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LONG TERM VARIABILITY OF RADIOSOURCES IN THE FREQUENCIES OF 22 GHz AND 44 GHz

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RESUMO. As radiofontes 3C273, OV236, Cen A e Sgr A foram observadas num período de seis anos (1980-1986), nas frequências de 22 GHz e 44 GHz, utilizando-se o radiotelescópio do Itapetinga (Brasil). O objetivo deste trabalho é a detecção de variabilidade temporal e na forma dos espectros dessas radiofontes. Todas as fontes apresentaram variabilidade de longo período, destacando-se o quasar 3C273, que após um período de intensa atividade (1981-1985), voltou a seu nível quiescente em fins de 1985 e início de 1986. O aumento na densidade de fluxo nestas duas frequências está ligado ao aparecimento de novas componentes na parte central do quasar, como comprovado nas observações realizadas empregando técnicas de VLBI.

ABSTRACT. The radio sources 3C273, OV236, Cen A and Sgr A were observed during a period of six years (1980-1986), in the frequencies of 22 GHz and 44 GHz, with the Itapetinga radiotelescope (Brasil). The objective of this work was the detection of variability in the intensity and in the shape of the spectra of the sources. All of them presented some variability, specially the quasar 3C273, which after a period of intense activity (1981-1985), returned to its quiescent level at the end of 1985. The increase of the flux density in these frequencies is associated to the ejection of new components by the central source in the quasar, as observed in the maps obtained by VLBI techniques.

Key words: RADIO SOURCES-VARIABLE

I. INTRODUCTION

The spectra of quasars and active galactic nuclei in the radio range indicate that the emission is due to synchrotron radiation of relativistic electrons, with a power law in the energy distribution (Ginzburg, 1969; Pacholczyk, 1970). Models of both homogeneous and non-homogeneous sources predict a maximum in the spectrum, which depends on the flux density, angular size, magnetic field and redshift (Condon and Bessel, 1973; Pacholczyk, 1977; Marscher, 1977). However, a large fraction of quasars have flat spectra in a large frequency range. An interpretation of this fact is that the spectrum of a quasar is formed by the superposition of the spectra of several emission sources of different angular sizes, probably in expansion. Observations made with VLBI techniques confirm this hypothesis (Cohen et al.,1975; Cotton et al., 1979).

Compact radiosources are known to be variable in a large range of wavelengths (Kellermann and Pauliny-Toth, 1981), however the correlation between the variability in the different wavelengths is not well established (Epstein et al.,1982). In general, the variability starts at high frequencies and it propagates to lower frequencies (O'Dee, Dent and Balonek, 1984). VLBI maps of 3C273 show the existence of a compact nucleus and of bright knots ejected from the nucleus at apparently superluminal speeds (Unwin et al., 1985). The higher the frequency, the closer to the nucleus we can observe, thus, observations at the frequencies of 22 GHz and 44 GHz provide a better understanding of the nuclear regions of the radiosources.

II. OBSERVATIONS

The observations were made with the 13.7 m radome enclosed Itapetinga radiotelescope at the frequencies of 22 GHz and 44 GHz during the period July 1980 - September 1986. The receiver, operated in the total power mode, had a bandwidth of 1 GHz and a system temperature of 1000K. The radome has a transmission factor of 0.77 in 22 GHz and 0.67 in 44 GHz. The observations consisted in scans across the source with an amplitude of 60' in 22 GHz and 30' in 44 GHz. The beam width was 4' and 2' in these frequencies respectively. Each scan lasted 20s and each observation consisted in the mean value of 30 scans. The observations were calibrated with a room temperature load, which eliminates the atmospheric absorption (Ulich and Hass, 1976; Abraham et al., 1984). The transformation factor from antenna temperature to flux density was obtained from the observations of Virgo A and Jupiter (Jansen et al., 1974).

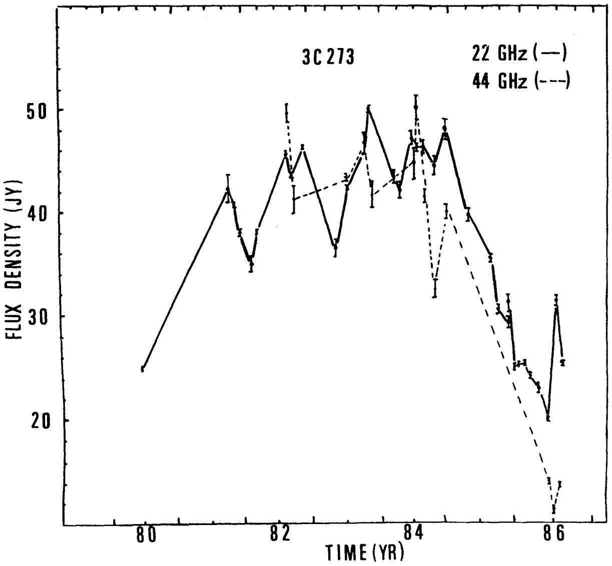
III. RESULTS

The temporal behaviour of the radiosources 3C273, OV236, Cen A and Sgr A in the frequencies of 22 GHz and 44 GHz is presented in Figs.1-4.

The quasar 3C273 showed variability between 20 JY and 50 JY in both frequencies. VLBI observations (Unwin et al., 1985) show that the radiation in 22 GHz arises in a compact core, unresolved at the frequencies of 5 GHz and 10 GHz. The variability we observed was probably due to the ejection of knots, as the ones seen at lower frequencies. The existence of several peaks in the flux density implies that the rate of ejection is about 1/year; the decaying time of the components is of the same order of magnitude. A large increase in the infrared flux density of 3C273 was detected at the begining of 1983 (Clegg et al., 1983). It is not clear if this flare propagated towards lower frequencies with the same peak intensity as the source expanded, or if the flux density observed at 22 GHz and 44 GHz is due to another component. The quasar OV236 showed also strong variability, specialy at the end of 1984, when the flux density increased from 6 Jy to 20 Jy, followed by a rapid decay. A strong explosion in this quasar was observed in December 1978 (Epstein et al., 1980) in 90 GHz, which motivated the beginning of our observations. It is important to note that during the explosion in 1984, the flux density increased first in 44 GHz, in such a way that the spectrum between 22 GHz and 44 GHz was inverted.

The radio galaxy Cen A presented an overall decrease in the flux density, both in 22 GHz and 44 GHz, superposed to smaller fluctuations. The flux density reached a minimum value at 22 GHz similar to the observed by Kaufmann et al. (1977) in 1976.

The radiosource Sgr A, located at the center of our galaxy presented fluctuations of about 10% with relation to the mean value. The uncertainties in the calibration due to the different propagation conditions in the atmosphere do not allow us to acertain if the fluctuations are real.



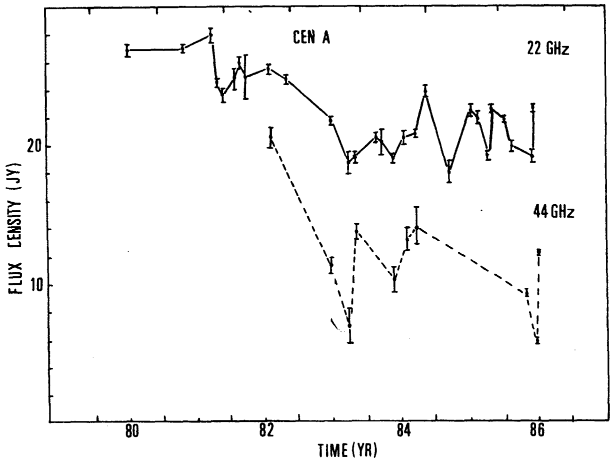
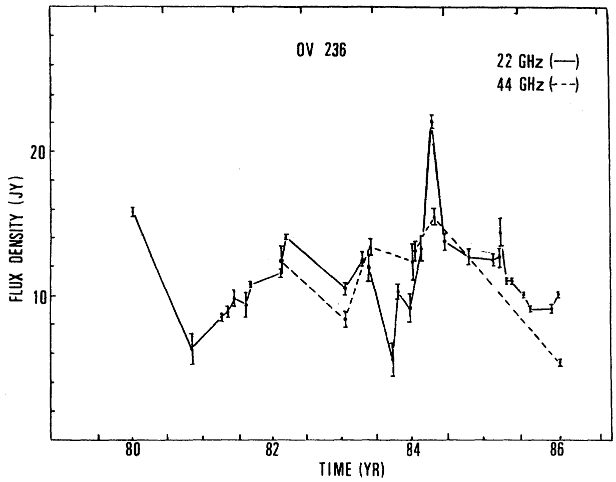


Fig. 1. Temporal behaviour of the quasar 3C273 in the frequencies of 22 GHz and 44 GHz, observed during a period of six years.

Fig. 2. Temporal behaviour of the radio galaxy Centaurus A in the frequencies of 22 GHz and 44 GHz.



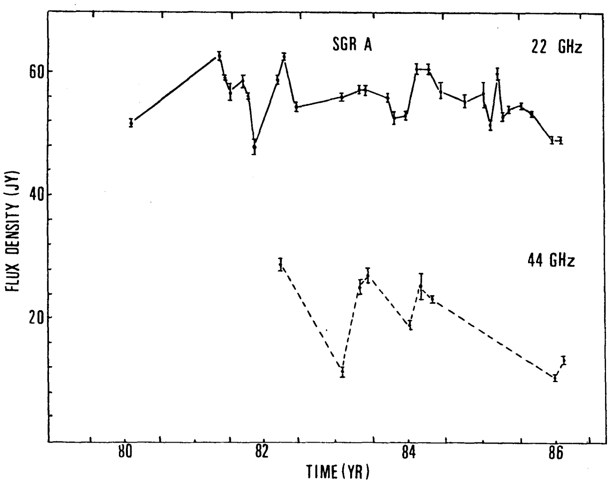


Fig. 3. Temporal behaviour of the quasar OV 236 in the frequencies of 22 GHz and 44 GHz, observed during a period of six years.

Fig. 4. Temporal behaviour of the radiosource Sgr A, located at the center of our galaxy, observed in the frequencies of 22 GHz and 44 GHz during six years.

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