ASTRONOMY

Yu. N. PARIISKII

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Fig. 1

Figure 1: Fig. 1

Abstract

Full Text

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Yu. N. PARIISKII

FEATURES OF THE RADIO EMISSION OF NGC 4486

(Presented by Academician V. A. Ambartsumian, 28 IX 1960)

In December 1959, observations of the radio emission of Virgo A (NGC 4486; M 87) at a wavelength of 9.4 cm were carried out on the large Pulkovo radio telescope. These observations showed that the angular dimensions of the radio source at a wavelength of 9.4 cm are apparently substantially smaller than the dimensions determined by Mills at a wavelength of $\lambda 3.5$ m ([1]). To confirm this effect, observations of Virgo A were resumed in February 1960. A more sensitive direct-amplification radiometer at a wavelength of $\lambda 8.7$ cm, on three LBV, was used. The signal was recorded with a time constant of 6^s, at which the sensitivity of the radiometer was not worse than $0^\circ.15$ K. An example of the record is shown in Fig. 1.

The record averaged over several observations showed that, within the limits of measurement errors, the half-width of the record is equal to the half-width of the theoretical antenna beam pattern. From this it was possible to conclude that the angular dimensions of the radio-emission source in right ascension do not exceed $1'$, whereas according to interferometric observations at meter wavelengths the size of the source in this direction is $6'$. Unfortunately, the angular-size measurements of Virgo A carried out in 1951–1952 by Mills are the only ones so far.

Fig. 1

These measurements were made with a two-element interferometer with a variable baseline, and only the amplitudes of the brightness-distribution spectrum were recorded. Therefore the interpretation of the records depended substantially on the adopted model of the radio source. In 1955, Smith discovered an extended corona surrounding the central radio source. According to Mills' s report at the radio-astronomy symposium in Paris in 1958, this corona has an asymmetric shape; it is strongly elongated to the west in the direction of the ejection observed in the optical spectral region; the linear dimensions of

the corona are about 100 kpc, and the radio-emission flux amounts to 20% of the radio-emission flux of the source as a whole. Using these data on the corona of NGC 4486, we constructed the expected spectrum of the brightness distribution, assuming that the central source is point-like. Comparison of the expected spectrum with Mills' s observations showed that at meter wavelengths the angular dimensions of the central radio source are not less than $5'$, and the radio-emission flux from the central condensation is considerably greater than the flux from the corona. Thus, we arrive at the conclusion that the distribution

the radio brightness of the radio source Virgo A depends very substantially on the wavelength. The angular dimensions of the central source at centimeter wavelengths are at least 5 times smaller than at meter wavelengths. According to the results of interferometric observations at Nançay (France), kindly communicated to the author by Heidmann, the angular dimensions of Virgo A at a wavelength $\lambda 21$ cm do not exceed $1'.5$.

Such a strong dependence of size on frequency has not previously been observed for any radio source; it is therefore highly desirable to repeat the measurements at meter wavelengths.

A fundamental question is whether the radio emission is associated with the center of the galaxy or with the jet. To resolve it, accurate measurements were made of the coordinates of the center of gravity of the radio emission at $\lambda 8.7$ cm*. To exclude possible errors, these measurements were carried out with a fixed antenna; the moments of transit through the antenna pattern of the radio source and of the Moon were determined successively on the day when the declination of the Moon was equal to the declination of the radio source. Preliminary observations of the distribution of radio brightness over the lunar disk at $\lambda 8.7$ cm showed that, at this wavelength, the asymmetry associated with the lunar phase cycle is insignificant. Thus the difference in right ascensions of the center of the lunar disk and of the radio source was determined.

The coordinates of the radio source were found to be: $\alpha_{1950.0} = 12^h 28^m 15^s \pm 1^s$, i.e., the radio emission comes from a region displaced by $45'' \pm 15''$ to the west of the center of the spheroidal galaxy, toward the jet. Further refinement of the coordinates, planned at the Main Astronomical Observatory of the USSR Academy of Sciences, will make it possible to determine whether the radio source is located in the jet or is displaced still farther westward from the center of the galaxy. If one assumes that the centimeter radio emission comes from the jet, then it should be polarized, since the mean polarization of the continuous emission in the jet in the optical wavelength range is not less than 10%. However, observations at $\lambda 10$ cm showed that the polarization does not exceed 3% ([2]). The absence of appreciable polarization in the radio range may be interpreted as the depolarizing action of the Faraday effect. An estimate of the magnetic-field strength can be made from energy considerations; it turns out to be about 10^{-3} gauss. Therefore an electron density in the jet of 10^{-2} cm^{-3} is sufficient to wash out the polarization over a distance of 100 pc (the size of the jet along the line of sight). This gives a minimum value for the mass of ionized gas in the jet,

$$M \geq 10^4 M_\odot.$$

Main Astronomical Observatory
Academy of Sciences of the USSR

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CITED LITERATURE

1. B. Y. Mills, *Nature*, **170**, 1063 (1952).

2. C. H. Mayer, R. M. Sloanaker, *Astr. J.*, **64**, No. 1273, 340 (1959).

* The coordinate measurements were carried out jointly with O. N. Shivris and V. Prasolova.

Note: Figure translations are in progress. See original paper for figures.