ARE QUAZARS WHITE HOLES?

Anatoly V. Belyakov
E-mail: belyakov.lih@gmail.com

Based on the mechanistic interpretation of J. Wheeler's geometrodynamic concept, which allows for transitions between distant regions of space, it was suggested that a quasar is a cosmological object, i.e. a white hole, where gravitational forces are replaced with dynamic ones with together the balance of electric and magnetic forces. Thus, a schematic model of a typical quasar was proposed. Its parameters (calculated on the basis of this model) are consistent with the observational data on quasars.

1 Quazars according to Wheeler's geometrodynamics

Quasars are still the most striking mystery of modern astrophysics. According to the most common hypothesis, a quasar is a distant active galaxy with a supermassive *black hole* in the centre. An alternative hypothesis belongs to V. Ambartsumyan. According to the latter, quasar nuclei are the place of matter transition from prestellar existence in the form of super-dense bodies to existence in the form of stars and rarefied interstellar medium, which are more common for astronomy. The transition can occur in the following sequence: super-dense state – kinetic energy – synchrotronic radiation. This process may be connected with formation of a *white hole*. Possibility of existence of white holes is also admitted by some other researchers [1, 2].

This approach is the closest to J. Wheeler's geometrodynamic concept allowing for drain-source transitions between distant regions of space ("wormholes"), thus ensuring circulation of matter along the *vortex tubes* (power lines) along some closed *contour*. The mechanistic interpretation of Wheeler's idea that only uses balances of main forces (electric, magnetic, gravitational and dynamic ones) makes it possible to build schematic models of cosmological objects and successfully determine some of their important parameters [3, 4]. In this case, there is no need to delve into the complex dynamics of phenomena and their mechanisms, which are the research subjects of specialised scientific disciplines. The same approach was used here to construct a schematic model of a quasar, assuming that it is a white hole.

Indeed, the most dramatic transition in the general circulation of matter is the transition, when the gravitational forces are replaced with dynamic ones (centrifugal forces in our case). In other words, it is the transition when interactions change their polarity. Probably, such a phase transition (inversion) occurs in quasars, where the super-dense state of matter transforms into radiation and diffused matter followed by its condensation. Under such a phase transition, the initially closed contour, which are based on the balance of gravitational and magnetic forces, break leaving unclosed vortex tubes with contradirectional currents. These currents carry charges of different polarity at the circuit break point. The charges are gradually destructing each other (not necessarily through annihilation). The reverse process occurs in black holes, respectively.

At the same time, the characteristic value of R_c (determined by the balance of electric and magnetic forces [3]) is preserved, since the same result is obtained from the balance of gravitational and magnetic forces, when the *evolutionary parameter* ε (characterises the difference of the material medium from vacuum) becomes numerically equal to the ratio of electric forces to gravitational ones. The R_c value is the geometric mean of linear values. They are the distance between the charges r and length of the conductor (force line, current line or contour) l:

$$R_c = (l\, r)^{1/2} = 7.52\times10^8 \text{ m.} \qquad (1)$$

Assuming that the energy release in the quasar is due to mutual destruction of the charges with opposite polarity, the quasar may be schematically represented as a number of z charge unit contours or vortex thread concentrated to the maximum extent in the region with the radius R_c typical of the transition. Let us determine their number as follows:

$$z = (R_c / r)^3. \tag{2}$$

As the central mass, the quasar mass is determined by the following virial:

$$M = v^2 l / \gamma , \tag{3}$$

where v is the velocity of matter circulation in the contour, also known as peripheral speed and γ is the gravitational constant.

As the total mass of all the contours, the same mass is determined as follows:

$$M = z\, \varepsilon_0\, l, \tag{4}$$

where ε_0 is linear density of the unit contour, which is equal to $m_e / r_e = 3.23\times10^{-16}$ kg/m^3.

It is clear that the evolutionary parameter of the general contour is increased proportionally to the number of unit counters, so $\varepsilon = z$.

Solving equations (1) to (4), we find the number of unit contours, distance between the charges, length of the contour and quasar mass:

$$z = v^2 / \varepsilon_0 \gamma , \tag{5}$$

$$r = R_c / z^{1/3}, \tag{6}$$

$$l = z^{1/3} R_c , \tag{7}$$

$$M = z^{4/3} \varepsilon_0 R_c . \tag{8}$$

Let us assume that the process of mutual destruction of charges occurs at the velocity of matter motion in the contour in all the individual contours simultaneously. Then the quasar's life time is:

$$\tau = l / v, \tag{9}$$

the average energy released by the quasar 'burnout' is:

$$N = M v^2 / \tau = z\, \varepsilon_0\, v^3, \tag{10}$$

and minimum radiation wavelength, referring to [3], is:

$$\lambda = \lambda_k\, c / v, \tag{11}$$

where λ_k is the Compton electron wavelength equal to 2.426×10^{-12} m.

Each contour has minimum reference length:

$$l_{min} = l / z^{1/3} = R_c , \tag{12}$$

then the minimum characteristic time interval for the quasar "burnout" or radiation will be:

$$\tau_{min} = R_c / v\,, \tag{13}$$

thus, the characteristic or standard mass converted into radiation during this time interval is:

$$M_{st} = M\,\tau_{min} / \tau = M / z^{1/3}, \tag{14}$$

and the number of standard masses in the mass of the quasar is:

$$n_{st} = M / M_{st} = z^{1/3}. \tag{15}$$

To some extent, the quasar inherits some super-dense state (microcosm) features, so the visible size of the quasar – its core l_0 – is determined by analogy with the Bohr atom, assuming that the core is $(an)^2$ times smaller than the contour size. Therefore:

$$l_0 = l /(an)^2, \tag{16}$$

where a is the reverse fine structure constant.

To determine the quasar's parameters, we need to know the velocity of matter circulation in the contour, *i.e.* the quantum number n. The main quantum number for a standard electronic contour [5] is:

$$n_s = c_0^{1/3}/a = 4.884, \tag{17}$$

and velocity is

$$v = cc_0^{1/3}/(an_s)^2 = 4.48\times10^5 \text{ m/sec}, \tag{18}$$

with indication of $c_0 = c$ / [m/sec].

As shown by (4), (5), (17) and (18), the ratio of the quasar core linear density M / l_0 to the same of the electron m_e/r_e for such a standard quasar becomes the maximum possible and equal to the ratio of electric to the gravitational forces $f = c^2/\varepsilon_0\,\gamma = 4.17\times10^{42}$, i.e. $\varepsilon = f$. Moreover, as we see from the dependencies above, kinetic energy $M\,v^2$ for a quasar contour is equal to electrostatic energy, provided that the number of individual charges placed along the length of the unit contour equals to l / r_e, and the distance between them is equal to the size of a standard contour. For a unit contour, this energy is equal to the following:

$$E_i = \varepsilon_0^{2/3} v^{8/3} R_c / \gamma^{1/3} = 1.03\times10^{17} \text{ J}. \tag{19}$$

2 The balance of electric and magnetic forces requires "stretching" charge contours of quasars to cosmic distances.

Thus, the quasar model includes linear objects (force lines or vortex tubes) with the length of hundreds of light-years. This indicates the need for a mechanism of energy transfer from the quasar core to remote distances. Apparently, such extended formations are double radio sources. They often have a compact radio source between them, coinciding by its coordinates with the optical object - a quasar or a galaxy [6]. Notably, the outer edges of these structures are the brightest parts of the radio components. It is clear that in our model they are associated with the ends of quasar vortex tubes. The latter may be considered as super-charges, which are gradually destroying each other. Radiation comes from the peripheral part of the contours as charged particles move in the areas of the magnetic field's force lines with the greatest curvature, which are sources of synchrotron radiation.

Let us estimate the nature of the radiation emitted by such a contour. Continuing the analogy with the Bohr atom, we shall consider this contour as a super-atom. For a proton-electron contour, the wave range is within the range from 3.7×10^{-6} to 0.95×10^{-7} m under transitions within quantum numbers from n_s to 1. We suppose that, for the super-atom quasar, the wavelength increases in proportion to the ratio $r/(n_s^2 R_B)$. Then their range changes up to the range 1.05 m to 0.027 m (290 MHz to 11,000 MHz), which exactly covers most of the radio emission spectrum of typical galaxies and quasars.

Dual radio sources are relatively rare (it is possible due to that reason that we observe not the true size of a radio source but its projection into the celestial sphere [7]). This implies that most of the long contours of the quasar are completely or partially spirally twisted forming a vortex structure or a tube immersed in the Y area (an extra dimension or a degree of freedom in relation to our world [8]). We can say that this vortex tube "is beaded" with future standard stellar masses convertible into radiation in respective portions (a sort of quanta).

Thus, the quasar as a phenomenon – on the much greater scale though – resembles the process of neutronisation [3], but occurs reversely, when the nominal one-dimensional vortex tube of the quasar is eventually transformed into a nominal two-dimensional disk spiral structure and further into a galaxy.

Some parameters of the quasar can be estimated using the most general equations obtained for stellar objects in the paper [3]. Thus, the core diameter is:

$$l_0 = M^j R_s, \tag{20}$$

where $j = 1\ldots1/3$, the factor considering packing (the shape) of the object with the greatest value at $j = 1$ (a sphere) coinciding with the result of formula (16), and the lowest value at $j = 1/3$ (a vortex tube) being close to the size of the Earth's orbit.

It is logical to assume that the quasar pulses relative to the symmetry axis, as do stellar objects, which is manifested in changing luminosity of the quasar. Thus, duration of the generalized momentum τ_i of a pulsar with the mass of a quasar as a vortex tube is:

$$\tau_i = 2.51\, M^{1/2\ldots1/4} \text{ sec}, \tag{21}$$

and pulsation periods of the core τ_0 and periphery $\tau_{0\mathrm{m}}$ of a stellar object with the mass of a quasar as a two-dimensional spiral object are:

$$\tau_0 = 2.51\, (f/\varepsilon)\, (M/M_m)^{2/3} \text{ sec}, \tag{22}$$

$$\tau_{0\mathrm{m}} = 2.51\, (f/\varepsilon)^3 (M/M_m)^{4/3} \text{ sec}, \tag{23}$$

where $M_m = 1.013\times10^{36}$ kg is the characteristic mass, determined by the formula (3) with $r = R_c$ and $v = c$. We may take $\varepsilon = f$ for the initial period of the quasar's life (the super-dense state). Then the periods determined by (22) and (23) are only dependent on the mass of the object.

Since the quasar pulsation periods vary depending on its form, the quasar emits at different frequencies. In addition, variability of radiation within different frequency ranges is asynchronous [9]. In particular, Seyfert galaxies – with a quasar presumably located in the centre of each – have a rapid high-amplitude radiation component (weeks and months) along with the slow low-amplitude radiation component (years), and the variability of radiation within different ranges is shifted in time. Thus, radio bursts can lag behind optical flares by years.

The state of a quasar in the form of a vortex tube may be observed as a *blazar*, which is believed to be an extremely compact quasar. It is characterised by rapid and considerable changes in luminance in all the spectrum ranges over a period of several days or even several hours [10].

It is understood that the quasar's parameters and its external appearance seen by the viewer will depend on the quantum number, density of packing of the charge pairs in the quasar volume, as well as on the quasar's age, pulsation phase, possible shape and orientation relative to the viewer. In general, the model estimates are consistent with the available data on quasars.

Calculated parameters of a standard quasar with n_s = 4.884 are shown in Table 1.

Table 1

Parameters	*Value*
Number of individual contours, z	9.33×10^{36}
Quasar mass, M, kg	4.76×10^{42}
Total energy of the quasar, E, J	9.61×10^{53}
Average radiation power, N, W	2.72×10^{38}
Contour length or the maximum size of the quasar, l, m	1.58×10^{21} (1.67×10^{5} light year)
Observed size of the quasar core, l_0, m	3.53×10^{15} … 1.26×10^{11}
Distance between charges, r, m	3.57×10^{-4}
Minimum radiation wavelength, λ, m	1.62×10^{-9}
Core pulsation period (minimum), τ_0, sec	70,400 (19.6 hour)
Periphery pulsation period (maximum), τ_{0m}, sec	1.98×10^{9} (62.6 year)
Generalised pulse duration of the vortex tube, τ_i, sec	117…5,440
Minimum light period, τ_{min}, sec	1,675
Quasar life time, τ, year	1.12×10^{8}
Standard "burnable" mass, M_{st}, kg	2.26×10^{30}
Number of standard masses in the quasar, n_{st}	2.10×10^{12}

Indeed, the quasar mass estimated by the mass-luminance ratio should be about 10^{12} or more masses of the Sun; cumulative luminance throughout the spectrum may reach 10^{39} W to 10^{40} W; and energy contained in radio components alone may reach 10^{52} J. As for the quasar's life time, the analysis of the radio source observation data shows that energy emitted by the core as a result of a continuous (non-explosive) process may be emitted for 10^7 to 10^9 years [11 - 13].

The quasar's radiation is variable in all the wavelength ranges up to the X-ray and gamma radiation. The variability periods characteristic of quasars - months or even days - indicate that the generating area of the quasar radiation is not large, i.e. the linear dimensions of the emitting area (the quasar's core or active part) are fairly small - from one light year to the Solar System size [2, 10]. The shortest variation observed had a period of about one hour, which is within the range of the generalized pulse duration. This is consistent with the "burnout" time of the standard mass that corresponds to a typical stellar mass.

At the same time, the areas emitting within the radio range (double radio sources) are dozens and hundreds or more light-years away from the central optical object – a quasar or a galaxy [6, 7] – which is consistent with the length of the open contour. Their variability (months or years) may depend on the period of the quasar's outer cycle time (the periphery). As the quasar evolves, its evolutionary parameter ε decreases, but pulsation periods increase. We may assume that the initial configuration of the quasar is inherited in future, as matter condensates and stars form, and somehow "freezing" with a sharp decrease in the periphery spin velocity, it manifests itself in various forms of galaxies (elliptical or spiral).

Conclusion

It has been established by now that there were a lot more quasars at the earlier stages of the Universe evolution than there are now. Obviously, the quasar is the ancestor of other subsequent cosmological objects. In particular, this may explain the oddity of closeness of their energies of various origins, noted by astrophysics. Thus, we can conclude that quasars, their varieties and different types of galaxies (with quasars or black holes in the centre) are cosmological objects, gradually and naturally evolving from the white hole singularity to the black hole singularity.

References

1. Retter A., Heller S. The revival of white holes as small bangs. arXiv:1105.2776.:1105.2776.

2. Narlikar J. Violent Phenomena in the Universe. Oxford New York. Oxford University Press. 1984.

3. Belyakov A.V. Evolution of Stellar Objects According to J. Wheeler's Geometrodynamic Concept. *Progress in Physics*, 2013, v.1, 25–40.

4. Belyakov A.V. On Some General Regularities of Formation of the Planetary Systems. *Progress in Physics*, 2014, v.10, 28–35.

5. Belyakov A.V. Charge of the electron, and the constants of radiation according to J.A.Wheeler's geometrodynamic model. *Progress in Physics*, 2010, v.4, 90–94.

6. Verkhanov O.V., Pariysky Yu.N. Radio Galaxies and Cosmology. Fizmatlit, Moscow, 2009.

7. Amirkhanyan V. R. Angular size — redshift: experiment and calculation. *Astrophysical Bulletin*, 2014, v. 69, no. 4, 383–389.

8. Belyakov A.V. Macro-analogies and gravitation in the micro-world: further elaboration of Wheeler's model of geometrodynamics. Progress in Physics, 2012, v.2, 47–57.

9. Serjeant S., Rawlings S. Hidden quasars reddened by dust? Nature, v.379, issue 6563 (25 January 1996), 304.

10. Nimisha G. Kantharia. Decoding quasars: gravitationally redshifted spectral lines! arXiv:1609.01593 v1 [astro-ph.GA] 6 Sep 2016.

11. Shklovsky I.S. Radiogalaxies, *Soviet Uspekhi-Physics*, 1962, v.77, no. 5, 365–400.

12. Vorontsov-Velyaminov B.A. Extragalactic Astronomy. Revised and Exp. edition, Harwood Academic Publishers, 1987.

13. Pakholchik A. G., Radiogalaxies, Pergamon Press, 1977.