Perseus in Sicily: From Black Hole to Cluster Outskirts
Proceedings IAU Symposium No. 342, 2018
K. Asada, E. de Gouveia Dal Pino, M. Giroletti,
H. Nagai & R. Nemmen, eds.
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doi:10.1017/S1743921318008001

Bending of the pc scale jet in 3C84

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Abstract. We have conducted VLBI monitoring observations for a radio galaxy 3C 84 to investigate how the pc scale jet structure changes over a long period. VERA, a VLBI observation network in Japan, was used for the observation. The C3 component of the jet has continuously moved toward the south from the core. The motion was, however, not straight, but it showed a bending of about 0.3 mas (0.1 pc) with a time scale of 500-1000 days. Two models explaining the bending, local brightness distribution change or real change of the jet traveling direction, are discussed.

Keywords. galaxies: active, galaxies: individual(3C 84/NGC 1275), galaxies: jets, radio continuum: galaxies

1. Introduction

The bright radio source 3C 84 is associated with the giant elliptical galaxy NGC 1275 ($z = 0.0176$), which is a dominant member of the Perseus cluster.

Fig 1 shows a 22 GHz total intensity image of 3C 84 . In previous studies it was shown that the parsec-scale structure is consisted of four components. We have investigated the detailed kinematics of C3 with the GENJI programme data at 22 GHz for the period from 2015 January to 2016 December, 33 epochs. The GENJI programme [1] is a monitoring program of gamma-ray bright AGN with VERA array (VLBI Exploration of Radio Astrometry). Thanks to the high cadence monitoring of GENJI, we can observe the detailed motion of components in 3C 84 on subparsec scales. We also focus on the correlation between changes in radio structure (Fig 1) and the gamma-ray activity, that may provide a clue to identify of the gamma-ray radiation region of 3C84.

2. Results and Discussions

Hiura et al. (2018) made a monitoring of jet motion in 3C84 in the period before 2015. The position of the jet components relative to the core that we derived are shown in Fig 2 as overlapped to the result of Hiura et al. (2018). Although, all the components have moved to the south, the motion is not ballistic. A striking steep bending (flip motion) was observed for C3 in 2015. The position of C3 suddenly shifted 0.5 mas to the east with a time scale of 400 days, and is going back to the south-west in 2016. In addition, the flux density of C3 quickly increased from 10 Jy to 17 Jy during 2016, while the other components did not show prominent variability.

We considered the origin of this flip motion. A simple and plausible model is changing the local brightness distribution. Change in local brightness distribution may cause an apparent bending of the trajectory of C3. Since C3 has a spread structure, the peak position of the brightness distribution could be shifted by a slight brightness change. Such local brightening occur if the jet collide with an ambient matter and a shock occurred, and

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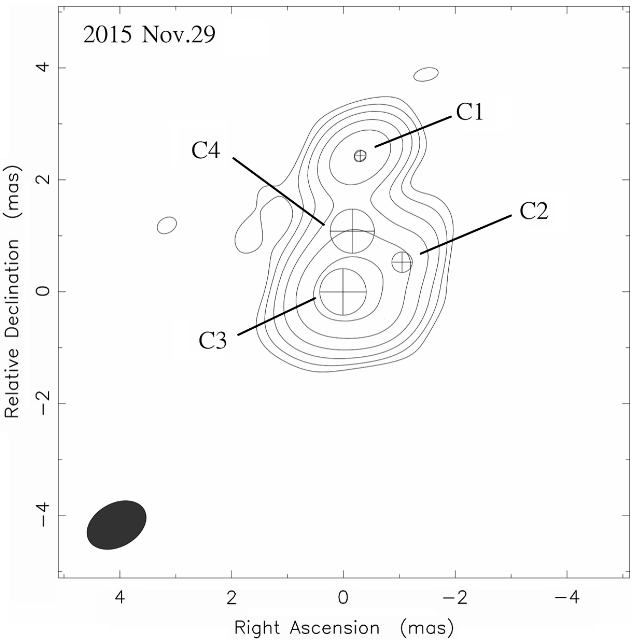

Figure 1. A 22 GHz total intensity image of 3C84 on Nov 29, 2015 by VERA with circular Gaussian components imposed.

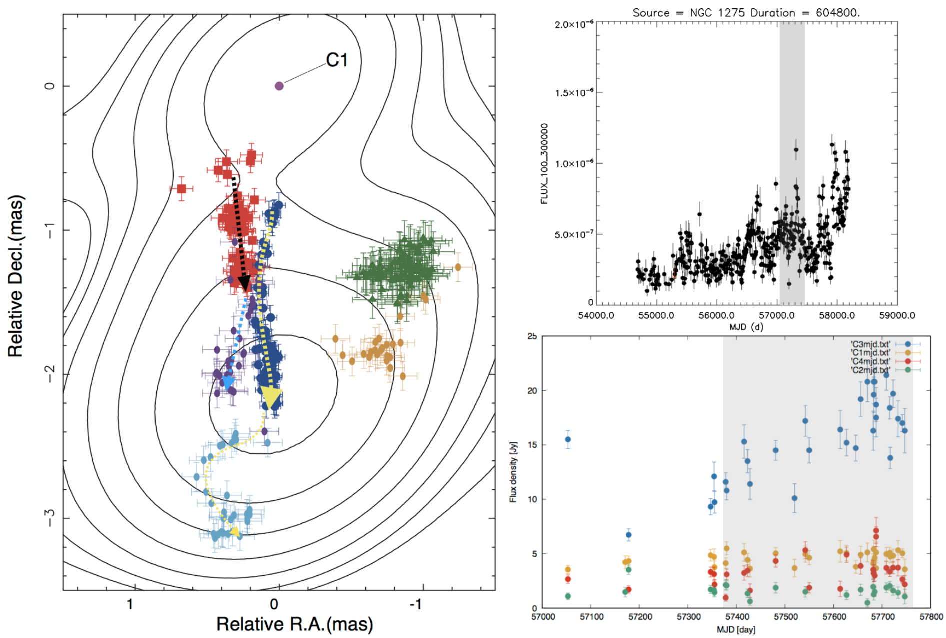

Figure 2. (Left) The positions of the jet components relative to the core (C1) for 33 epoch from 2015 to 2016 (C2: orange, C3: light blue, C4: purple) overlapped to the result by Hiura et al. (2018) from 2007 to 2013 (C2: green, C3: blue, C4: red). It superposed on the contours of the 22 GHz intensity distribution at January 6, 2014. Right) Radio (upper-panel) and gamma-ray (lower-panel) light curves. The gray zones in two panels indicate the period in which the flux density of C3 increases.

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high energy particles are generated in the shock, consequently the synchrotron radiation is strengthened. As well as the radio emission, gamma-rays would increase in such shock region. The flux of the gamma-ray was at high-level during the bending period (Fig 2), and this may be caused by the shock.

References

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