VLA AND OPTICAL MAPPING OF THE QUASAR PKS 0812+020

F.D. Ghigo and L. Rudnick, University of Minnesota
K.J. Johnston, Naval Research Laboratory
P.A. Wehinger, Arizona State Univ. and Northern Arizona Univ.
S. Wyckoff, Arizona State University

Observations are reported of the remarkable object PKS 0812+020, the first quasar found to have optical emission in one of its radio lobes. A distinct radio jet is also seen, and there is radio and optical evidence that the quasar is near the center of a galaxy cluster.

Because the quasar PKS 0812+020 (z = 0.402) had a faint associated nebulosity (Wyckoff, Wehinger and Gehren 1981) a number of studies at radio and optical wavelengths were undertaken (Wyckoff et al. 1981). The number of diffuse images in the optical field suggests that the quasar may be in a galaxy cluster. New VLA observations at λλ20, 6, and 2 cm amplify the previous radio studies. Also, new optical astrometry on the deep ESO plates has allowed accurate relative positioning of the radio and optical maps, which has strengthened the case for a faint optical object ($m_R \approx 22$) being associated with the north lobe radio hot spots.

The north radio lobe has two hot spots, about 1" (5 kpc) apart, aligned roughly perpendicular to the main source axis. At high resolution (2 cm), emission is seen between the spots. A straight radio jet points from the quasar toward the stronger of the two north hot spots.

The polarization position angle differs by 90° between the spots. The spectral index in the stronger (west) spot is $\alpha \sim 1.1$ and in the weaker (east) spot is $\alpha \sim 1.5$. Faraday rotation is seen in the east spot, for which $\log N_e(cm^{-3}) \approx -5$ is estimated, but not in the west. The west spot thus appears to be a younger, higher energy place than the east, making it tempting to suggest that the west spot is where the beam is stopped by the intergalactic medium.

Assuming equipartition, the synchrotron lifetime for the extended optical emission is about 300 years, considerably less than the light travel time between the two hot spots. Acceleration must occur at many places in the north lobe. The north lobe optical spectrum shows a non-thermal continuum.

D. S. Heeschen and C. M. Wade (eds.), Extragalactic Radio Sources, 43–44.

To study the extended radio halo, we removed the high surface brightness flux from the low resolution (5".2) 20 cm map by cleaning the 1".5 resolution 20 cm map of 250 components at 20% loop gain, restoring it with a 5".2 beam, and subtracting the result from the low resolution map (see Fig. 1). Intensity profiles through the resulting difference map appear consistent with two spherical to slightly shell-like distributions of emission centered 6" south and 7".5 north of the quasar. These profiles suggest largely static confinement by an intergalactic medium.

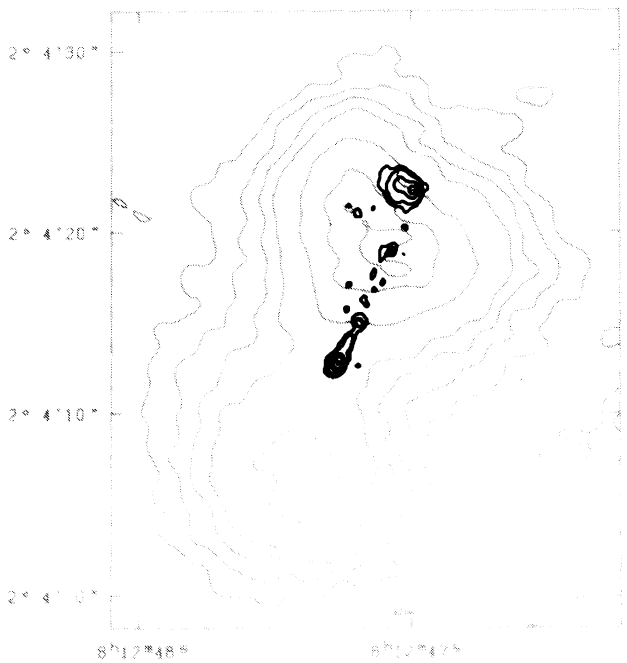

Fig. 1: Deconvolved 20 cm low surface brightness halo (5".2 beam) superimposed on 6 cm (0".5 beam; bold lines) map. Contour levels are λ20 cm: 8, 16, 25, 33, 49, 66, 78 mJy; λ6 cm: 2, 5, 30, 75, 180 mJy.

Work at U of Minnesota is supported in part by NSF grant 79-000304. The VLA (NRAO) is operated by Associated Universities, Inc., under contract with NSF. ESO and the Max Planck Gesellschaft have supported the optical observations.

REFERENCES

Wyckoff, S., Wehinger, P.A. and Gehren, T.: 1981, Ap.J. 247, 750-761.
Wyckoff, S., Johnston, K., Ghigo, F., Rudnick, L., Wehinger, P.A. and Boksenberg, A.: 1981, Ap.J. (in press).