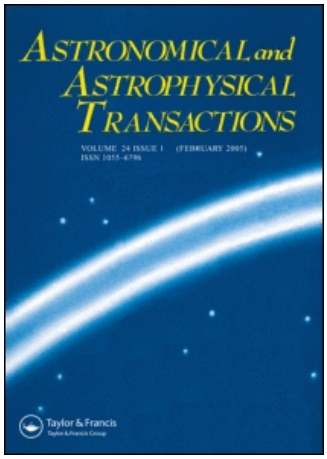

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ON THE SECULAR DECREASE OF THE RADIO FLUX FROM CAS A AT LOW FREQUENCIES

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(3 March, 1992)

Since 1987, systematic observations of Cas A (3C461) and Cyg A (3C405) (as a comparison source) have been carried out at 25 MHz (radiotelescope URAN-4). The result indicates that the problem of the secular decrease of Cas A radio flux at low frequencies can be solved only when the season–day effect, determined by observation conditions, has been taken into account.

KEY WORDS Supernovae, Cas A, evolution of radioemission

The investigation of the evolution of Cas A supernova remnant flux (RSN) is of interest in two aspects. First, as a verification of theoretical models. Second, all the relative measurements of the fluxes of cosmic sources at low frequencies use Cas A as the principal calibration source.

Our results are based on observations carried out during separate years throughout the period over 30 years. The secular decrease of Cas A flux has been found at frequencies above 80 MHz. This decrease is due to the adiabatic expansions of the RSN envelope. The rate of decrease increases when frequency decreases as (Rees, 1990)

$$d(\nu)\% \text{ per year} = 0.97(-0.04) - 0.30(+0.04)\log(\nu)\ \text{GHz} \qquad (1)$$

Here the variation in Cas A RSN flux is determined with respect to the Cyg A flux. It is supposed that the latter source is stable, and the flux ratio Cas A/Cyg A is free of ionosphere effects. Equation (1) implies that at low frequencies (<40 MHz) the flux decrease amounts to more than 40% within the 30 years.

However, observations at 38 MHz performed by other authors during other epochs indicate a considerably weaker secular decrease of the flux. A scaller of measurements can be noticed even for close epochs.

On the other hand, the measurements carried out at UTR-1 and UTR-2 in the same month (January) in separate epochs of 1962–1987 at frequencies 25, 20 and 16.7 MHz (Zhuck, 1987) do not reveal any noticeable flux variations (see Figure 1b).

Such ambiguous behavior of the Cas A flux at different frequencies, as well as discrepancies between the data obtained by different authors at the same frequency, result in two alternatives: either the flux varies quasiperiodicity at the period of 2–6 years or there is a frequency dependence of the secular flux variation (Read 1987, Rees 1990). The above two effects may be present simultaneously.

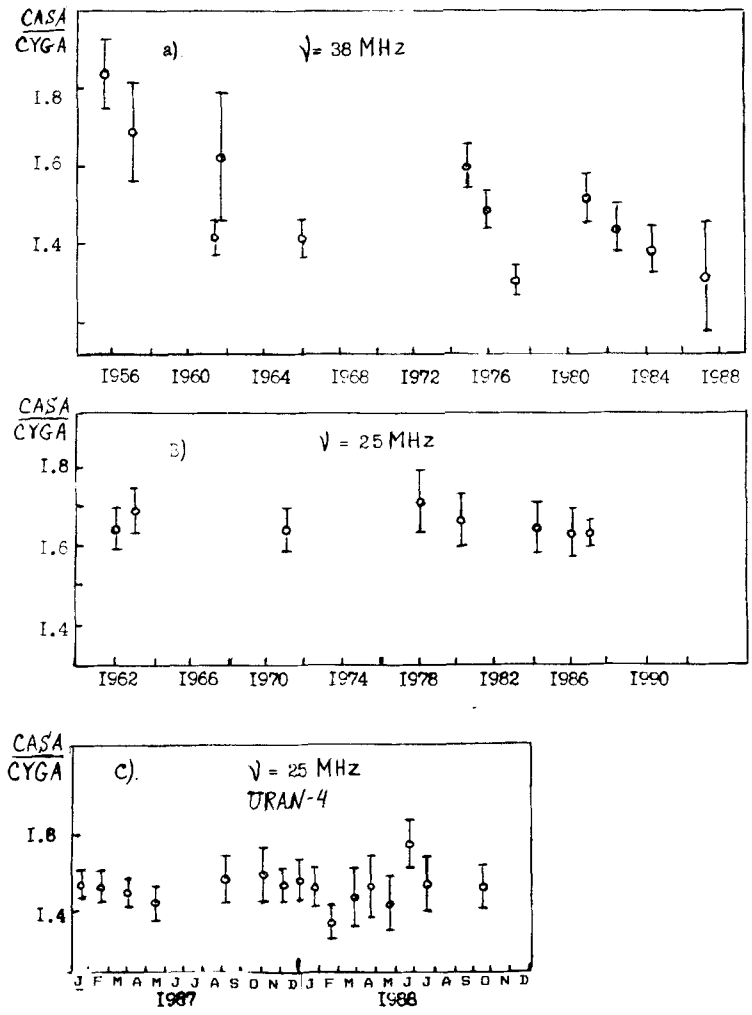

Figure 1 (a) Variation values of 3C461/3C405 ratios at 38 Hz. (b) Variation values of 3C461/3C405 ratios at 25 MHz. (c) Variation average values of 3C461/3C405 ratios at 25 MHz (Radiotelescope URAN-4). (d) Variation of daily fluxes ratios 3C461/3C405 upon time interval between scans (Radiotelescope URAN-4).

Since 1987, systematic observations of Cas A (3C461) and Cyg A (3C405) as a comparison source have been carried out at the frequency 25 MHz (radiotelescope URAN-4) at Odessa Observatory of Radioastronomical Institute, Academy of Science of the Ukraine.

The aim of our observations was to investigate the origin of the flux fluctuations at low frequencies. The measurements were made every month in cycles of 7–10 days; during the day the source 3C461 was observed in the hour angle interval $-60^m \pm 120^m$ with the step of 60^m (4 scans) in the regime of the source pass-

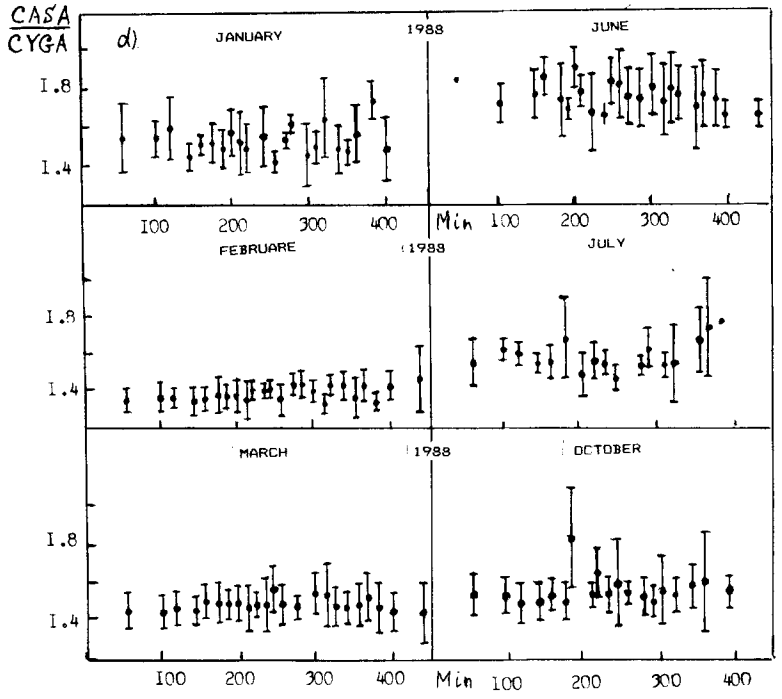

Figure 1 (a) Variation values of 3C461/3C405 ratios at 38 Hz. (b) Variation values of 3C461/3C405 ratios at 25 MHz. (c) Variation average values of 3C461/3C405 ratios at 25 MHz (Radiotelescope URAN-4). (d) Variation of daily fluxes ratios 3C461/3C405 upon time interval between scans (Radiotelescope URAN-4).

ing through a fixed beam. The source 3C405 was observed in the hour angle interval $-120^m \pm 80^m$ with the step of 40^m (6 scans).

From the observation throughout 1987–1988, the average values of the flux ratio 3C461/3C405 have been deduced for each cycle basing on the daily values for different pairs of scan combinations (see Figure 1c).

Furthermore, we have analyzed the dependence of the flux ratio on time interval between the scans (see Figure 1d). As can be seen from these plots, the average value of the 3C461/3C405 ratio varies within the range 1.3–1.7. The dispersion and average value within one cycle of measurements depend on the season of measurements made.

When the flux ratio is calculated from observations carried out in different days, the mean values are shifted and dispersion is larger.

Hence, for solving the problem of secular decrease of Cas A radio flux at low frequencies, the season–day effect determined by observation should be taken into account. This effect results in scatter of the ratio 3C461/3C405 within the range 1.3–1.7 and enhanced dispersion if one or both sources are observed through non-stable ionosphere. As our observations show, the sources free of scintillations have parameters of flux scatter within the above limits, which implies a wide range of the scales of inhomogeneities in the ionosphere.

A more detailed discussion of the observational data obtained at RT URAN-4 will be given elsewhere.

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