

May PKS 1155+251 be the habitat of a binary black hole?

Xiaolong Yang^{1,2} and Xiang Liu¹

¹Xinjiang Astronomical Observatory, Chinese Academy of Sciences, Urumqi, 830002, China;
email: yangxiaolong@xao.ac.cn

²Graduate University of Chinese Academy of Sciences, 100049, Beijing, China

Abstract. Close binary black holes (BBH) are important not only in astrophysics but they would be the strongest gravitational wave sources in the universe. Galaxy-galaxy merging systems are mostly found in optical and X-ray images. In radio, however, the VLBI can resolve the close binary system at pc scale, if their nuclei are radio loud. Recently we analyzed the archive VLBI data of PKS 1155+251, it shows twin core-jets like VLBI structure. In this poster, we present preliminary result from analyzing of the archive data. Further investigations with high frequency VLBI observations are required to confirm if it is a true BBH system.

Keywords. black hole physics: binary – galaxies: jets – quasars: general – radio continuum

1. Radio continuum images

PKS 1155+251 as a BBH candidate (Liu 2014), is a flat spectrum radio quasar, at $z = 0.2016$. The radio continuum images of PKS 1155+251 are obtained at 4 bands (C-band, X-band, U-band and S-band). Figure 1 shows naturally weighted 4.9 GHz and 15 GHz images. We can see that the 15 GHz image contains two bright and compact components, the two components are labeled as C1 and C2, other component labels can be seen from the images. Kellermann *et al.* (2004) has identified the bright component C1 to be the core and classified this source as a core-jet. Tremblay *et al.* (2008) observed this source in 2006, and identified it to be a CSO and C2 to be the core. However, we find the structure of this source show twin core-jets like structure, which can not be fully explained with the CSO scenario, i.e. it appears C1 to have a jet. We also find faint bridges among the bright components, this can rule out the possibility that one of the components to be a foreground or background source Rodriguez *et al.* (2006).

We set a logarithm contour level and set first level contour to the 3σ . The Fig.1 left shows large scale structure at 4.9 GHz, it exhibits east-west jet structure. The Fig.1 right shows small scale structure at 15 GHz with a higher resolution, interestingly, this image shows south-north jet morphology. The binary black holes interaction could be account for the jet orientation difference, which could be due to a dramatic change of the jet axis.

2. Component motions

Apparent motion of large scale structure. We obtained S-band data taken in three epochs 1996, 1997 and 2003. The apparent motion was estimated by settling component C1 as the reference center and all images were laid on Fig.2. We select the largest beam to restore all of three images to get the same resolution, then logarithm contour levels were used, first contour level was set to be 3σ to get acceptable signal to noise ratio, the σ was the largest one in the three images. The resulted images can be seen in Fig.2 left.

Small scale component motions. In order to obtain relative motions of components,

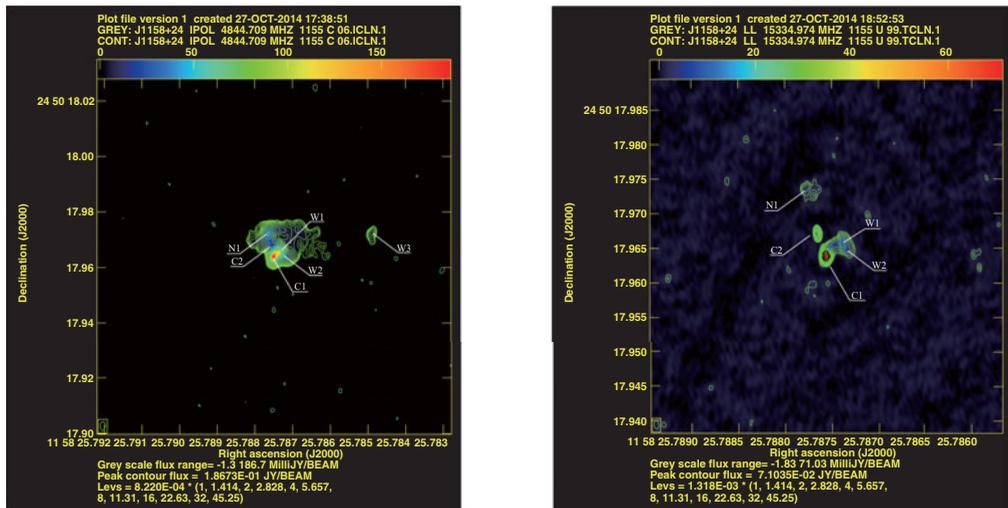


Figure 1. The VLBI morphologies of PKS 1155+251.

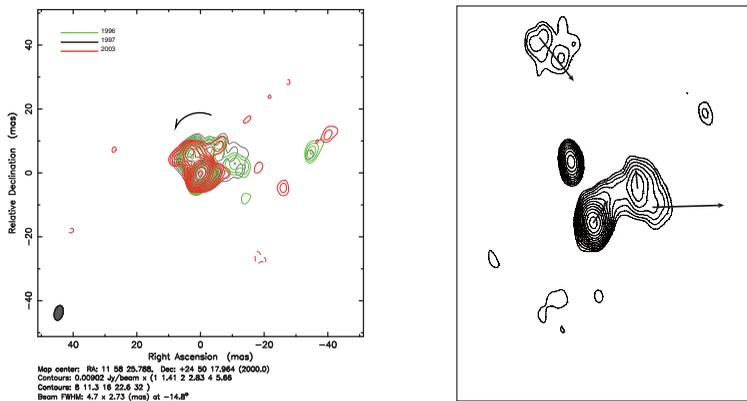


Figure 2. Component Motions.

we used fully calibrated U-band archive data, the time baseline is 2 years. Component motion studies were performed by fitting 5 Gaussian components in Difmap software to the 1999 visibility data. Then we used this model to fit the 2001 visibility data, all parameters were fixed at 1999 values except for position and flux density. We choose component C2 as the reference, the result has been showed in Fig.2 right. We add arrows at 1999 image to show the direction of motion of each component. This source appears to be shrinking, which may be due to the binary black holes interaction.

References

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