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On the Slowly Varying Flux Component from the Nucleus of Cen A (NGC 5128)

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Summary. X-ray measurements from Cen A have suggested the presence of a slowly varying component to the flux which seems to be confirmed by 22 GHz ($\lambda = 13.5$ mm) measurements performed at maximum and minimum phases of the phenomenon.

Key words: galaxies — radio galaxies — active galactic nuclei

An extended study of flux variability of the nucleus of Centaurus A, at radio and X-rays frequencies, was recently published (Beall et al., 1978). In this study, it has been reported that the X-ray flux at 2–6 keV and the 100 keV flux density have changed slowly from 1972 to 1976. Concurrent Northern Hemisphere radio observations with the same general variability are also reported. The maximum intensity inferred from these observations seems to have occurred sometime in 1974, when the radio and X-ray fluxes were 2–3 times larger than those measured in 1972 and in 1976. Independent studies at mm-wavelengths have suggested the possibility of variability on a timescale of days (Kellerman, 1974; Kaufmann et al., 1977). On the other hand, from nine spaced observations taken in eight months during 1974, Fogarty and Schuch (1975) concluded the source was nearly constant, with a flux of approximately 22 Jy at 22 GHz.

Due to the controversial nature of the variability of the nucleus of Cen A, it is interesting to report radio observations at 22 GHz ($\lambda = 13.5$ mm) from the Southern Hemisphere performed in 1974 and 1976 which seem to confirm a significant flux reduction.

The radio observations were performed using the 45 ft Itapetinga radio telescope. In May–June 1974, a 22 GHz radio map was obtained for the entire galaxy (Kaufmann et al., 1974). The antenna beam size was of 4′, and all the measurements were normalized in relation to the flux measured in the direction of the center, which we define as the position of the infrared hot spot (Kunkel and Bradt, 1971). The resulting normalized map is reproduced in Fig. 1 (full lines).

In October–November 1976, in the course of a search for fast variability of Cen A's nucleus (Kaufmann et al., 1977), we performed another partial radio map at 22 GHz for declinations north of about $-42°46'$ (i.e., covering the center and the North-East lobe of the source). The measurements were again

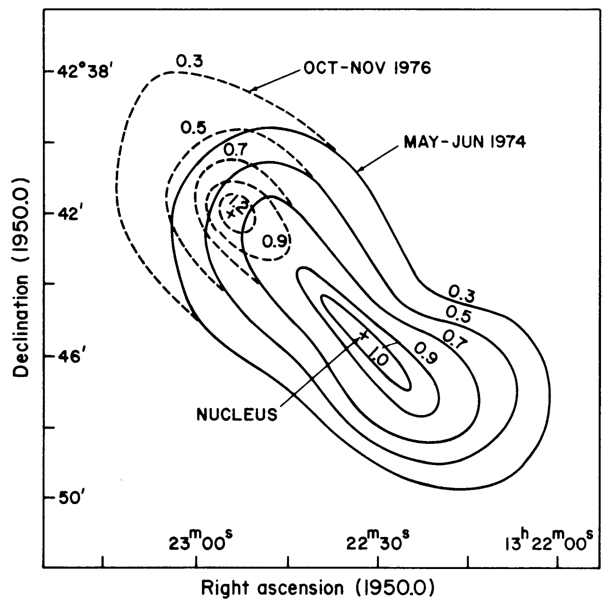

Fig. 1. 22 GHz radio maps of NGC 5128 obtained at Itapetinga with a 4′ beam

normalized in relation to the center. The resulting map is shown in Fig. 1, in dashed lines. The NE lobe is apparently enhanced with reference to the center, in comparison to the May–June 1974 map. The absolute rms pointing accuracy of the Itapetinga radio-telescope is known to be better than 10″, which is negligible compared to the antenna beam at this wavelength. No important instrumental correction parameter in pointing was added from 1974 to 1976. We can consider the two maps as being obtained under similar experimental conditions. Both maps were normalized to the center. By doing this we nearly cancel spurious errors which might have been produced by miscalculations of the atmospheric transmission at different days, and at different epochs, used to correct the data.

Since both maps were normalized to the center, the apparent enhancement of the NE lobe with respect to the center in 1976 implies either an increase in the intensity of the NE lobe, or a decrease in the radio flux from the nucleus. In view of the large physical size of the NE radio lobe and the largely averaged nature of these measurements, we conclude that the 22 GHz flux from the nucleus of Cen A was stronger in May–June 1974, in comparison to October–November 1976. The measurements

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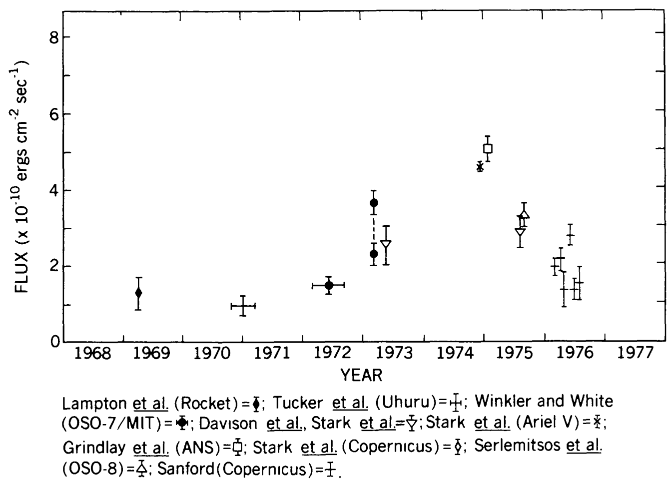

Fig. 2. History of Cen A 2–6 keV X-ray flux, after Beall et al. (1978). Data taken from Lampton et al. (1972), Tucker et al. (1973), Winkler and White (1975), Davison et al. (1975), Sanford (1977)

of the nucleus (T_c) and the measurements of the NE lobe (T_{NE}) had a ratio of $T_c/T_{NE} \sim 1.7$ in May–June 1974, and $T_c/T_{NE} \sim 0.8$ in October–November 1976.

The variability of the source in the nucleus of Cen A has a small influence on the flux density integrated over the entire source. In May–June 1974, the integrated flux density for NGC 5128 at 22 GHz was 60 ± 10 Jy (1 Jy = 10^{-26} W m^{-2} Hz^{-1}). The contribution of the nuclear source to the integrated flux density is difficult to estimate, since we do not know the exact contribution from neighboring regions included within the 4′ beam. For a rough comparison, we used Virgo A as a calibrator (21.4 Jy at 22 GHz) and obtained from the map a mean flux density of 22.7 ± 0.2 Jy in May–June 1974 (ten observations) and 18.5 ± 0.2 Jy in November–December 1976 (18 observations). This confirms the slow reduction of the flux from the nuclear component.

The radio map data of NGC 5128, as well as the averaged flux data obtained at 22.2 GHz, thus seem to confirm the X-ray measurements and Northern Hemisphere radio measurements which show a maximum in 1974, and a significant reduction towards the end of 1976 (Fig. 2). The ratio of change from mid 1974 to the end 1976 was approximately 2.5 and 3.0 at 2–6 keV and 100 keV, respectively (Beall et al., 1978), which is comparable to the variation found at 22 GHz.

The much faster flux variability that has been reported for the nucleus of Cen A (Kellerman, 1974; Kaufmann et al., 1977; Beall et al., 1978; Mushotzky et al., 1978), may be a different phenomenon. Its association to the slowly varying component bears further investigation.

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References

Beall, J. H., Rose, W. K., Graf, W., Price, K. M., Dent, W. A., Hobbs, R. W., Conklin, E. K., Ulich, B. L., Dennis, B. R., Crannell, C. J., Dolan, J. F., Frost, K. J., Orwig, L. E.: 1978, *Astrophys. J.* **219**, 836

Davison, P. J. N., Culhane, J. L., Mitchell, R. J., Fabian, A. C.: 1975, *Astrophys. J. Letters* **196**, L23

Kaufmann, P., Scalise, Jr., E., Santos, P. M., Fogarty, W. G.: 1974, *Monthly Notices Roy. Astron. Soc.* **169**, 15

Kaufmann, P., Santos, P. M., Raffaelli, J. C., Scalise, Jr., E.: 1977, *Nature* **269**, 311

Kellerman, K. I.: 1974, *Astrophys. J. Letters* **194**, L135

Kunkel, W. E., Bradt, H. V.: 1971, *Astrophys. J. Letters* **170**, L7

Lampton, M., Margon, B., Bowyer, C. S., Mahoney, W., Anderson, K.: 1972, *Astrophys. J. Letters* **171**, L45

Mushotzky, R. F., Serlemitsos, P. J., Becker, R. H., Baldt, E. A., Holt, S. S.: 1977, Rept. X-661-77-237 NASA, Goddard Space Flight Center, Greenbelt, Md., USA

Sanford, P. W.: 1977, in *Proc. of the Eighth Texas Symposium on Relativistic Astrophysics*, New York, Acad. of Sciences **302**, 387

Tucker, W., Kellogg, E., Gursky, H., Giacconi, R., Tananbaum, H.: 1973, *Astrophys. J.* **180**, 715

Winkler, P. F., White, A. E.: 1975, *Astrophys. J. Letters* **199**, L139