is interesting to search for the jet width structure of CTA 102 in details in order to understand the jet break and transition of the streamline.

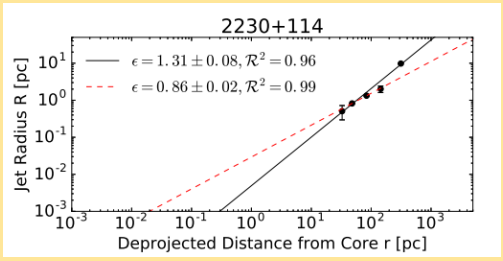

Figure 1: Jet width structure of CTA 102. J. C Algaba et. al. (2017)

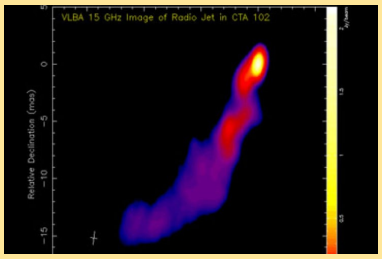

Figure 2: VLBA image of CTA 102 at 15 GHz. MOJAVE program, M. Lister (Purdue University et al)

To investigate the jet break, a lower frequency is required to look at the extended region of the jet.

Special treatment has to be done to the source because it is obvious that the jet has some curve based on the MOJAVE data.

Methodology

- Data reduction, calibration and imaging of the 2 GHz archive data (Project code: BA0064) is carried out using AIPS and DIFMAP.
- To get the streamline of the jet, a slice is taken at an angle to the jet structure and a point is taken at 50% of the total flux along the slice.
- A total of 93 slices are taken and the points are connected to show the streamline of the jet.
- Several streamlines are taken by making the slice at different angle to the jet structure and shown in the result.

Results

The streamline is important to search for the jet width structure of the jet to avoid bias arise when determine the jet break together with the geometry transition.

The bias is possible to arise when the jet width is taken by combining two weighting, causing bending to the jet which might give a false result.

By using the jet streamline and taking slice perpendicular to the streamline will be able to give a better picture on the jet width structure.

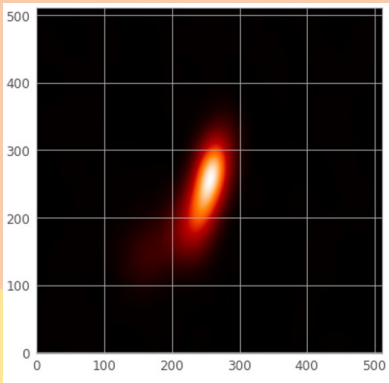

Figure 3: clean map

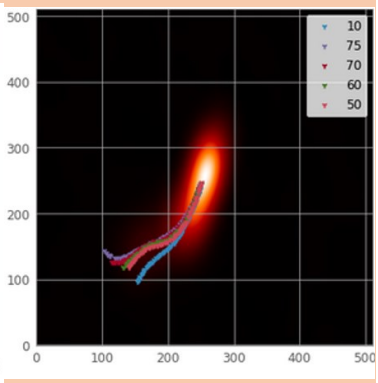

Figure 4: Streamline of CTA102 at

Future Work

We fit the slice with one or multiple gaussian and define the widths of the jets as the deconvolved FWHM for one gaussian fitting and the distance between the outer edges of the FWHMs as the width of the jet for multiple gaussian fitting case.

$$\theta_{\text{jet}}^2 = \theta_{\text{fit}}^2 - \theta_{\text{res}}^2$$

The 2GHz frequency will be combined with other frequency to have a full picture of the jet width structure and locate a possible geometry transition of the jet.

References

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2. Asada, K., & Nakamura, M. (2012). The structure of the M87 jet: A transition from parabolic to conical streamlines. *The Astrophysical Journal Letters*, *745*(2), L28.