EMISSION REGIONS IN CENTAURUS A

R. M. Price
University of New Mexico

J. A. Graham
Cerro Tololo Inter-American Observatory

Centaurus A, at an estimated distance of five megaparsecs, is the closest radio galaxy. It presents the best opportunity to examine in detail the physical mechanisms and resulting structures that are to be found in radio galaxies. Centaurus was first studied in detail at radio wavelengths by Cooper, Price and Cole (1965), hence CPC. Many of the comments, interpretations, and conclusions recorded in that paper remain valid today and provide the broader framework in which the more detailed studies using today's more powerful instrumentation can be understood. Historically, it is also interesting to note that Centaurus A was the first extragalactic radio source in which linear polarization and Faraday rotation were discovered and extensively studied.

Recent work at radio, optical and X-ray wavelengths had dealt with the nuclear regions of NGC 5128 and the middle or NE radio lobe. The comparative or relative distribution of the different wavelength emissions has several noteworthy features. The optical "jet" first described by Blanco et al., 1975, is at a position angle of 58 degrees and a distance of 15 minutes from the center of NGC 5128. It is fairly closely aligned with the "nuclear" X-ray and radio jet which has a length of approximately four minutes (Schreier et al., 1979, 1981). The faint optical HII regions (25' from the nucleus) and the middle radio lobe are more closely aligned with the well-known inner double radio source at position angle 45 degrees. The X-radiation discussed by Feigelson in this volume is roughly coextensive with the radio (CPC) and the optical filaments studied in detail by Graham and Price (1981). The X-ray and optical emission lie closer to the S side of the lobe (unresolved), particularly with respect to the polarized emission from this region as reported by CPC. We believe this relative alignment could be a significant piece of information regarding the physical processes that have led to the formation of the HII regions in this area. This also could be indicative of the distribution of Faraday depolarization in the vicinity of the HII regions. The rotation measure reported by CPC appears uniform across this region but lacks sufficient detail to shed light on the current situation.

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The degree of excitation in the HII regions was studied by Graham and Price. Using log [O III]/Hα as a useful indicator of HII region excitation, we noted that the degree of excitation clearly falls off with distance from the center of NGC 5128, although not monatonically (see fig. 7 in Graham and Price, 1981).

Another measure of the degree of excitation of HII regions was log Hα/[NII] compared to log [OIII]/Hβ. In the NE radio lobe of Centarus we note regions that show a much higher degree of excitation than is normally found in HII regions in spiral galaxies (see Searle, 1971; and figs. 7 and 8 in Graham and Price, 1981).

There are a number of conclusions and conjectures which can be made from an analysis of the information provided over the entire spectrum in the northeast lobe of Centaurus A:

•Ionized hydrogen regions are found at distances of at least 45 kiloparsecs from the center of the galaxy NGC 5128. Spectra of the HII regions are not consistent with a simple photoionization mechanism.

•The degree of excitation of the HII regions decreases as a function of distance from the center of NGC 5128 and indicates that the ultimate energy source lies in the nucleus of the galaxy.

•Some of the regions show higher excitation than for HII regions in normal spiral galaxies.

•The disparity in position angle between the nuclear radio and X-ray jet and the middle radio lobe requires precession of the channel through which energy flows from the nucleus of NGC 5128.

Finally, we stress the need for further radio polarization measurements in this region.

References

Blanco, V. M., Graham, J. A., Lasker, B. M., and Osmer, P. S. 1975, Ap. J. (Letters) 198, L63.
Cooper, B. F. C., Price, R. M., and Cole, D. 1965, Australian J. Phys. 18, 589.
Graham, J. A. and Price, R. M. 1981, Ap. J. 247, 823.
Schreier, E. J., Burns, J. O. and Feigelson, E. D. 1981, Ap. J. (in press).
Schreier, E. J., Feigelson, E., Delaville, J., Giacconi, R., Grindley, J., Schwartz, D. A., and Fabian, A. C. 1979, Ap. J. (Letters) 254, L39.
Searle, L. 1971, Ap. J., 168, 327.