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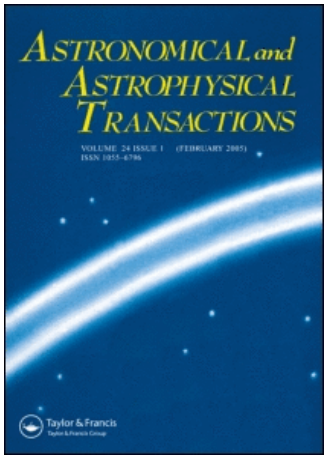

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Flux density evolution of the sources 3C273, 3C279 and 3C454.3 at the frequencies 102 MHz-36.8 GHz

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Flux density evolution of the sources 3C273, 3C279 and 3C454.3 at the frequencies 102 MHz–36.8 GHz

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The results of long-term monitoring of the sources 3C273, 3C279 and 3C454.3 at 102 MHz–36.8 GHz are presented. Numerical analysis of irregular temporal rows of the integral fluxes allowed us to detect the quasiperiodic constituents of the emission flux variations. The analysis of the parameters of binary black holes in the central regions of non-stationary objects demonstrates that these super-massive objects have an insignificant variation between the sizes of the orbits of partners, and that they are in the stage of evolution different from the time of merging by a period of less than 10^4 years.

Keywords: Flux variations; Non-stationary extragalactic radio sources; Binary black holes

1. Introduction

At present, much attention is being paid to the study of non-stationary extragalactic radio sources. This is related to the need to construct a picture of the physical processes of energy release in the central areas of these objects, resulting in the observed phenomenon of the variability of emission fluxes. In spite of the generally accepted hypothesis about what exists in the centre of variable extragalactic sources of massive and super-massive binary black holes, a detailed picture of the processes occurring there has remained unclear until now.

First it is necessary to specify the mechanisms which initiate the phenomenon of the transmission of perturbations into bipolar jets. The reasons for the change in the rate of accretion on the disc of the central component are not studied. We do not even confidently know the parameters of the medium in which the motions of the partner in the orbit take place.

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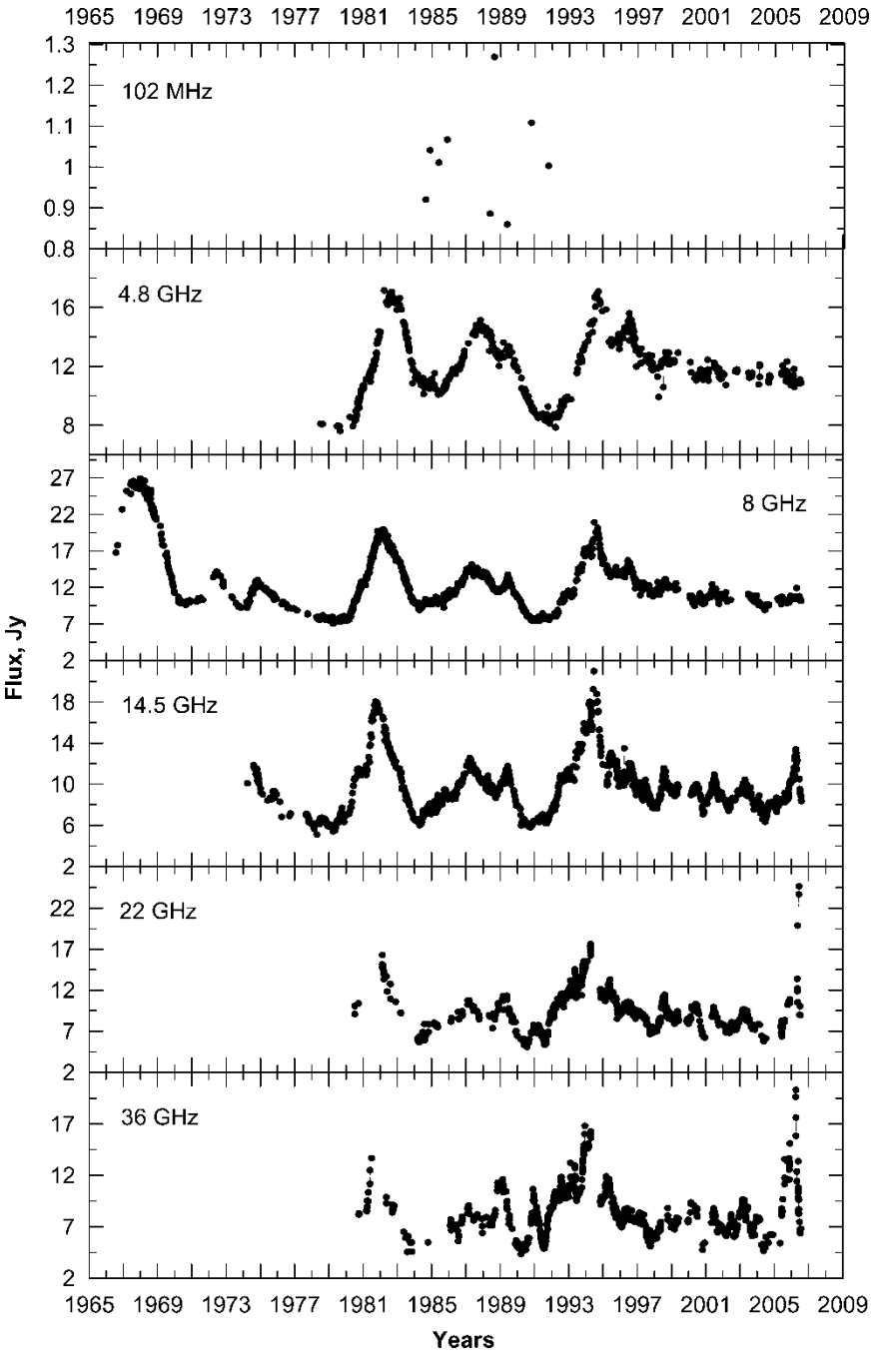

Figure 2. Light curves for 3C454.3 at 102 MHz–36.8 GHz.

due to gravitational radiation correspond to the values 3×10^{16} cm r 10^{17} cm. The time of existence of such close double systems is about 10^4 years. The values of the masses of the central black hole and its partner were obtained for 3C454.3 according to $M = 5 \times 10^9 M$ and $m = 6 \times 10^8 M$. It was determined using the following values: the Lorentz factor $\Upsilon = 5$

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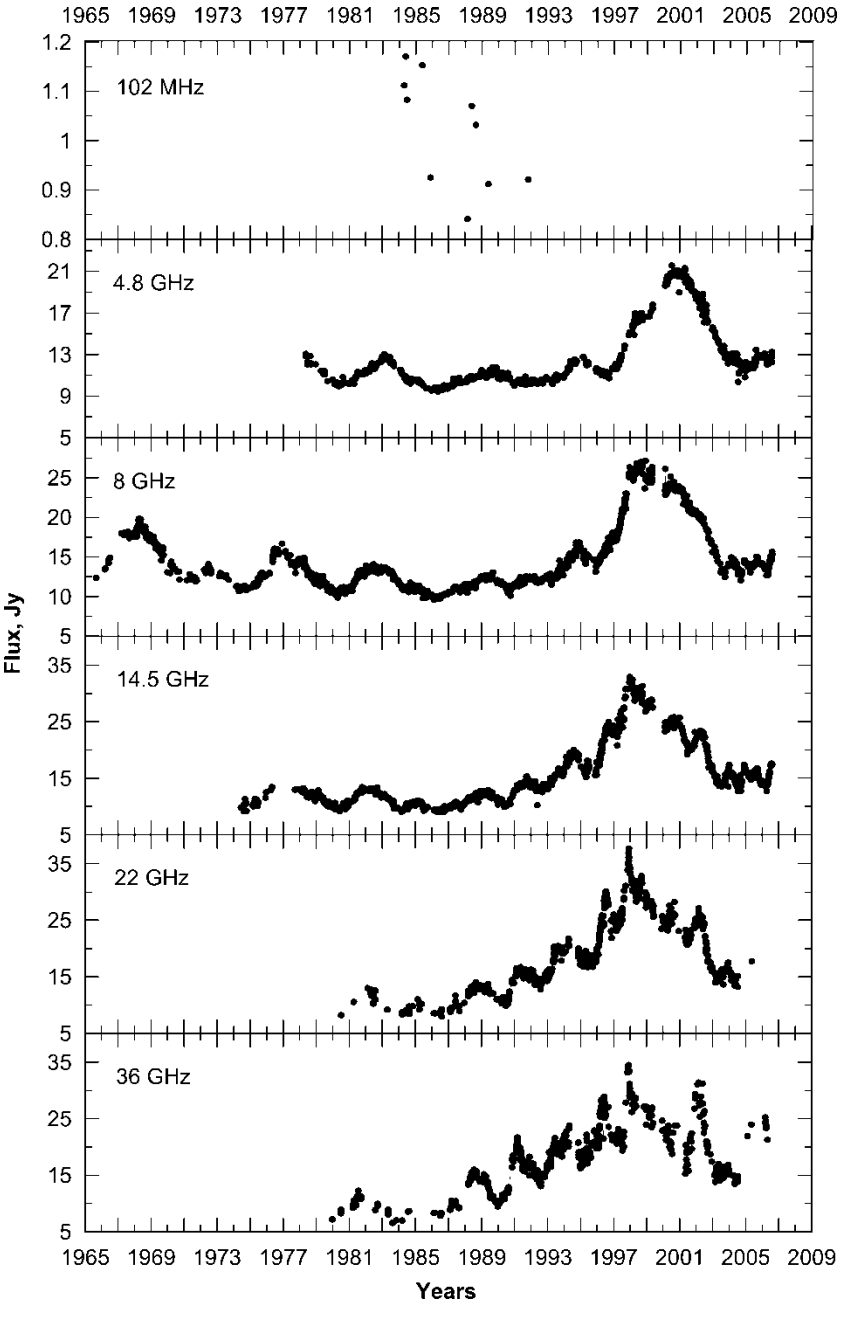

Figure 3. Light curves for 3C279 at 102 MHz–36.8 GHz.

and the red shift of the object $z = 0.86$. The narrow interval for the parameters of the orbit of the partner is being investigated, including the strong dependence of its mass on the size of the orbit.

Similar calculations for source 3C273 with the initial data $T_{\rm pr} = 16$ years and $T_{\rm orb} = 1.55$ years at $\Upsilon = 10.8$ and $z = 0.16$ result in the value $(m + M)/m = 8$, which means that the central black hole is seven times more massive its partner.

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Appropriate values for the masses, $m = 5 \times 10^7 M$ and $M = 4 \times 10^8 M$, ensure that the size of the orbit of the partner remains at the former level. We note that on increasing the masses of the central black hole and its partner by an amount of the order of the size, the sizes of the orbit of the partner are multiplied just twofold. The substantial appearance of the physical picture of the partner does not change.

From the harmonic analysis of source 3C279 (figure 3) it is possible to determine the presence of a period of about 30 years. The characteristic trends found in the light curves at the resulting frequencies confirm this fact. A short period of 1 year is presented. The value of $(m + M)/m$ equals 30, which exceeds by almost eight times the previous values for 3C273 and 3C454.3. Values for the masses of the partner and the central black hole are $m = 6 \times 10^8 M$ and $M = 1.9 \times 10^9 M$, respectively. Of the three systems of binary black holes considered, the most massive binary system is 3C454.3.

The basic conclusions from the resulting analysis of the parameters of binary black holes in the central regions of non-stationary objects is that these super-massive objects have an insignificant variation in the sizes of the orbits of their partners and that they are in a stage of the evolution different from the time of merging by a period of less than 10^4 years.

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