Galaxies and Their Constituents at the Highest Angular Resolutions
IAU Symposium, Vol. 205, 2001
R.T. Schilizzi, S. Vogel, F. Paresce and M. Elvis

Space VLBI Observations of PKS 1921–293

Zhi-Qiang Shen, Philip G. Edwards

ISAS, Yoshinodai 3-1-1, Sagamihara, Kanagawa 229-8510, Japan

Seiji Kameno, Makoto Inoue

NAO, Osawa 2-21-1, Mitaka, Tokyo 181-8588, Japan

James E. J. Lovell

ATNF, CSIRO, P.O. Box 76, Epping, NSW 2121, Australia

Abstract. We present results of the first space VLBI observations of PKS 1921−293. An inner jet component about 1.5 mas north of the core is revealed for the first time. The compact core is partially resolved, but still has a brightness temperature (at the source rest frame) of 3.0×10^{12} K. A spectral index map made by combining the 1.6 GHz VSOP image with the 5.0 GHz VLBA+Y image at the first epoch is also presented.

1. Introduction

PKS 1921–293 is one of the brightest radio-loud blazars. At a redshift z = 0.3525, 1 mas corresponds to 4.6 pc (H_0 = 65 km s^{-1} Mpc^{-1} and q_0 =0.5). VLBI observations showed a typical core-jet morphology. The core is very compact and bright with a brightness temperature (T_b) in excess of 10^{12} K in the rest frame of the quasar. The jet feature is quite straight but diffuse at λcm wavelengths, and shows a superluminal bending at λ7 mm with a significant change (>50°) in the position angle from λ7 mm to λcm (Shen, Moran, & Kellermann 2000, in preparation).

With high resolution, VSOP observations enable us to study the compactness (i.e., high T_b) of the core and the bending structure within the jet. The 1.6 GHz VSOP observations have a matched resolution to the 5.0 GHz VLBA observations. This kind of imaging observations, if made simultaneously, can be used to produce spectral index maps.

2. Observations and Results

VSOP observations of PKS 1921–293 were carried out at both 1.6 GHz and 5.0 GHz on 1997 July 18, and at 5.0 GHz only on 1998 June 19. The participating antennas are the HALCA spacecraft, 10 VLBA antennas and phased VLA (Y). Radio signals were recorded in VLBA format at each station and later correlated at the VLBA correlator in Socorro. Post-correlation data reduction was

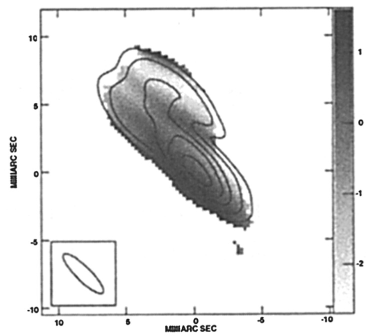

Figure 1. A spectral index (α; $S_\nu \propto \nu^\alpha$) map (gray scale) of PKS 1921–293 made from the 1.6 GHz VSOP image and the matched-resolution 5.0 GHz VLBA+Y image, superimposed on the 1.6 GHz VSOP image (contour). The restoring beam is 4.1 mas$\times$ 1.1 mas.

done in NRAO AIPS and Caltech Difmap. All images are made with uniform weighting to ensure the highest spatial resolutions. These VSOP images are in good agreement with previous ground-only VLBI results on its core-jet structure along a position angle of 30°. We summarize the results as follows.

2.1. Core brightness temperatures (T_b)

The core is partially resolved on ground-space baselines. The derived core T_b, in the rest frame of the source, is about 3.0×10^{12} K from all three VSOP images, significantly in excess of the 10^{12} K limit. Our analysis is not in favor of any particular model among various theoretical explanations, including the inverse Compton catastrophe model, inhomogeneous relativistical jet model, and equipartition brightness temperature model.

2.2. An inner jet

An inner jet located at 1.5 mas north of the core was revealed for the first time (Shen et al. 1999). This feature may be moving along a common curved trajectory connecting the jet within a few pcs to the 10-pc-scale jet emission.

2.3. Spectral index map (Fig. 1)

The resulting spectral index distribution changes gradually from the core through the inner pc-scale jet (within 5 mas from the core) to the region beyond. The central core region has an inverted spectrum, which might be due to the synchrotron self-absorption. The extended jet $\sim$5.6 mas from the core has a steep spectrum, a common characteristic of jets. The inner jet region has a spectral index in between, which can be viewed as an indication of emergence of new components.

References

Shen, Z.-Q. et al. 1999, PASJ, 51, 513