THE POLARIZATION STRUCTURE OF CENTAURUS A

Jack O. Burns and David A. Clarke
Institute for Astrophysics
University of New Mexico
Albuquerque, NM 87131 USA

ABSTRACT: New VLA observations have revealed sharp gradients in both the depolarization and rotation measure in the lobes of Cen A. We attribute these jumps to a forground screen in the southern lobe, and to the passage of the jet through a shock in a Malin shell in the northern lobe.

We have made new multiconfiguration, multiwavelength (6, 18, 21 cm) VLA observations of the inner lobe structure of Cen A at 4"x1" resolution as shown in Fig. 1. The polarization data indicate a strong interaction of the radio radiation and plasma with the galaxy, NGC 5128.

A one dimensional slice of the depolarization ratio (m_{18}/m_6) across the southern lobe of Cen A is shown in Fig. 2. A jump in both the depolarization and 3-frequency rotation measure (RM) occurs about half way across the lobe. Burns <u>et al.</u> (1983) previously argued that the northern lobe is in front of the optical galaxy and the southern lobe is behind. If this is true, then the polarized radiation in the southern lobe must pass through a clumpy, possibly magnetized region in the dust lane of NGC 5128. If the clumps are smaller than the beam, external depolarization and Faraday rotation are expected to be strongest near the galaxy and decline further out as is observed. Thus, we appear to see direct evidence of a clumpy forground screen produced by NGC 5128.

The depolarization ratio (Fig. 3) and RM are both relatively constant across the northern lobe until the region of transition from lobe to jet in the southern part of the lobe. The entire jet is strongly depolarized whereas no depolarization is seen in the lobe. This abrupt change in radio morphology and polarization coincides with the location of a Malin stellar shell (Gopal-Krishna and Saripalli, 1984). This jump may be consistent with the jet shock disruption model recently proposed by Norman, Burns, and Sulkanen (1988). If so, this is the first evidence of gas (and shocks) in such stellar shells.

R. Beck et al. (eds.), Galactic and Intergalactic Magnetic Fields, 469–471.

ACKNOWLEDGEMENTS

This work was supported by grant AST-8611511 from the U.S. National Science Foundation.

REFERENCES

Burns, J., Feigelson, E., and Schreier, E. (1983) 'The Inner Radio Structure of Centaurus A: Clues to the Origin of the Jet X-ray Emission', Ap.J., **273**, 128-153.

Gopal-Krishna and Saripalli, L. (1984) 'Possible Relationship Between the Radio and Optical Structures Associated with the Active Galaxy Centaurus A', Astron. Astrophys., **141**, 61-66.

Norman, M., Burns, J., and Sulkanen, M. (1988) 'Disruption of Galactic Radio Jets by Shocks in the Ambient Medium', Nature, **335**, 146-149.

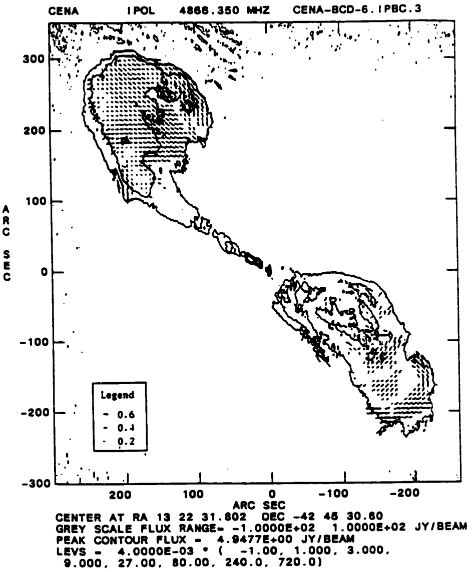

Fig. 1 (Upper left). Polarization B-vectors overlayed onto 6-cm total intensity contours. Beam is 4"x1". The innermost Malin shell is located at about (150",100").

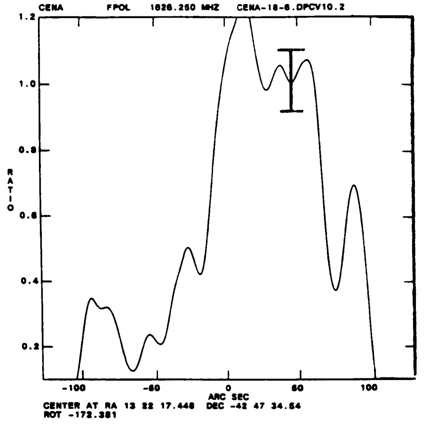

Fig. 2 (Upper right). Depolarization ratio for the southern lobe. Left is north and right is to the south.

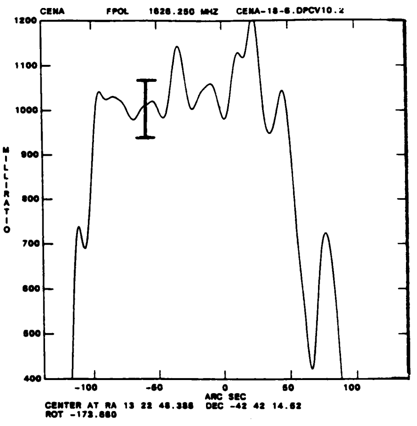

Fig. 3 (Lower right). Same as Fig. 2, but for the northern lobe.

GARRINGTON: You suggest that the depolarization occurs in a foreground screen, which you identify with gas seen in the optical image of Cen A. Would this gas produce depolarization at the wavelength you observe?

BURNS: First, the observed RM and depolarization ratio are clearly inconsistent with a simple slab model for internal Faraday dispersion within the lobes. Second, external depolarization produced by magnetized clouds in the ISM of NGC 5128 can reproduce the observations if one assumes a Gaussian dispersion with a tangled B-field on the scale size of the VLA beam.

KRONBERG: In confirming that the observed RM and depolarization were "as expected", did you specifically use equipartition fields from the inferred radio volume distribution?

BURNS: Yes, equipartition B-fields for the lobe coupled with a clumpy ISM can reproduce the polarization properties.

HAYNES: May I ask what you expect in the way of polarization in the more extensive outer lobes of Centaurus A?

BURNS: We do not have any VLA data on the outer lobes. However, our 6 cm observations of the northern middle lobe (~40 kpc from nucleus) show the peak in the lobe to be polarized at a level of ≈ 0.6%. Off of the lobe peak, the fraction polarization rises to 40%.

HAYNES: I can confirm that we also see extensive polarization in the outer southern large lobe of Cen A. On a time scale of 6 months we will complete new surveys of the total Cen A field at 6 and 3 cm with full polarization facilities.